The management of hip fracture in adults

METHODS, EVIDENCE & GUIDANCE

Produced by the National Clinical Guideline Centre

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Acronyms and abbreviations

ADL	Activities of Daily Living
ANOVA	Analysis of variance
AO	Arbeitsgemeinschaft für Osteosynthesefragen
BNF	British National Formulary
CCA	Cost-consequences analysis
CEA	Cost-effectiveness analysis
c.f.	Confer (refer to)
CI / 95% CI	Confidence interval / 95% confidence interval
CT	Computed tomography
CUA	Cost-utility analysis
DH	Department of Health
DSA	Deterministic Sensitivity Analysis
ED	Emergency Department
ESD	Early Supported Discharge
EQ-5D	EuroQol-5D
GA	General anaesthesia
GORU	Geriatric Orthopaedic Rehabilitation Unit
GDG	Guideline Development Group
GP	General Practitioner
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HES	Hospital Episode Statistics
HFP	Hip fracture programme
HR	Hazard Ratio
HRQoL	Health-related quality of life
HTA	Health technology assessment
IC	Intermediate care
ICD-10	International Classification of Diseases, 10th edition
ICER	Incremental cost-effectiveness ratio

IQR	Interquartile range
INMB	Incremental Net Monetary Benefit
IRR	Inter-rater reliability
ITT	Intention to treat
LOS	Length of Stay
LR^+	Positive likelihood ratio
LR^-	Negative likelihood ratio
LY	Life-Year
MD	Mean Difference
MDR	Multi-Disciplinary Rehabilitation
MARU	Mixed Assessment and Rehabilitation Unit
MRI	Magnetic resonnance imaging
NCGC	National Clinical Guideline Centre
N/A	Not applicable
NHS	National Health Service
NHSEED	The NHS Economic Evaluation Database
NICE	National Institute for Health and Clinical Excellence
NNT	Number needed to treat
NPV	Negative predictive value
NSAID	Non steroidal anti-inflammatory drugs
OR	Odds ratio
PICO	Framework incorporating patients, interventions, comparison and outcome
POMA	Tinetti's performance oriented mobility assessment
PFF	Proximal femoral fracture
PPP	Purchasing Power Parity
PPV	Positive predictive value
p.r.n	Pro re nata
PSA	Probabilistic sensitivity analysis
QALY	Quality-adjusted life year
QUADAS	Quality assessment tool for diagnostic accuracy studies
RA	Regional anaesthesia
RCT	Randomised controlled trial
RNS	Radionuclide scan
ROC	Receiver operating characteristic
RR	Relative risk

SCIE	Social Care Institute for Excellence
SD	Standard deviation
SE	Standard error
SPC	Summary of product characteristics
SR	Systematic review
US	Ultrasound
WTP	Willingness to pay

1 Introduction

Hip fracture is the plain English term for a proximal femoral fracture or PFF. It refers to a fracture occurring in the area between the edge of the femoral head and 5 centimetres below the lesser trochanter (Figure 1). These fractures are generally divided into two main groups depending on their relationship to the capsule of the hip joint. Those above the insertion of the capsule are termed intracapsular, subcapital or femoral neck fractures. Those below the insertion are extracapsular. The extracapsular group is split further into trochanteric (inter- or pertrochanteric and reverse oblique) and subtrochanteric as shown. The division into intra and extracapsular fractures relates to both the blood supply of the femoral head and the mechanics of fixation.

Hip fracture is a major public health issue due to an ever increasing ageing population. About 70,000 to 75,000 hip fractures (proximal femoral fractures) occur annually in the UK[39], with a cost (including medical and social care) amounting to about £2 billion a year. Demographic projections indicate that the UK annual incidence will rise to 91,500 by 2015 and 101,000 in 2020[39], with an associated increase in annual expenditure. The majority of this expenditure will be accounted for by hospital bed days and a further substantial contribution will come from health and social aftercare. At present about a quarter of patients with hip fracture are admitted from institutional care, and about 10–20% of those admitted from home ultimately move to institutional care.

Hip fracture is the commonest reason for admission to an orthopaedic trauma ward and is usually a 'fragility' fracture[1] caused by a fall affecting an older person with osteoporosis or

[1] The strict definition of a fragility fracture is one caused by a fall from standing height or less. For the purposes of this guidance, the definition is slightly more flexible to encompass all hip fractures judged to have an osteoporotic or osteopaenic basis

osteopaenia (a condition in which bones lose calcium and become thinner, but not as much as in osteoporosis). The National Hip Fracture Database reports the average age of a person with hip fracture as 84 years for men and 83 for women, 76% of fracture occur in women. Mortality is high – about 10% of people with a hip fracture die within 1 month and about one third within 12 months. Most of the deaths are due to associated co morbidities and not just to the fracture itself reflecting the high prevalence of comorbidity in people with hip fracture. It is often the occurrence of a fall and fracture that signals underlying ill health. Thus, hip fracture is by no means an exclusively surgical concern. Its effective management requires the co-ordinated application of medical, surgical, anaesthetic and multidisciplinary rehabilitation skills and a comprehensive approach covering the full time course of the condition from presentation to subsequent follow-up, including the transition from hospital to community.

Although hip fracture is predominantly a phenomenon of later life, it may occur at any age in people with osteoporosis or osteopenia, and this guidance is applicable to adults across the age spectrum. Skills in its management have, however been accrued, researched and reported especially by collaborative teams specialising in the care of older people (using the general designation 'orthogeriatrics'). These skills are applicable in hip fracture irrespective of age, and the guidance includes recommendations that cover the needs of younger patients by drawing on such skills in an organised manner.

This guidance covers the management of hip fracture from the point of admission to secondary care through to final return to the community and discharge from specific follow-up. It assumes that anyone clinically suspected of having a hip fracture will be referred for immediate hospital assessment other than in exceptional circumstances. It excludes (other than by cross-reference) aspects covered by parallel NICE guidance, most notably primary and secondary prevention of fragility fractures, but recognises the importance of effective linkage to these closely related elements of comprehensive care.

The diagnosis of hip fracture is easily missed and in a small minority of patients the fracture may not be apparent on a plain X-ray. In view of the serious nature of hip fracture the guidance has sought to identify the most cost-effective imaging strategies to ensure this does not happen.

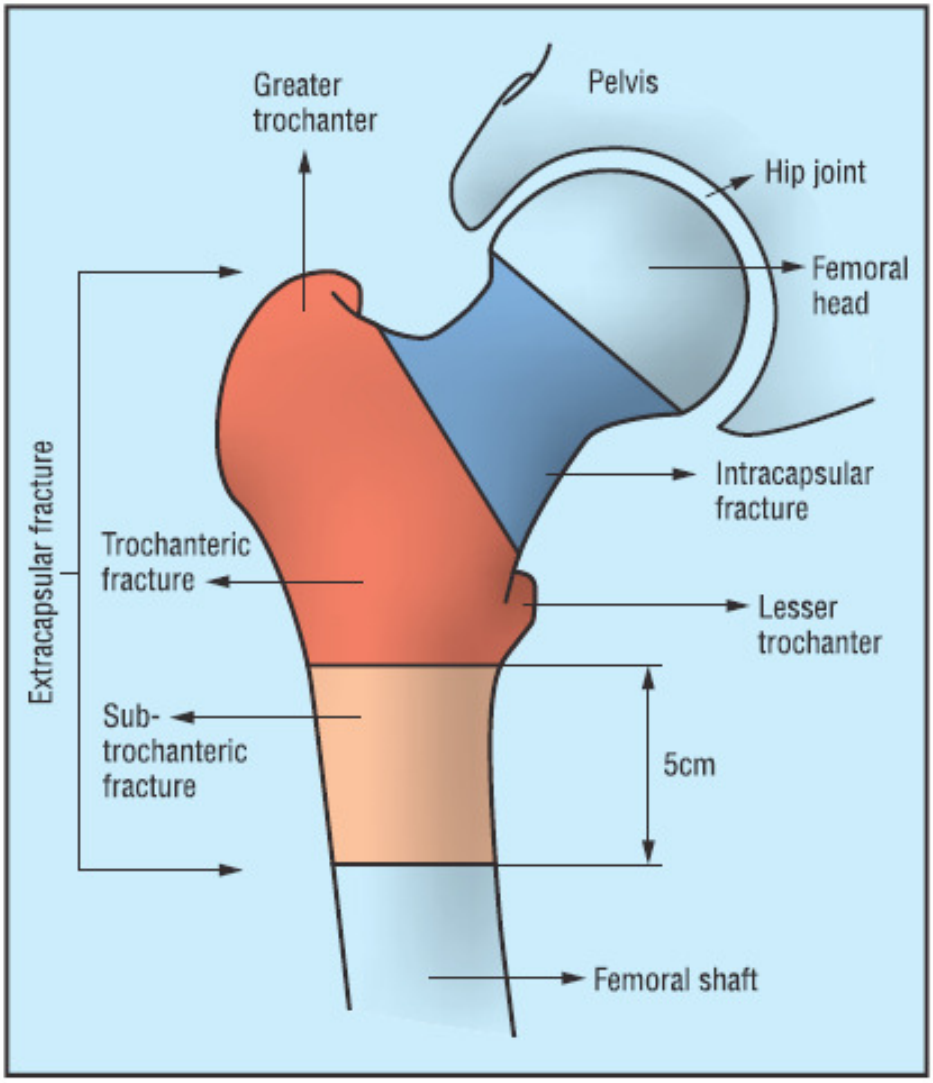
Although not a structured service delivery evaluation, the Guideline Group was required to extend its remit to cover essential implications for service organisation within the NHS where these are fundamental to hip fracture management, and this has been done. In general it is the case that suboptimal care and/or fragmentation of care result in longer periods of dependency and/or hospitalisation leading to greater cost as well as inferior outcome. There is substantial variation and lack of clarity in the UK in the extent, timing, manner and organisation of the necessary collaborative and multidisciplinary elements of effective management, including the timely achievement of rehabilitation after surgery according to individual need. A further concern is the occurrence of delay before necessary surgery is carried out. Prompt surgery has been generally recognised to be important, but surgery is sometimes delayed for administrative or clinical reasons. Emerging evidence from the National Hip Fracture database indicates substantial variation across centres in England and Wales in this and other indicators of clinical and service quality. Such variation has potentially profound economic implications, and priority has been given where appropriate to underpinning recommendations with any available evidence of cost-effectiveness in the NHS. Since work began on the guideline the Department of Health in England has launched a high priority Best Practice Tariff initiative targeting a range of performance variables for

hip fracture, and the GDG have been aware of this contextual change as well as of humanitarian issues in evaluating the evidence and formulating recommendations.

At all stages of hip fracture management, the importance of optimal communication with, and support for, patients themselves and those who provide or will provide care – including unpaid care family members or others – has been a fundamental tenet of guidance development.

The view of the GDG is that an exceptional contemporary window of opportunity exists in the NHS to achieve major improvements in the delivery of hip fracture care, to the benefit not only of patients but of the system as a whole in terms of efficiency and cost. It is hoped that implementation of this guidance will be instrumental to that end.

Figure 1: Types of hip fracture (Parker M & Johansen A, 2006)[259,270]



Classification of hip fractures. Fractures in the blue area are intracapsular and those in the red and orange areas are extracapsular

Reproduced from BMJ, Parker, M., Johansen, A., 333(7557), 27-30, 2006 with permission from BMJ Publishing Group Ltd

2 Development of the guideline

2.1 What is a NICE clinical guideline?

NICE clinical guidelines are recommendations for the care of individuals in specific clinical conditions or circumstances within the NHS – from prevention and self-care through primary and secondary care to more specialised services. We base our clinical guidelines on the best available research evidence, with the aim of improving the quality of health care. We use predetermined and systematic methods to identify and evaluate the evidence relating to specific review questions.

NICE clinical guidelines can:

- provide recommendations for the treatment and care of people by health professionals
- be used to develop standards to assess the clinical practice of individual health professionals
- be used in the education and training of health professionals
- help patients to make informed decisions
- improve communication between patient and health professional

While guidelines assist the practice of healthcare professionals, they do not replace their knowledge and skills.

We produce our guidelines using the following steps:

- Guideline topic is referred to NICE from the Department of Health
- Stakeholders register an interest in the guideline and are consulted throughout the development process.
- The scope is prepared by the National Clinical Guideline Centre (NCGC)
- The NCGC establishes a guideline development group
- A draft guideline is produced after the group assesses the available evidence and makes recommendations

- There is a consultation on the draft guideline.
- The final guideline is produced.

The NCGC and NICE produce a number of versions of this guideline:

- the **full guideline** contains all the recommendations, plus details of the methods used and the underpinning evidence
- the **NICE guideline** lists the recommendations
- the **quick reference guide** (QRG) presents recommendations in a suitable format for health professionals
- information for the public ('**understanding NICE guidance' or UNG**) is written using suitable language for people without specialist medical knowledge.

This version is the full version. The other versions can be downloaded from NICE www.NICE.org.uk and the NCGC website www.ncgc.ac.uk.

2.2 Remit

NICE received the remit for this guideline from the Department of Health. They commissioned the NCGC to produce the guideline.

The remit for this guideline is:

To prepare a clinical guideline on the management of fractured neck of femur.

2.3 Who developed this guideline?

A multidisciplinary Guideline Development Group (GDG) comprising professional group members and consumer representatives of the main stakeholders developed this guideline (see section on Guideline Development Group Membership and acknowledgements).

The National Institute for Health and Clinical Excellence funds the National Clinical Guideline Centre (NCGC) and thus supported the development of this guideline. The GDG was convened by the NCGC and chaired by Professor Cameron Swift in accordance with guidance from the National Institute for Health and Clinical Excellence (NICE).

The group met every 6-8 weeks during the development of the guideline. At the start of the guideline development process all GDG members declared interests including consultancies, fee-paid work, share-holdings, fellowships and support from the healthcare industry. At all subsequent GDG meetings, members declared arising conflicts of interest, which were also recorded.

Members were either required to withdraw completely or for part of the discussion if their declared interest made it appropriate. The details of declared interests and the actions taken are shown in Appendix B.

Staff from the NCGC provided methodological support and guidance for the development process. The team working on the guideline included a project manager, systematic reviewers, health economists and information scientists. They undertook systematic searches of the literature, appraised the evidence, conducted meta analysis and cost effectiveness analysis where appropriate and drafted the guideline in collaboration with the GDG.

2.4 What this guideline covers

The population of this guideline covers:

a) Adults aged 18 years and older presenting to the health service with a clinical diagnosis (firm or provisional) of fragility fracture of the hip.

b) People with the following types of hip fracture:

- intracapsular (undisplaced and displaced)
- extracapsular (trochanteric and subtrochanteric).

c) Those with comorbidity strongly predictive of outcome, and those without such comorbidity. The influence (if any) of advanced age or gender on clinical decision-making, management and outcome will be specifically evaluated.

For further details please refer to the scope in Appendix A and review protocols in Appendix C.

Key clinical areas in this guideline are:

a) Using alternative radiological imaging to confirm or exclude a suspected hip fracture in patients with a normal X-ray.

b) Involving a physician or orthogeriatrician in the care of patients presenting with hip fracture.

c) Early surgery (within 48 hours).

d) Optimal preoperative and postoperative analgesia (pain relief), including the use of nerve blockade.

e) Regional (spinal – also known as 'epidural') versus general anaesthesia in patients undergoing surgery for hip fracture.

f) Surgeon experience and seniority

g) For displaced intracapsular fracture:

- Internal fixation versus arthroplasty (hip replacement surgery)
- Total hip replacement versus hemiarthroplasty (replacing the head of the femur only).

h) Choice of surgical implants - Sliding hip screw versus intramedullary nail for trochanteric extracapsular fracture.

i) Choice of surgical implants - Sliding hip screw versus intramedullary nail for subtrochanteric extracapsular fracture.

j) Cemented versus non-cemented arthroplasty implants.

k) Hospital-based multidisciplinary rehabilitation for patients who have undergone hip fracture surgery.

l) Early transfer to community-based multidisciplinary rehabilitation for patients who have undergone hip fracture surgery.

2.5 What this guideline does not cover

The population of this guideline does not cover:

a) People younger than 18 years.

b) People with fractures caused by specific pathologies other than osteoporosis or osteopaenia (because these would require more condition-specific guidance).

Clinical areas not included in this guideline are:

a) Primary and secondary prevention of fragility fracture.

b) Prevention and management of pressure sores.

c) Prophylaxis for venous thromboembolism.

d) Prevention and management of infection at the surgical site.

e) Nutritional support.

f) Selection of prostheses for hip replacement.

g) Complementary and alternative therapies.

2.6 Relationships between the guideline and other NICE guidance

Related NICE Health Technology Appraisals:

Alendronate, etidronate, risedronate, raloxifene, strontium ranelate and teriparatide for the secondary prevention of osteoporotic fragility fractures in postmenopausal women (amended). NICE technology appraisal guidance TA161 (2011). Available from www.nice.org.uk/TA161

Alendronate, etidronate, risedronate, raloxifene and strontium ranelate for the primary prevention of osteoporotic fragility fractures in postmenopausal women (amended). NICE technology appraisal guidance TA160 (2011). Available from www.nice.org.uk/TA160

Denosumab for the prevention of osteoporotic fractures in postmenopausal women. NICE technology appraisal guidance TA204 (2010). Available from www.nice.org.uk/TA204

Guidance on the use of metal on metal hip resurfacing arthroplasty. NICE technology appraisal guidance 44 (2002). Available from www.nice.org.uk/guidance/TA44

The selection of prostheses for primary total hip replacement. NICE technology appraisal guidance TA2 (2000). Available from www.nice.org.uk/TA2

Related NICE Interventional Procedures Guidance:

Minimally invasive hip replacement. NICE interventional procedure guidance (2010). Available from www.nice.org.uk/guidance/IPG363

Related NICE Clinical Guidelines:

Delirium: diagnosis, prevention and management of delirium. NICE clinical guideline CG103 (2010). Available from http://guidance.nice.org.uk/CG103

Venous thromboembolism – reducing the risk. NICE clinical guideline CG92 (2010). Available from http://guidance.nice.org.uk/CG92

Surgical site infection. NICE clinical guideline CG74 (2008). Available from www.nice.org.uk/CG74

Dementia: supporting people with dementia and their carers in health and social care. Nice clinical guideline CG42 (2006). Available from www.nice.org.uk/CG42

Nutrition support in adults. NICE clinical guideline CG32 (2006).Available from www.nice.org.uk/CG32

The management of pressure ulcers in primary and secondary care. NICE clinical guideline CG29 (2005). Available from www.nice.org.uk/CG29

Falls. NICE clinical guideline CG21 (2004). Available from www.nice.org.uk/CG21

Preoperative tests. NICE clinical guideline CG3 (2003). Available from www.nice.org.uk/CG3

NICE Related Guidance currently in development:

Osteoporosis: risk assessment of people with osteoporosis. NICE clinical guideline. Publication date to be confirmed.

3 Methods

This guidance was developed in accordance with the methods outlined in the NICE Guidelines Manual 2009 [233]

3.1 Developing the review questions and outcomes

Review questions were developed in a PICO framework (patient, intervention, comparison and outcome) for intervention reviews, and with a framework of population, index tests, reference standard and target condition for reviews of diagnostic test accuracy. This was to guide the literature searching process and to facilitate the development of recommendations by the guideline development group (GDG). They were drafted by the NCGC technical team and refined and validated by the GDG. The questions were based on the key clinical areas identified in the scope (Appendix A). Further information on the outcome measures examined follows this section.

Chapter	Review question	Outcomes
Radiology	In patients with a continuing clinical suspicion of hip fracture, despite negative radiographic findings, what is the clinical and cost-effectiveness of additional imaging (radiography after at least 48 hours), Radionuclide scanning (RNS), ultrasound (US) and computed tomography (CT), compared to magnetic resonance imaging (MRI), in confirming, or excluding, a hip fracture?	▪ Sensitivity ▪ Specificity ▪ Positive and negative predictive values ▪ Positive and negative likelihood ratios
Timing of surgery	In patients with hip fractures what is the clinical and cost effectiveness of early surgery (within 24, 36 or 48 hours) on the incidence of complications such as mortality, pneumonia, pressure sores, cognitive dysfunction and increased length of hospital stay?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge ▪ Place of residence (compared with baseline) 12 months after fracture ▪ Functional status (30 days, 3 months, 1 year) ▪ Quality of life (30 days, 3 months, 1 year) ▪ Complications (including pressure ulcers)
Analgesia	In patients who have or are suspected of having a hip fracture, what is the clinical and cost effectiveness of nerve blocks compared to systemic analgesia in providing adequate pain relief and reducing side effects and mortality?	▪ Pain Need for 'breakthrough' analgesia ▪ Mortality ▪ Adverse effects
Anaesthesia	In patients undergoing surgical repair for hip fractures, what is the clinical and cost effectiveness of regional (spinal/epidural) anaesthesia compared to general anaesthesia in reducing complications such as mortality, cognitive dysfunction thromboembolic events, postoperative respiratory morbidity, renal failure and length of stay in hospital?	▪ Patient preference ▪ Early mortality up to 1 month ▪ Functional status up to 1 year ▪ Pain Adverse effects

Surgeon seniority	Does surgeon seniority (consultant or equivalent) reduce the incidence of mortality, operative revision and poor functional outcome?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Reoperation rate ▪ Dislocations ▪ Wound infection
Cement	In hip fracture patients undergoing total hip replacement what is the clinical and cost effectiveness of cemented total hip replacement versus uncemented total hip replacement on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?	▪ Perioperative mortality ▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture ▪ Wound healing complications
Intracapsular fractures	In patients undergoing repair for intracapsular hip fractures what is the clinical and cost effectiveness of internal fixation compared to hemiarthroplasty compared to total hip replacement on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture
Surgical approach	In patients having surgical treatment for intracapsular hip fracture with hemiarthroplasty what is the clinical and cost effectiveness of anterolateral compared to posterior surgical approach on mortality, number of reoperations, dislocation, functional status, length of hospital stay, quality of life and pain?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of hospital stay ▪ Reoperation rate ▪ Dislocations ▪ Functional status ▪ Quality of life ▪ Pain

Hemiarthroplasty stem design	In patients undergoing surgery for hip fracture what is the clinical and cost effectiveness of 'OEDP 10A rating' designs of stems in preference to Austin Moore or Thompson stems when inserting a hemiarthroplasty on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture
Extracapsular fractures	In patients undergoing repair for trochanteric extracapsular hip fractures what is the clinical and cost effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation (operative or postoperative fracture of the femur, cut-out and non-union) ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Wound healing complications
Extracapsular fractures	In patients undergoing repair for subtrochanteric extracapsular hip fractures, what is the effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation (operative or postoperative fracture of the femur, cut-out and non-union) ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Wound healing complications

Mobilisation strategies	In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of early mobilisation (<48 hours after surgery) compared to late mobilisation on functional status, mortality, place of residence/discharge, pain and quality of life?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Discharge destination
Mobilisation strategies	In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of intensive physiotherapy compared to non intensive physiotherapy on functional status, mortality, place of residence/discharge, pain and quality of life?	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Discharge destination ▪ Mobility
Multidisciplinary rehabilitation	In patients with hip fracture what is the clinical and cost effectiveness of 'orthogeriatrician' involvement in the whole pathway of assessment, peri-operative care and rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge ▪ Place of residence (compared with baseline) 12 months after fracture ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Multidisciplinary rehabilitation	In patients with hip fracture what is the clinical and cost effectiveness of hospital-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge ▪ Place of residence (compared with baseline) 12 months after fracture ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)

Multidisciplinary rehabilitation	In patients with hip fracture what is the clinical and cost effectiveness of community-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge ▪ Place of residence (compared with baseline) 12 months after fracture ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Carer involvement	In patients who have been discharged after hip fracture repair, what is the clinical and cost effectiveness of having a non paid carer (e.g. spouse, relative, friends) on mortality, length of stay, place of residence/discharge, functional status, hospital readmission and quality of life?	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge ▪ Place of residence (compared with baseline) 12 months after fracture ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)

3.2 Searching for evidence

3.2.1 Clinical literature search

Systematic literature searches were undertaken to identify evidence within published literature in order to answer the review questions as per The Guidelines Manual [233]. Clinical databases were searched using relevant medical subject headings, free-text terms and study type filters where appropriate. Studies published in languages other than English were not reviewed. Where possible, searches were restricted to articles published in English language. All searches were conducted on core databases, MEDLINE, Embase and *The Cochrane Library*. Additional subject specific databases were used for some questions: PsycInfo for patient views and patient education questions; Cinahl for every question except those on anaesthesia, analgesia and the surgical procedures. All searches were updated on the 31st August 2010. No papers after this date were considered.

Search strategies were checked by looking at reference lists of relevant key papers, checking search strategies in other systematic reviews and asking the GDG for known studies. The questions, the study types applied, the databases searched and the years covered can be found in Appendix D.

During the scoping stage, a search was conducted for guidelines and reports on the websites listed below and on organisations relevant to the topic. Searching for grey literature or unpublished literature was not undertaken. All references sent by stakeholders were considered.

- Guidelines International Network database (www.g-i-n.net)
- National Guideline Clearing House (www.guideline.gov/)
- National Institute for Health and Clinical Excellence (NICE) (www.nice.org.uk)
- National Institutes of Health Consensus Development Program (consensus.nih.gov/)
- NHS Evidence (www.evidence.nhs.uk/)

3.2.2 Health economic literature search

Systematic literature searches were also undertaken to identify health economic evidence within published literature relevant to the review questions. The evidence was identified by conducting a broad search relating to the guideline population in the NHS economic evaluation database (NHS EED) and health technology assessment (HTA) database with no date restrictions. Additionally, the search was run on MEDLINE and Embase, with a specific economic filter, to ensure recent publications that had not yet been indexed by these databases were identified. This was supplemented by additional searches that looked for economic papers specifically relating to the radiological imaging question on MEDLINE, Embase, NHS EED and HTA databases, and the Health Economic Evaluations Database (HEED) as it became apparent that some papers in this area were not being identified through the first search. Studies published in languages other than English were not reviewed. Where possible, searches were restricted to articles published in English language.

The search strategies for health economics are included in Appendix D. All searches were updated on the 31st August 2010. No papers published after this date were considered.

3.3 Evidence of effectiveness

The Research Fellow

- Identified potentially relevant studies for each review question from the relevant search results by reviewing titles and abstracts – full papers were then obtained.
- Reviewed full papers against pre-specified inclusion / exclusion criteria to identify studies that addressed the review question in the appropriate population and reported on outcomes of interest (review protocols are included in Appendix C).

- Critically appraised relevant studies using the appropriate checklist as specified in The Guidelines Manual[233].
- Extracted key information about the study's methods and results into evidence tables (evidence tables are included in Appendix E).
- Generated summaries of the evidence by outcome (included in the relevant chapter write-ups):
    - Randomised studies: meta analysed, where appropriate and reported in GRADE profiles (for clinical studies) – see below for details
    - Observational studies: data presented as a range of values in GRADE profiles
    - Diagnostic studies: data presented as a range of values in adapted GRADE profiles
    - Qualitative studies: each study summarised in a table where possible, otherwise presented in a narrative.

3.3.1 Inclusion/exclusion

See the review protocols in Appendix C for full details.

3.3.2 Methods of combining clinical studies

Data synthesis for intervention reviews

Where possible, meta-analyses were conducted to combine the results of studies for each review question using Cochrane Review Manager (RevMan5) software. Fixed-effects (Mantel-Haenszel) techniques were selected to calculate risk ratios (relative risk) for the binary outcomes. The continuous outcomes were analysed using an inverse variance method for pooling weighted mean differences and where the studies had different scales, standardised mean differences were used.

Statistical heterogeneity was assessed by considering the chi-squared test for significance at $p<0.05$ or an I-squared inconsistency statistic of >50% to indicate significant heterogeneity. Where significant heterogeneity was present, we carried out predefined subgroup analyses as defined in the protocol for each question (Appendix C). Sensitivity analysis based on the quality of studies was also carried out if there were differences, with particular attention paid to allocation concealment, blinding and loss to follow-up (missing data).

Assessments of potential differences in effect between subgroups were based on the chi-squared tests for heterogeneity statistics between subgroups. If no sensitivity analysis was found to completely resolve statistical heterogeneity then a random effects (DerSimonian and Laird) model was employed to provide a more conservative estimate of the effect.

For binary outcomes, absolute event rates were also calculated using the GRADEpro software using event rate in the control arm of the pooled results.

Data synthesis for diagnostic test accuracy review

For diagnostic test accuracy studies, the following outcomes were reported: sensitivity, specificity, positive predictive value, negative predictive value and positive and negative likelihood ratios.In cases where the outcomes were not reported, 2 by 2 tables were constructed from raw data to allow calculation of these accuracy measures. Summary receiver operative characteristic (ROC) curves were not generated as we did not explore the effect of different cut-off thresholds on sensitivity and specificity for the imaging questions.

3.3.3 Appraising the quality of evidence by outcomes

The evidence for outcomes from the included RCT and observational studies were evaluated and presented using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group (http://www.gradeworkinggroup.org/). The software (GRADEpro) developed by the GRADE working group was used to assess the quality of each outcome, taking into account individual study quality and the meta-analysis results.The summary of findings was presented as two separate tables in this guideline. The "Clinical/Economic Study Characteristics" table includes details of the quality assessment while the "Clinical /Economic Summary of Findings" table includes pooled outcome data, where appropriate, an absolute measure of intervention effect and the summary of quality of evidence for that outcome. In this table, the columns for intervention and control indicate the sum of the sample size for continuous outcomes. For binary outcomes such as number of patients with an adverse event, the event rates (n/N: number of patients with events divided by sum of number of patients) are shown with percentages. Reporting or publication bias was only taken into consideration in the quality assessment and included in the Clinical Study Characteristics table if it was apparent. Each outcome was examined separately for the quality elements listed and defined in Table 3-1 and each graded using the quality levels listed in

Table 3-2. The main criteria considered in the rating of these elements are discussed below (see section 3.3.4 Grading of Evidence). Footnotes were used to describe reasons for grading a quality element as having serious or very serious problems. The ratings for each component were summed to obtain an overall assessment for each outcome.

Table 3-3. The GRADE toolbox is currently designed only for randomised trials and observational studies but we adapted the quality assessment elements and outcome presentation for diagnostic accuracy studies.

Table 3-1: Descriptions of quality elements in GRADE for intervention studies

Quality element	*Description*
Limitations	Limitations in the study design and implementation may bias the estimates of the treatment effect. Major limitations in studies decrease the confidence in the estimate of the effect
Inconsistency	Inconsistency refers to an unexplained heterogeneity of results
Indirectness	Indirectness refers to differences in study population, intervention, comparator and outcomes between the available evidence and the review question, or recommendation made
Imprecision	Results are imprecise when studies include relatively few patients and few events and thus have wide confidence intervals around the estimate of the effect relative to the clinically important threshold
Publication bias	Publication bias is a systematic underestimate or an overestimate of the underlying beneficial or harmful effect due to the selective publication of studies

Table 3-2: Levels for quality elements in GRADE

Level	*Description*
None	There are no serious issues with the evidence
Serious	The issues are serious enough to downgrade the outcome evidence by one level
Very serious	The issues are serious enough to downgrade the outcome evidence by two levels

Table 3-3: Overall quality of outcome evidence in GRADE

Level	*Description*
High	Further research is *very unlikely* to change our confidence in the *estimate of effect*
Moderate	Further research is *likely* to have an important impact on our confidence in the *estimate of effect* and may change the estimate
Low	Further research is *very likely* to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low	*Any estimate of effect is very uncertain*

3.3.4 Grading the quality of clinical evidence

After results were pooled, the overall quality of evidence for each outcome was considered. The following procedure was adopted when using GRADE:

1. A quality rating was assigned, based on the study design. RCTs start HIGH and observational studies as LOW, uncontrolled case series as LOW or VERY LOW
2. The rating was then downgraded for the specified criteria: Study limitations, inconsistency, indirectness, imprecision and reporting bias. These criteria are detailed below. Observational studies were upgraded if there was: a large magnitude of effect, dose-response gradient, and if all plausible confounding would reduce a demonstrated effect or suggest a spurious effect when results showed no effect. Each

quality element considered to have “serious” or “very serious” risk of bias were rated down -1 or -2 points respectively.

3. The downgraded/upgraded marks were then summed and the overall quality rating was revised. For example, all RCTs started as HIGH and the overall quality became MODERATE, LOW or VERY LOW if 1, 2 or 3 points were deducted respectively.
4. The reasons or criteria used for downgrading were specified in the footnotes.

The details of criteria used for each of the main quality element are discussed further in the following sections 4.3.5 to 4.3.8.

3.3.5 Study limitations

The main limitations for randomised controlled trials are listed in Table 3-4.

The GDG accepted that investigator blinding in surgical intervention studies was impossible and participant blinding was also impossible to achieve in most situations. Therefore, open-label studies for surgery were not downgraded in the quality rating across the guideline. Studies were downgraded for unclear or inadequate allocation concealment. .

Table 3-4 lists the limitations considered for randomised controlled trials.

Table 3-4: Study limitations of randomised controlled trials

Limitation	*Explanation*
Allocation concealment	Those enrolling patients are aware of the group to which the next enrolled patient will be allocated (major problem in “pseudo” or “quasi” randomised trials with allocation by day of week, birth date, chart number etc.)
Lack of blinding	Patient, caregivers, those recording outcomes, those adjudicating outcomes, or data analysts are aware of the arm to which patients are allocated
Incomplete accounting of patients and outcome events	Loss to follow-up not accounted and failure to adhere to the intention to treat principle when indicated
Selective outcome reporting	Reporting of some outcomes and not others on the basis of the results
Other limitations	For example: • stopping early for benefit observed in randomised trials, in particular in the absence of adequate stopping rules • use of unvalidated patient-reported outcomes • carry-over effects in cross-over trials • recruitment bias in cluster-randomised trials

3.3.6 Inconsistency

Inconsistency refers to an unexplained heterogeneity of results. When estimates of the treatment effect across studies differ widely (i.e. heterogeneity or variability in results), this suggests true differences in underlying treatment effect. When heterogeneity was

measured at either Chi square p<0.05 or I- squared inconsistency statistic of >50%, but no plausible explanation can be found, the quality of evidence was downgraded by one or two levels, depending on the extent of uncertainty to the results contributed by the inconsistency in the results. In addition to the I- square and Chi square values, the decision for downgrading was also dependent on factors such as whether the intervention is associated with benefit in all other outcomes or whether the uncertainty about the magnitude of benefit (or harm) of the outcome showing heterogeneity would influence the overall judgment about net benefit or harm (across all outcomes).

If inconsistency could be explained based on prespecified subgroup analysis, the GDG took this into account and considered whether to make separate recommendations based on the identified explanatory factors, i.e. population and intervention.Where subgroup analysis gives a plausible explanation of heterogeneity, the quality of evidence would not be downgraded.

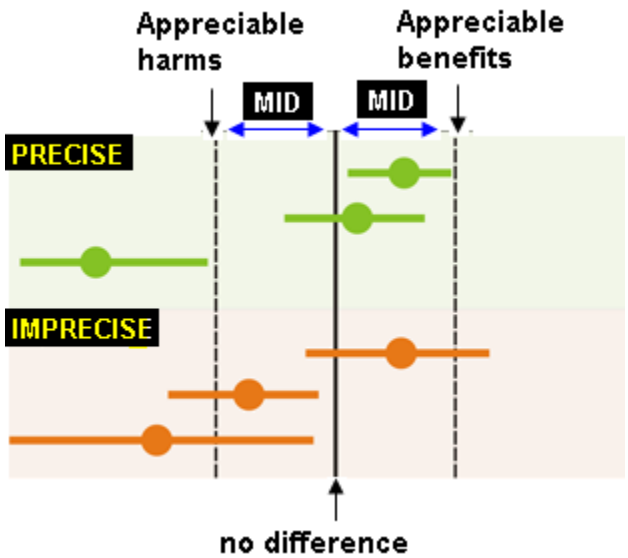
3.3.7 Indirectness

Directness refers to the extent to which the populations, intervention, comparisons and outcome measures are similar to those defined in the inclusion criteria for the reviews. Indirectness is important when these differences are expected to contribute to a difference in effect size, or may affect the balance of harms and benefits considered for an intervention.

3.3.8 Imprecision

The sample size, event rates and the resulting width of confidence intervals were the main criteria considered. Where the minimal important difference (MID) of an outcome is known, the optimal information size (OIS), i.e. the sample size required to detect the difference with 80% power and p≤0.05 was calculated and used as the criteria. The criteria applied for imprecision are based on the confidence intervals for pooled or the best estimate of effect as illustrated in Figure 3-1.

Figure 3-1: Illustration of precise and imprecise outcomes based on the confidence interval of outcomes in a forest plot



MID = minimal important difference determined for each outcome. The MIDs are the threshold for appreciable benefits and harms. The confidence intervals of the top three points of the diagram were considered precise because the upper and lower limits did not cross the MID. Conversely, the bottom three points of the diagram were considered imprecise because all of them crossed the MID and reduced our certainty of the results. Figure adapted from GRADEPro software.

The following are the MID for the outcomes and the methods used to calculate the OIS in this guideline:

- Any statistically significant difference in mortality
- The default confidence intervals in GRADE for relative risk of 0.75 and 1.25 for all other outcomes.

3.4 Evidence of cost-effectiveness

Evidence on cost-effectiveness related to the key clinical issues being addressed in the guideline was sought. The health economist:

- Undertook a systematic review of the economic literature
- Undertook new cost-effectiveness analysis in priority areas

3.4.1 Literature review

The Health Economist:

- Identified potentially relevant studies for each review question from the economic search results by reviewing titles and abstracts – full papers were then obtained.
- Reviewed full papers against pre-specified inclusion / exclusion criteria to identify relevant studies (see below for details).
- Critically appraised relevant studies using the economic evaluations checklist as specified in The Guidelines Manual[233].
- Extracted key information about the study's methods and results into evidence tables (evidence tables are included in Appendix F).
- Generated summaries of the evidence in NICE economic evidence profiles – see below for details.

3.4.1.1 Inclusion/exclusion

Full economic evaluations (cost-effectiveness, cost–utility, cost-benefit and cost-consequence analyses) and comparative costing studies that addressed the review question in the relevant population were considered potentially applicable as economic evidence.

Studies that only reported cost per hospital (not per patient), or only reported average cost effectiveness without disaggregated costs and effects, were excluded. However, studies reporting the cost per hospital were included when it was possible to ascertain the cost per patient of each intervention. Abstracts, posters, reviews, letters/editorials, foreign language publications and unpublished studies were excluded. Studies judged to have had an applicability rating of 'not applicable' were excluded (this included studies that took the perspective of a non-OECD country).

Remaining studies were prioritised for inclusion based on their relative applicability to the development of this guideline and the study limitations. For example, if a high quality, directly applicable UK analysis was available other less relevant studies may not have been included. Where exclusions occurred on this basis, this is noted in the relevant section.

For more details about the assessment of applicability and methodological quality see the economic evaluation checklist (The Guidelines Manual, Appendix H[233] and the health economics research protocol in Appendix C.

When no relevant economic analysis was found from the economic literature review, relevant UK NHS unit costs related to the compared interventions were presented to the GDG to inform the possible economic implication of the recommendation to make.

3.4.2 NICE economic evidence profiles

The NICE economic profile has been used to summarise cost and cost-effectiveness estimates. The economic evidence profile shows, for each economic study, an assessment of applicability and methodological quality, with footnotes indicating the reasons for the assessment. These assessments were made by the health economist using the economic evaluation checklist from The Guidelines Manual, Appendix H[233]. It also shows incremental costs, incremental outcomes (e.g. QALYs) and the incremental cost-effectiveness ratio from the primary analysis, as well as information about the assessment of uncertainty in the analysis. See Table 3-5 for more details.

If a non-UK study was included in the profile, the results were converted into pounds sterling using the appropriate purchasing power parity[246].

Table 3-5: Content of NICE economic profile

Item	*Description*
Study	First author name, reference, date of study publication and country perspective.
Limitations	An assessment of methodological quality of the study*: • **Minor limitations** – the study meets all quality criteria, or the study fails to meet one or more quality criteria, but this is unlikely to change the conclusions about cost effectiveness. • **Potentially serious limitations** – the study fails to meet one or more quality criteria, and this could change the conclusion about cost

	effectiveness • **Very serious limitations** – the study fails to meet one or more quality criteria and this is very likely to change the conclusions about cost effectiveness. Studies with very serious limitations would usually be excluded from the economic profile table.
Applicability	An assessment of applicability of the study to the clinical guideline, the current NHS situation and NICE decision-making*: • **Directly applicable** – the applicability criteria are met, or one or more criteria are not met but this is not likely to change the conclusions about cost effectiveness. • **Partially applicable** – one or more of the applicability criteria are not met, and this might possibly change the conclusions about cost effectiveness. • **Not applicable** – one or more of the applicability criteria are not met, and this is likely to change the conclusions about cost effectiveness.
Other comments	Particular issues that should be considered when interpreting the study.
Incremental cost	The mean cost associated with one strategy minus the mean cost of a comparator strategy.
Incremental effects	The mean QALYs (or other selected measure of health outcome) associated with one strategy minus the mean QALYs of a comparator strategy.
ICER	Incremental cost-effectiveness ratio: the incremental cost divided by the respective QALYs gained
Uncertainty	A summary of the extent of uncertainty about the ICER reflecting the results of deterministic or probabilistic sensitivity analyses, or stochastic analyses of trial data, as appropriate.

*Limitations and applicability were assessed using the economic evaluation checklist from The Guidelines Manual, Appendix H [233]

When no cost-effectiveness evidence was available, the cost of the interventions being evaluated has in some cases been determined by conducing original cost analyses there were reported in Appendix H. Alternatively, the GDG was presented with the cost figures from relevant sources, such as the NHS reference cost for England and Wales.

3.4.3 Undertaking new health economic analysis

As well as reviewing the published economic literature for each review question, as described above, new economic analyses were undertaken by the Health Economist in priority areas. Priority areas for new health economic analysis were agreed by the GDG after formation of the review questions and consideration of the available health economic evidence.

Additional data for the analysis was identified as required through additional literature searches undertaken by the Health Economist, and discussion with the GDG. Model structure, inputs and assumptions were explained to and agreed by the GDG members during meetings, and they commented on subsequent revisions.

See Appendix H for details of the health economic analyses undertaken for the guideline.

3.4.4 Cost-effectiveness criteria

NICE's report 'Social value judgements: principles for the development of NICE guidance'[232] sets out the principles that GDGs should consider when judging whether an intervention offers good value for money. In general, an intervention was considered to be cost effective if either of the following criteria applied (given that the estimate was considered plausible):

a) The intervention dominated other relevant strategies (that is, it was both less costly in terms of resource use and more clinically effective compared with all the other relevant alternative strategies), **or**

b) The intervention cost less than £20,000 per quality-adjusted life-year (QALY) gained compared with the next best strategy.

If the GDG recommended an intervention that was estimated to cost more than £20,000 per QALY gained, or did not recommend one that was estimated to cost less than £20,000 per QALY gained, the reasons for this decision are discussed explicitly in the 'from evidence to recommendations' section of the relevant chapter. This is written with reference to the issues regarding the plausibility of the estimate or to the factors set out in the Social value judgements report [232].

3.5 Developing recommendations

Over the course of the guideline development process, the GDG was presented with:

- Evidence tables of the clinical evidence (Appendix E) and economic evidence (Appendix F) reviewed from the literature.
- Summary of clinical and economic evidence and quality (as presented in chapters 5 to 13).
- Forest plots (Appendix G)
- A description of the methods and results of the cost-effectiveness analysis undertaken for the guideline (Appendix H)

Recommendations were drafted on the basis of the GDG interpretation of the available evidence, taking into account the balance of benefits, harms and costs. When clinical and economic evidence was of poor quality, conflicting or absent, the GDG drafted recommendations based on their expert opinion. The considerations for making consensus based recommendations include the balance between potential harms and benefits, economic or implications compared to the benefits, current practices, recommendations made in other relevant guidelines, patient preferences and equality issues. The consensus recommendations were done through discussions in the GDG.

3.5.1 Research recommendations

When areas were identified for which good evidence was lacking, the guideline development group considered making recommendations for future research. Decisions about inclusion were based on factors such as:

- the importance to patients or the population
- national priorities
- potential impact on the NHS and future NICE guidance
- ethical and technical feasibility

3.6 Validation process

The guidance is subject to an eight week public consultation and feedback as part of the quality assurance and peer review of the document. All comments received from registered stakeholders are responded to in turn and posted on the NICE website when the pre-publication check of the full guideline occurs.

3.7 Updating the guideline

Following publication, and in accordance with the NICE guidelines manual, NICE will ask a National Collaborating Centre or the National Clinical Guideline Centre to advise NICE's Guidance executive whether the evidence base has progressed significantly to alter the guideline recommendations and warrant an update.

3.8 Disclaimer

Health care providers need to use clinical judgement, knowledge and expertise when deciding whether it is appropriate to apply guidelines. The recommendations cited here are a guide and may not be appropriate for use in all situations. The decision to adopt any of the recommendations cited here must be made by the practitioners in light of individual patient circumstances, the wishes of the patient, clinical expertise and resources.

The National Clinical Guideline Centre disclaim any responsibility for damages arising out of the use or non-use of these guidelines and the literature used in support of these guidelines.

3.9 Funding

The National Clinical Guideline Centre was commissioned by the National Institute for Health and Clinical Excellence to undertake the work on this guideline.

4 Guideline summary

4.1 Map of recommendations

The algorithms can be found in the quick reference guide, available from www.nice.org.uk/guidance/CG124/QuickRefGuide. In addition, NICE is developing a pathway, which will be published on the NICE website.

Key priorities for implementation

The GDG identified ten key priorities for implementation. The decision was made after discussion and voting by the GDG. They selected recommendations that would:

- Have a high impact on outcomes that are important to patients (**A**)
- Have a high impact on reducing variation in care and outcomes (**B**)
- Lead to a more efficient use of NHS resources (**C**)
- Promote patient choice (**D**)
- Promote equalities (**E**)
- Mean patients reach critical points in the care pathway more quickly (F).

In doing this the GDG also considered which recommendations were particularly likely to benefit from implementation support. They considered whether a recommendation:

- Requires changes in service delivery (**W**)
- Requires retraining of professionals or the development of new skills and competencies (**X**)
- Affects and needs to be implemented across various agencies or settings (complex interactions) (**Y**)
- May be viewed as potentially contentious, or difficult to implement for other reasons (**Z**)

For each key recommendation listed below, the selection criteria and implementation support points are indicated by the use of the letters shown in brackets above and are shown in the linking evidence to recommendations sections in the relevant chapters.

- Perform surgery on the day of, or the day after, admission. (A, B, C, F, W, Y and Z).
- Identify and treat correctable comorbidities immediately so that surgery is not delayed by:
    - anaemia
    - anticoagulation
    - volume depletion
    - electrolyte imbalance
    - uncontrolled diabetes
    - uncontrolled heart failure
    - correctable cardiac arrhythmia or ischaemia

- acute chest infection
- exacerbation of chronic chest conditions (A, B, C, F, Y and Z).

- Schedule hip fracture surgery on a planned trauma list (A, B, C, F, W, and Z).
- Perform replacement arthroplasty (hemiarthroplasty or total hip replacement) in patients with a displaced intracapsular fracture (A, B, C, F and Z).
- Offer total hip replacements to patients with a displaced intracapsular fracture who:
  - were able to walk independently out of doors with no more than the use of a stick and
  - are not cognitively impaired and
  - are medically fit for anaesthesia and the procedure (A, B, C, X, and Z).
- Use extramedullary implants such as a sliding hip screw in preference to an intramedullary nail in patients with trochanteric fractures above and including the lesser trochanter (AO classification types A1 and A2) (A, B, C, and Z).
- Offer patients a physiotherapy assessment and, unless medically or surgically contraindicated, mobilisation on the day after surgery (A, B, C, D, E, F, W, X, Y and Z).
- Offer patients mobilisation at least once a day and ensure regular physiotherapy review (A, B, F, and W).
- From admission, offer patients a formal, acute, orthogeriatric or orthopaedic ward-based Hip Fracture Programme that includes all of the following:
  - orthogeriatric assessment
  - rapid optimisation of fitness for surgery
  - early identification of individual goals for multidisciplinary rehabilitation to recover mobility and independence, and to facilitate return to prefracture residence and long-term well-being.
  - continued co-ordinated orthogeriatric and multidisciplinary review
  - liaison or integration with related services, particularly mental health, falls prevention, bone health, primary care and social services.
  - clinical and service governance responsibility for all stages of the pathway of care and rehabilitation, including those delivered in the community. (A,B,C,D,E,F,W,X,Y and Z).
- Consider early supported discharge as part of the Hip Fracture Programme, provided the Hip Fracture Programme multidisciplinary team remains involved, and the patient:
  - is medically stable and

- has the mental ability to participate in continued rehabilitation and
- is able to transfer and mobilise short distances and
- has not yet achieved their full rehabilitation potential, as discussed with the patient, carer and family (A,B,C, E,F,W, and Z).

4.2 Full list of recommendations

Some aspects of hip fracture management are already covered by NICE guidance and are therefore outside the scope of this guideline. In order to ensure comprehensive management and continuity, the following NICE guidance should be referred to when developing a complete programme of care for each patient:: osteoporotic fragility fracture prevention (TA 160, 161 & 204)[234-236], falls (CG21)[227], pressure ulcers (CG29)[228], nutrition support (CG32)[229], dementia (CG42)[230], surgical site infection (CG74)[231], venous thromboembolism (CG92)[237] and delirium (CG103)[230].

4.2.1 Imaging options in occult hip fracture

- Offer magnetic resonance imaging (MRI) if hip fracture is suspected despite negative X-rays of the hip of an adequate standard.~~despite negative anteroposterior pelvis and lateral hip X-rays.~~ If MRI is not available within 24 hours or is contraindicated, consider computed tomography (CT).

4.2.2 Timing of surgery

- Perform surgery on the day of, or the day after, admission.
- Identify and treat correctable comorbidities immediately so that surgery is not delayed by:
  - anaemia
  - anticoagulation
  - volume depletion
  - electrolyte imbalance
  - uncontrolled diabetes
  - uncontrolled heart failure
  - correctable cardiac arrhythmia or ischaemia
  - acute chest infection
  - exacerbation of chronic chest conditions.

4.2.3 Analgesia

- Assess the patient's pain:
    - immediately upon presentation at hospital and
    - within 30 minutes of administering initial analgesia and
    - hourly until settled on the ward and
    - regularly as part of routine nursing observations throughout admission.
- Offer immediate analgesia to patients presenting at hospital with suspected hip fracture, including people with cognitive impairment.
- Ensure analgesia is sufficient to allow movements necessary for investigations (as indicated by the ability to tolerate passive external rotation of the leg), and for nursing care and rehabilitation.
- Offer paracetamol every 6 hours preoperatively unless contraindicated.
- Offer additional opioids if paracetamol alone does not provide sufficient preoperative pain relief.
- Consider adding nerve blocks if paracetamol and opioids do not provide sufficient preoperative pain relief, or to limit opioid dosage. Nerve blocks should be administered by trained personnel. Do not use nerve blocks as a substitute for early surgery.
- Offer paracetamol every 6 hours postoperatively unless contraindicated.
- Offer additional opioids if paracetamol alone does not provide sufficient postoperative pain relief.
- Non steroidal anti-inflammatory drugs (NSAIDs) are not recommended.

4.2.4 Anaesthesia

- Offer patients a choice of spinal or general anaesthesia after discussing the risks and benefits.
- Consider intraoperative nerve blocks for all patients undergoing surgery.

4.2.5 Planning the theatre team

- Schedule hip fracture surgery on a planned trauma list.
- Consultants or senior staff should supervise trainee and junior members of the anaesthesia, surgical and theatre teams when they carry out hip fracture procedures.

4.2.6 Surgical procedures

- Operate on patients with the aim to allow them to fully weight bear (without restriction) in the immediate postoperative period.

- Perform replacement arthroplasty (hemiarthroplasty or total hip replacement) in patients with a displaced intracapsular fracture.

- Offer total hip replacement to patients with a displaced intracapsular fracture who:

    - were able to walk independently out of doors with no more than the use of a stick and

    - are not cognitively impaired and

    - are medically fit for anaesthesia and the procedure

- Use a proven femoral stem design rather than Austin Moore or Thompson stems for arthroplasties. Suitable designs include those with an Orthopaedic Data Evaluation Panel rating of 10A, 10B, 10C, 7A, 7B, 5A, 5B, 3A or 3B.

- Use cemented implants in patients undergoing surgery with arthroplasty.

- Consider an anterolateral approach in favour of a posterior approach when inserting a hemiarthroplasty.

- Use extramedullary implants such as a sliding hip screw in preference to an intramedullary nail in patients with trochanteric fractures above and including the lesser trochanter (AO classification types A1 and A2).

- Use an intramedullary nail to treat patients with a subtrochanteric fracture.

4.2.7 Mobilisation strategies

- Offer patients a physiotherapy assessment and, unless medically or surgically contraindicated, mobilisation on the day after surgery.

- Offer patients mobilisation at least once a day and ensure regular physiotherapy review.

4.2.8 Multidisciplinary management

- From admission, offer patients a formal, acute orthogeriatric or orthopaedic ward-based Hip Fracture Programme that includes all of the following:

    - orthogeriatric assessment

    - rapid optimisation of fitness for surgery

    - early identification of individual goals for multidisciplinary rehabilitation to recover mobility and independence, and to facilitate return to prefracture residence and long-term wellbeing.

    - continued, coordinated, orthogeriatric and multidisciplinary review

    - liaison or integration with related services, particularly mental health, falls prevention, bone health, primary care and social services.

- clinical and service governance responsibility for all stages of the pathway of care and rehabilitation, including those delivered in the community.

- If a hip fracture complicates or precipitates a terminal illness, the multidisciplinary team should still consider the role of surgery, as part of a palliative care approach that:
  - minimises pain and other symptoms and
  - establishes patients' own priorities for rehabilitation and
  - considers patients' wishes about their end-of-life care.
- Healthcare professionals should deliver care that minimises the patient's risk of delirium and maximises their independence, by:
  - actively looking for cognitive impairment when patients first present with hip fracture
  - reassessing patients to identify delirium that may arise during their admission
  - offering individualised care in line with 'Delirium' (NICE clinical guideline 103).
- Consider early supported discharge as part of the Hip Fracture Programme, provided the Hip Fracture Programme multidisciplinary team remains involved, and the patient:
  - is medically stable and
  - has the mental ability to participate in continued rehabilitation and
  - is able to transfer and mobilise short distances and
  - has not yet achieved their full rehabilitation potential, as discussed with the patient, carer and family.
- Only consider intermediate care (continued rehabilitation in a community hospital or residential care unit) if all of the following criteria are met:
  - intermediate care is included in the Hip Fracture Programme and
  - the Hip Fracture Programme team retains the clinical lead, including patient selection, agreement of length of stay and ongoing objectives for intermediate care and
  - the Hip Fracture Programme team retains the managerial lead, ensuring that intermediate care is not resourced as a substitute for an effective acute hospital Programme.
- Patients admitted from care or nursing homes should not be excluded from rehabilitation programmes in the community or hospital, or as part of an early supported discharge programme.

4.2.9 Patient and carer information

- Offer patients (or, as appropriate, their carer and/or family) verbal and printed information about treatment and care including:
    - diagnosis
    - choice of anaesthesia
    - choice of analgesia and other medications
    - surgical procedures
    - possible complications
    - postoperative care
    - rehabilitation programme
    - long-term outcomes
    - healthcare professionals involved.

4.3 Research recommendations

The GDG identified the following priority areas for research:

- Imaging options in occult hip fracture
- Anaesthesia
- Displaced intracapsular hip fracture
- Early supported discharge
- Physiotherapy

4.3.1 Research recommendation on imaging options in occult hip fracture

- In patients with a continuing suspicion of a hip fracture but whose radiographs are normal, what is the clinical and cost effectiveness of computed tomography (CT) compared to magnetic resonance imaging (MRI), in confirming or excluding the fracture?

Why this is important

The GDG's consensus decision to recommend CT over a radionuclide bone scan as an alternative to MRI to detect occult hip fractures reflects current NHS practice but assumes that advances in technology have made the reliability of CT comparable with that of MRI. If modern CT can be shown to have similar reliability and accuracy to MRI, then this has considerable implications because of its widespread availability out of hours and lower cost.

It is therefore a high priority to confirm or refute this assumption by direct randomised comparison. The study design would need to retain MRI as the 'gold standard' for cases of uncertainty and to standardise the criteria, expertise and procedures for radiological assessment. Numbers required would depend on the degree of sensitivity and specificity (the key outcome criteria) set as target requirement for comparability, but need not necessarily be very large.

4.3.2 Research recommendation on anaesthesia

- What is the clinical and cost effectiveness of regional versus general anaesthesia on postoperative morbidity in patients with hip fracture?

Why this is important

No recent randomised controlled trials were identified that fully address this question. The evidence is old and does not reflect current practice. In addition, in most of the studies the patients are sedated before regional anaesthesia is administered, and this is not taken into account when analysing the results. The study design for the proposed research would be best addressed by a randomised controlled trial. This would ideally be a multi-centre trial including 3000 participants in each arm. This is achievable given that there are about 70,000 to 75,000 hip fractures a year in the UK[39]. The study should have three arms that look at spinal anaesthesia versus spinal anaesthesia plus sedation versus general anaesthesia; this would separate those with regional anaesthesia from those with regional anaesthesia plus sedation. The study would also need to control for surgery, especially type of fracture, prosthesis and grade of surgeon.

A qualitative research component would also be helpful to study patient preference for type of anaesthesia.

4.3.3 Research recommendation on displaced intracapsular hip fracture

- What is the clinical and cost effectiveness of large-head total hip replacement versus hemiarthroplasty on functional status, reoperations and quality of life in patients with displaced intracapsular hip fracture?

Why this is important

Large-head total hip replacement is a development of traditional total hip replacement, where a larger head makes the joint more stable and hence reduces the risks of dislocation. Three small trials have shown traditional small-head total hip replacement to have better outcomes and function, albeit with an increased dislocation rate in selected groups of patients. The drawback with large-head arthroplasty is the additional implant cost and theatre time. This cost can account for up to 20% of current NHS tariff (up to £2000) and the study aims to address whether this translates to improved patient outcome. The study design for the proposed research would be best addressed by a randomised controlled trial. This would have two arms to compare current standard care (using hemiarthroplasty) with using large-head total hip replacement for patients sustaining displaced intracapsular hip fractures. The primary outcome would be patient mobility at 1 year and secondary outcomes would include functional outcomes, quality of life and cost effectiveness of the intervention.

It would be expected that a sample size of approximately 500 patients would be required to show a significant difference in the mobility, hip function and quality of life (assuming 80%

power, $p < 0.05$). By recruiting through a trauma research network it is estimated that 10 centres would be able to recruit 20 patients per month (from 45 eligible patients) giving a recruitment period of 25 months.

4.3.4 Research recommendation on early supported discharge

- What is the clinical and cost effectiveness of early supported discharge on mortality, quality of life and functional status in patients with hip fracture who are admitted from a care home?

Why this is important

Residents of care and nursing homes account for about 30% of all patients with hip fracture admitted to hospital. Two-thirds of these come from care homes and the remainder from nursing homes. These patients are frailer, more functionally dependent and have a higher prevalence of cognitive impairment than patients admitted from their own homes. One-third of those admitted from a care home are discharged to a nursing home and one-fifth are readmitted to hospital within 3 months. There are no clinical trials to define the optimal rehabilitation pathway following hip fracture for these patients and therefore represent a discrete cohort where the existing meta-analyses do not apply. As a consequence, many patients are denied structured rehabilitation and are discharged back to their care home or nursing home with very little or no rehabilitation input.

Given the patient frailty and comorbidities, rehabilitation may have a limited effect on clinical outcomes for this group. The fact that they already live in a home where they are supported by trained care staff, however, clearly provides an opportunity for a systematic approach to rehabilitation. Early multidisciplinary rehabilitation based in care homes ornursing homes would take advantage of the day-to-day care arrangements already in place and provide additional NHS support to deliver naturalistic rehabilitation, where problems are tackled in the patient's residential setting.

Early supported multidisciplinary rehabilitation could reduce hospital stay, improve early return to function, and affect both readmission rates and the level of NHS-funded nursing care required.

The research would follow a two-stage design: (1) an initial feasibility study to refine the selection criteria and process for reliable identification and characterisation of those considered most likely to benefit, together with the intervention package and measures for collaboration between the Hip Fracture Programme team, care-home staff and other community-based professionals, and (2) a cluster randomized controlled comparison (with two or more intervention units and matched control units) set against agreed outcome criteria. The latter should include those specified above, together with measures of the impact on care-home staff activity and cost, as well as qualitative data from patients on relevant quality-of-life variables.

4.3.5 Research recommendation on physiotherapy

- What is the clinical and cost effectiveness of additional intensive physiotherapy and/or occupational therapy (for example progressive, resistance training) after hip fracture?

Why this is important

The rapid restoration of physical and self care functions is a critical to recovery from hip fracture, particularly where the goal is to return to the patient to preoperative levels of function and residence. Approaches that are worthy of future development and investigation include progressive resistance training, progressive balance and gait training, supported treadmill gait re-training, dual task training, and activities of daily living training. The optimal time point at which these interventions should be started requires clarification.

The ideal study design is a randomised controlled trial. Initial studies may have to focus on proof of concept and be mindful of costs. A phase III randomised controlled trial is required to determine clinical effectiveness and cost-effectiveness. The ideal sample size will be around 400 to 500 patients, and the primary outcome should be physical function and health related quality of life. Outcomes should also include falls. A formal sample size calculation will need to be undertaken. Outcomes should be followed over a minimum of 1 year, and compare if possible, either the recovery curve for restoration of function or time to attainment of functional goals.

4.3.6 Additional research recommendations

The following research questions were selected by the GDG but were not prioritised in the top five recommendations for research.

4.3.6.1 Analgesia

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of preoperative and postoperative nerve blocks in reducing pain and achieving mobilisation and physiotherapy goals sooner in patients with hip fracture?

Why this is important

Nerve blocks may potentially find an important role in the management of hip fracture pain, both pre- and postoperatively, because of their potential to reduce the requirement for opioids and their associated unwanted effects. Economically there are considerations for staff training, but also for the potential benefits in terms of duration of stay and early mobilisation. It is not possible from the existing literature to determine this with any confidence and there is a pressing need for a definitive trial comparing these outcomes with nerve blocks against a defined protocol of systemic opioid use.

4.3.6.2 Timing of surgery

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of surgery within 36 hours of admission compared to surgery later than 36 hours from admission in mortality, morbidity and quality of life in patients with hip fracture?

Why this is important

Early and appropriate surgery for hip fractures is the most effective form of pain relief, potentially quickening the rehabilitation and reducing complications. Within the current literature no specific time interval threshold has been identified (up to 24hr) below which a reduction in delay has shown no benefit. In addition to the evidence of the cost

effectiveness below 48hr, pragmatic, organisational and humanitarian considerations have been utilised to arrive at the recommendation to operate not later than the day after admission. A formal study within the NHS based on an arbitrary but realistic 36hr threshold would provide additional important data to that already available, in order to inform more precisely the forward clinical and cost-effectiveness of the strategy. For ethical reasons, the research design would be an observational cohort study, correcting for confounding variables, possibly set in the context of the National Hip Fracture Database and examining the effect of the time to surgery and its cost on key outcomes, including mortality, complications, length of stay, time taken to rehabilitate and qualitative aspects of the experiences of patients.

4.3.6.3 Reverse oblique trochanteric fractures

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of intramedullary versus extramedullary total hip replacement on mortality, functional status and quality of life in patients with reverse oblique trochanteric hip fracture?

Why this is important

Reverse oblique trochanteric fractures account for approximately 5 % of all trochanteric hip fractures. This means it affects approximately over 1000 patients per year in the UK. Presently there is little evidence as to which is the preferable implant (which can be either extramedullary – outside the bone, or intramedullary - inside the bone). The potential biomechanical advantage of intramedullary advantage may be offset by increased cost (which can be over £1000 more expensive). A randomised trial comparing the two implants using patient mobility, function and re-operation would allow a more informed choice of treatment for this injury.

4.3.6.4 Designated hip fracture units

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of a designated hip fracture unit within the trauma ward compared to units integrated into acute trusts on mortality, quality of life and functional status in patients with hip fracture?

Why this is important

The increasingly structured approach to hip fracture care has led to a number of UK units considering or establishing a specific ‘hip fracture ward’ as a specialist part of their acute orthopaedic service.

Designated hip fracture wards may prove an effective means of delivering the whole programme of coordinated perioperative care and multidisciplinary rehabilitation which this NICE Guidance has proposed, but at present there is no high quality evidence of their clinical effectiveness when compared to such care within general orthopaedic or trauma beds.

It may not be practical to run an RCT within a trauma unit, but there is certainly potential for cohort studies to explore the effect of such units on individual patients' mobility,

discharge residence, mortality and length of stay. Units considering the establishment of hip fracture wards should be encouraged to consider performing such trials.

4.3.6.5 Care/nursing home residents

The GDG recommended the following research question:

- Do patients admitted to hospital with a fractured hip who live permanently in a care/nursing home have equal access to multidisciplinary rehabilitation as patients admitted from home?

Why this is important

The existing literature on the effectiveness of multidisciplinary rehabilitation typically excludes patients who live in care/nursing homes. From an equality perspective it hypothesised that this group of people do not have access to the same multidisciplinary rehabilitation as patients who are returning home as it is assumed patients returning to care/nursing homes will have their care needs met by the home. The research design would be a prospective observational cohort study to determine the extent and quality of rehabilitation services available to this group in comparison to patients returning to their own homes.

4.3.6.6 Patient and carer quality of life

The GDG recommended the following research question:

- What quality of life value do individual patients and their carers place on different mobility, independence and residence states following rehabilitation?

Why this is important

It is important in evaluating future priorities for intervention to determine whether the perceived clinical and health economic benefits of rehabilitation outcomes in the research literature are matched over the same time-frame by the quality of life judgements, aspirations and expectations of patients themselves and their carers. There is currently no evidence.

4.3.6.7 Patient experience

The GDG recommended the following research question:

- What is the patient's experience of being admitted to hospital with a hip fracture in relation to surgery, pain management, timeliness of information given, and rehabilitation?

Why this is important

No studies from NHS populations were identified where patients commented specifically on their surgery, their pain management and rehabilitation programme. There were comments in the patient views studies about not being kept informed about the management of their condition, however there was no information identified about the appropriate time to be told. It may be that different patients want the information at different times. The studies suggest that patients suffer from fear, pain and delirium until after surgery and it is

important to learn what (if anything) can be done to alleviate this which for many will be considered the worst stage in their treatment.

5 Imaging options in occult hip fracture

5.1 Introduction

The occult, or 'hidden', hip fracture is one in which the clinical findings are suggestive of a fracture but this is not confirmed by radiographs.

Most hip fractures can be readily diagnosed using radiographs, consisting of an antero-posterior (AP) and a lateral projection of the hip, whenever the clinical suspicion of a fracture first arises. Importantly, no clinical decision rule has yet become available that would allow clinicians to exclude a hip fracture without imaging. To avoid misdiagnosis with hip pain being attributed erroneously to soft tissue injury and the patient being discharged, a high index of clinical suspicion of hip fracture is required. This applies in all patients presenting with a typical history - usually hip pain following trauma, e.g. a fall – as certain typical features, such as the inability to bear weight or a shortened, abducted and externally rotated leg, may be absent.

Achieving an accurate diagnosis as soon as possible is advantageous for a variety of reasons. The primary reason is that without an accurate diagnosis it is not possible to formulate a proper management plan. A fracture which is not obviously evident on radiographs is likely to be undisplaced. Once the hip fracture is demonstrated early diagnosis may allow for a simple procedure to fix the fracture in situ. Should it be confirmed that no hip fracture is present then other diagnoses may be sought, there is less chance of the patient being kept unnecessarily immobile and the patient may not need to stay in hospital.

Hip radiographs have an estimated sensitivity of between 90% and 98%, and the initial films will therefore miss only a small proportion of hip fractures. It is, however, essential to ensure that the radiographs are of satisfactory quality. In particular, if the initial AP film of the entire pelvis together with the lateral hip projection (taken in the position of comfort) show no fracture, a third film is sometimes taken centred on the hip with the hip in 10 degrees of internal rotation to position the femoral neck at 90 degrees to the x-ray beam and ensure an optimum view of this area. All subsequent discussion and recommendations assume that clinicians suspect a fracture despite two or three radiographs of adequate quality as detailed above.

The prevalence of occult hip fractures is estimated to be around 3 – 4%; up to 9% in some series (though a proportion of this may reflect radiographs of inadequate standard as

discussed above). Bone resorption around the fracture site, or cortical displacement, will render most occult hip fractures visible if radiographs are repeated after a few days. This is due to bone resorption occurring along the fracture line making it radiographically more obvious, but displacement or impaction may occur during this interval due to the patient having walked with the fracture. Delays in surgery due to late diagnosis are associated with prolonged suffering and poorer health outcomes for patients, and expose clinicians to the risk of litigation.

Optimal strategy for patient selection and timing of secondary imaging strategies to ensure early diagnosis of occult hip fractures, while avoiding over investigation of patients with soft tissue injury only, is yet to be determined. However, the inability to weight bear on the day following the injury, in spite of adequate analgesia, should prompt clinicians to re-evaluate the patient and have a high index of suspicion of hip fracture.

Imaging modalities used to assist in the early detection of occult hip fractures include computed tomography (CT), radionuclide scan (RNS), magnetic resonance imaging (MRI) and, rarely, ultrasound scanning (US). The type of secondary imaging modalities used locally is often determined by considerations of access, particularly outside normal working hours, and radiological expertise available. MRI is usually considered to be the reference standard, as numerous studies have found MRI to have the highest accuracy (100% sensitivity and between 93% and 100% specificity, depending on experience and skill of radiologist interpreting the images).

In this chapter we consider the clinical and cost-effectiveness of a number of alternative imaging modalities that can be used to detect an occult hip fracture when MRI is unavailable or precluded for safety or technical reasons.

5.2 Review question

In patients with a continuing clinical suspicion of hip fracture, despite negative radiographic findings, what is the clinical and cost-effectiveness of additional imaging (radiographs after at least 48 hours, RNS, US and CT, compared to MRI, in confirming, or excluding, a hip fracture?

5.3 Radiographs

5.3.1 What is the diagnostic accuracy of additional radiographs (X-Rays) after 48 hours compared to MRI in the diagnosis of occult hip fractures

Radiographs are the most widely available imaging technique (in- and out-of hours) utilised for diagnosis of hip fracture. They can be acquired quickly (5 minutes) and experience in image interpretation is widespread.

A hip fracture not visible on the original radiographs may become evident on films taken a few days later because of bone resorption (reduced bone density) along the fracture line, impaction (fracture line becomes more dense) or displacement.

5.3.1.1 Clinical evidence

No studies were identified.

5.3.1.2 Economic evidence.

No studies were identified.

5.3.1.3 Recommendations and link to evidence

See Section 5.6.2

5.4 Radionuclide bone scan (RNS)

For a RNS of the skeleton a short-life radio-isotope (technetium 99m) is linked to methylene diphosphonate (MDP) which is taken up in areas of bone formation (osteoblastic activity) resulting in 'hot spots'. The isotope is injected intravenously and then there has to be a delay of three hours before scanning, using a gamma camera and which takes 30 minutes, will detect increased uptake in the skeleton. Other causes of high bone turnover such as arthritis, synovitis and tumor may lead to false positive results and these are more frequent in patients over the age of 70. It is common practice to defer RNS until 72 hours after injury to avoid false negative scans but some authors suggest that the modern three-phase technique may give accurate results after only 24 hours.

5.4.1 What is the diagnostic accuracy of RNS compared to MRI in the diagnosis of occult hip fractures

Two RCTs with a total of 99 particpants were identified. See Evidence Table 1, Appendix E.

5.4.1.1 Clinical evidence

Table 5-6: Bone scanning – Quality assessment

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations*
Diagnostic accuracy [88,286]	2	Cross sectional study	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Bone scanning was carried out up to 72 after admission

(a) Evans 1994[88] study did not clearly report patient demographics
(b) Not clear who interpreted the results and whether they were blind to the results of the reference standard test

Table 5-7: - Clinical summary of findings

Outcome	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)	Likelihood Ratio (+ve)	Likelihood Ratio (-ve)	Quality
Diagnostic accuracy	75-98	100	93-96	100	0	0.02-0.25	Low

5.4.2 Economic evidence

No studies were identified. The cost of the procedures in England and Wales were presented to the GDG: a category 3 RNS costs £205, and an MRI (one area, no contrast) costs £206 (source: National schedule of reference costs 2008-09; NHS trusts and PCTs combined).

5.4.2.1 Evidence statement(s)

Clinical The sensitivity of bone RNS compared to MRI ranged from 75% to 98% and specificity was 100%. This means that between 2% and 25% of those who have a fracture, the fracture will have been missed. However, all patients who tested positively do actually have a fracture. (LOW QUALITY)

Economic No studies were identified on the cost-effectiveness of the diagnostic accuracy of RNS compared to MRI in the diagnosis of occult hip fractures.

5.4.3 Recommendations and link to evidence

See section 5.6.2

5.5 Ultrasound (US)

In ultrasound (US) imaging a probe emits ultrasound waves which are reflected off surfaces and recored to form the image. Good contact is required between skin and probe (coupling), generally achieved with gel, but may be problematic if there is pain or soft tissue swelling in the site being scanned, which may be the case in hip fracture. US is widely available, both in- and out-of-hours, does not use ionising radiation and is relatively inexpensive. However, it takes considerable skill and expertise to acquire optimum images and for interpretation of the appearances. Currently this kind of US scanning is performed by a minority of specialised musculo-skeletal radiologists in the UK.

Ultrasound scanning of the hip may detect bone surface changes, effusions or haemorrhage in patients with fractures but the results are non-specific and usually require confirmation by MRI or CT. The technique is highly operator-dependent.

5.5.1 Diagnostic accuracy of ultrasound (US) compared to MRI in the diagnosis of occult hip fractures

One study with 30 participants was identified. See Evidence Table 1, Appendix E and forest plot G2 in Appendix G

5.5.1.1 Clinical evidence

Table 5-8: Ultrasound (US) – Quality assessment

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations*
Diagnostic accuracy[297]	1	Cross sectional	No serious limitations	No serious inconsistency	No serious indirectness	Sonographic examinations were performed by highly experienced muskuloskeletal radiologists

Table 5-9: Ultrasound (US) - Clinical summary of findings

Outcome	*Sensitivity (%)*	*Specificity (%)*	*NPV (%)*	*PPV (%)*	*Likelihood Ratio (+ve)*	*Likelihood Ratio (-ve)*	*Quality*
Diagnostic Accuracy	100	65	100	59	2.85	0	Moderate

5.5.1.2 *Economic evidence*

No studies were identified. The costs *of the procedures in England and Wales were presented to the GDG:* ultrasound (US) *costs* £48 for a procedure lasting less than 20 minutes, and £62 for a procedure lasting more than 20 minutes. The cost of an MRI (one area, no contrast) is £206 (source: National schedule of reference costs 2008-09; NHS trusts and PCTs combined)

5.5.1.3 Evidence statement(s)

Clinical The sensitivity of ultrasound (US) compared to MRI was 100% and specificity was 65%. This means that none of the patients who had a fracture have been missed. However, of those who tested positive 35% do not actually have a fracture – i.e. there is a high percentage of false positives (sonographic abnormalities indistinguishable from those attributable to conditions other than fracture) (LOW QUALITY)

Economic No studies were identified on the cost-effectiveness of the diagnostic accuracy of ultrasound (US) compared to MRI in the diagnosis of occult hip fractures.

5.5.2 Recommendations and link to evidence

See section 5.6.2

5.6 Computed tomography (CT)

CT uses rings of sensitive detectors and an X-ray tube which rotates around the patient to acquire transverse axial images through the body. CT is a readily available imaging modality but its value for the detection of occult hip fractures has not been extensively evaluated. There is evidence that undisplaced fractures running parallel to the axial plane can be missed and limited resolution of osteoporotic trabecular bone may make the technique less reliable for the detection of fractures of the hip than of other areas of the body. However, technical developments in CT (spiral, multi-detector referred to as MDCT) have enabled thin 2 dimensional (2D) sections to be acquired very rapidly and from which 3D volumetric reconstructions can be acquired and displayed at bone, or a variety of soft tissue, settings. This has greatly enhanced the potential application of CT to imaging occult hip fractures. The scan is rapid (2minutes)(slice thickness 1.25mm; MAs between 100 to 355 depending on patient size/weight; field of view 36cm) and from which coronal, sagittal and other planar/3D reformations can be generated. CT is particularly good for imaging bone, but does not show the marrow changes (oedema) which occur in hip fracture adjacent to the fracture line.

5.6.1.1 Clinical evidence

No studies that meet our inclusion criteria were identified.

5.6.1.2 *Economic evidence*

No studies were identified. The costs of the procedures in England and Wales were presented to the GDG: the cost for a CT scan (one area, no contrast) is £101. The cost of an MRI (one area, no contrast) is £206 (source: National schedule of reference costs 2008-09; NHS trusts and PCTs combined)

5.6.1.3 Evidence statement(s)

Clinical No studies were identified directly comparing the diagnostic accuracy of CT with MRI and that meet our inclusion criteria.

Economic No studies were identified on the cost-effectiveness of the diagnostic accuracy of CT compared to MRI in the diagnosis of occult hip fracture.

5.6.2 Recommendations and link to evidence

Recommendation	**Offer magnetic resonance imaging (MRI) if hip fracture is suspected despite negative X-rays of the hip of an adequate standard. If MRI is not available within 24 hours or is contraindicated, consider computed tomography (CT).**
Relative values of different outcomes	Reliability (in terms of diagnostic accuracy) was considered the primary outcome of interest. A false positive diagnosis carries the risks either of unnecessary surgery or of delay and increased cost caused by the need for additional radiographic investigation; a false negative result carries the risks associated with subsequent fracture displacement and its consequences as well as avoidable

prolonged immobility and pain. It is therefore important for the selected method to minimise both false positives and false negatives.

Trade off between clinical benefits and harms

MRI cannot be used in patients with certain types of metallic implants but does not otherwise have known harmful effects other than the potential to cause claustrophobia due to the need for patients to remain in a confined space for a considerable length of time. MRI was considered to be the first choice option in view of its superior diagnostic accuracy (up to 100% specificity and sensitivity).

If limitations in the local availability of MRI lead to unacceptably prolonged delay to diagnosis offering an RNS or CT may have a net benefit to the patient even though both carry the risks of exposure to ionising radiation. A delay of several days may, however, be required for RNS to achieve the required sensitivity, it is also generally unavailable out-of-hours (a further cause of delay), and may provide less precise information for surgical planning.

Repeat radiographs after 48 hours have limited sensitivity and carry the risks of displacement during the intervening period, as well as those of delay to surgery.

Ultrasound (US) has no known harms but it's low specificity means that further imaging confirmation (with resulting delay) is required to determine whether a positive US represents a fracture, thus limiting its use. Conversely, a negative US reliably excludes fracture and could in theory enable immediate discharge of this small subset of patients from Emergency departments.

The advent of MRI has enabled the accurate early identification of occult hip fractures that would previously have been missed. The precise natural history of such occult fractures (and therefore the precise place of surgical intervention) has therefore only begun to be fully clarified. It is at least theoretically possible that a proportion of occult fractures might not require surgery. At the same time techniques of fracture fixation have also become less traumatic and invasive. Unless and until these issues of benefit/harm are fully resolved, precise and reliable early diagnosis as a basis for surgical decision making remains a clinical priority.

Economic considerations

In England and Wales, the cost of a radionuclide scan (RNS) and of an MRI is very similar: a category 3 RNS costs £205, and an MRI (one area, no contrast) costs £206. However, an MRI is cost saving compared to an RNS, as the latter may result in a longer length of hospital stay (and the possible consequences of delay to surgery) before the fracture is diagnosed.

The GDG also considered MRI to be cost-effective compared to US, since in the case of a positive US, its low specificity would still necessitate additional imaging (notably MRI or CT) to confirm the diagnosis. The possible consequences of delay to surgery would need to be added to those of additional imaging.

Quality of evidence

Two cross sectional studies comparing RNS to MRI were identified.

These studies had serious methodological limitations due to the limited reporting of patient demographics and lack of clarity as to whether the assessors were blinded to the results of the index test when interpreting the results of the reference standard and vice versa.

One cross sectional study comparing ultrasound (US) to MRI was identified. This study was of moderate quality. The GDG considered that the reproducibility was a potential limitation as the sonographic readings were performed by highly experienced muskuloskeletal radiologists.There were no serious inconsistencies or indirectness in any of the identified studies.

The assumption that MRI is the gold standard for detecting occult hip fracture and the recommendation advising use of CT as an alternative to MRI were based on unanimous GDG consensus.

Other considerations

The diagnosis and management of occult hip fracture is still very much an evolving area of practice. In the absence of an evidence-based clinical decision rule clinicians must exert clinical judgement to decide when suspicion of hip fracture after normal plain radiographs is great enough to warrant additional imaging.

Before radiographs are regarded as excluding a hip fracture one should ensure that radiographic quality is optimized. When AP pelvic or hip radiographs are performed the leg should be a little internally rotated with the great toes of the feet overlapping so as to bring the anteverted femoral neck parallel to the X-ray table. In this position little of the lesser trochanter should be visible medial to the femoral cortex (the more externally rotated is the leg the more obvious is the lesser trochanter). Optimising the positioning enables the greater trochanter to be better visualized and not obscured behind the femur. When a hip fracture is present it may prove impossible to position the leg in this optimum position because of pain, but this may be compensated for by appropriate X-ray tube angulation. It should also be ensured that the X-ray exposure factors are optimum to demonstrate both the entire pelvis, to check that fractures are not present in sites additional to the hip, and also for the hip suspected of fracture. To attain this separate exposures and radiographs may be required.

Whilst the GDG considered that MRI was the best test to use to detect occult hip fracture and that this should be the first choice, they noted that there may be occasions where MRI is not available and thought it was important to give guidance as to which test to use in these circumstances. The GDG's consensus decision to recommend CT over RNS is based on greater availability, especially outside the working week, and shorter delay to diagnosis. It also reflects current NHS practice.

In addition, the technical aspects of RNS of bone (a 3 hour delay after radionuclide is given until gamma emission can be recorded; also increased uptake of radionuclide depends on increased osteoblastic activity which may take several days to occur following fracture; lack of availability out of hours) makes this the least

appropriate now for imaging occult hip fractures and is now not often used in this scenario, since the advent of CT and MRI.

The GDG were also aware that rapid advances in CT technology, such as 64-slice scanners and sophisticated 3 dimensional reconstruction algorithms, may well overcome the limitations of CT reported in the published literature about its value for detection of occult hip fractures.

5.7 Research recommendation on imaging options in occult hip fracture

The GDG recommended the following research question:

In patients with a continuing suspicion of a hip fracture but whose radiographs are normal, what is the clinical and cost effectiveness of computed tomography compared to magnetic resonance imaging, in confirming or excluding the fracture?

Why this is important

The GDG's consensus decision to recommend CT over a radionuclide bone scan as an alternative to MRI to detect occult hip fractures reflects current NHS practice but assumes that advances in technology have made the reliability of CT comparable to that of MRI. If modern CT indeed can be shown to have similar reliability and accuracy to MRI, then this has considerable implications because of its widespread availability out of hours and lower cost. It is a high priority, therefore, to confirm or refute this assumption by direct randomised comparison. The study design would need to retain MRI as "gold standard" for cases of uncertainty and would clearly need to standardise the criteria, expertise and procedures for radiological assessment. Numbers required would depend on the degree of sensitivity/specificity (the key outcome criteria) set as target requirement for comparability, but need not necessarily be very large.

6 Timing of surgery

6.1 Introduction

The timing of treatment for patients sustaining fractures of the proximal femur remains one of the biggest challenges to a health care system. It involves multidisciplinary co-ordination between accident and emergency departments, acute orthopaedic trauma services, orthogeriatricians, anaesthetists, as well as the availability of appropriate theatre space

with trained staff and relevant equipment. In the past these patients were given low priority in the hospital system, which led to many delays and repeated periods of starvation. It is recognised that it is not only the time a patient takes to get to surgery that is important, but that the patient has to be medically optimised, with the anaesthetic, surgical and theatre team being appropriately experienced. When planning any emergency care it is not always possible to predict the number of cases which can present, so any system which is set up must have the flexibility to adapt to the peaks and troughs of admissions. This can lead to potential free theatre capacity in quieter periods.

As it would be unethical to enforce an unnecessary delay for patients sustaining fractures of the proximal femur, all studies reported are retrospective cohort studies. As such the level and quality of the evidence is poor.

The timing of surgery is an early marker of a patient's progress following a hip fracture. The surgery does not stand alone. The pathway to safe, timely surgery includes proper organisation and expertise in diagnosis, medical optimisation and anaesthesia. In the last decade many orthopaedic trauma emergencies are now treated on dedicated planned trauma lists. A planned trauma list is one with a rostered senior anaesthetist, senior surgeon and dedicated theatre time. These by their nature usually concentrate the expertise required.

There are sometimes legitimate reasons for delay and it is important to look at the excluded patients in these studies. In a few patients delay to surgery is unavoidable. However, it should be anticipated that many patients with hip fractures will be frail and have comorbidities. The following would be common findings in patients presenting with hip fractures:

- Anaemia
- Anticoagulation
- Volume depletion
- Electrolyte imbalance
- Uncontrolled diabetes
- Uncontrolled heart failure
- Correctable cardiac arrhythmia or ischaemia
- Acute chest infection
- Exacerbation of chronic chest conditions

Provided these problems are sought and measures initiated to correct them are taken promptly the majority can be optimised within 24 hours.

When looking at the timings measured it is generally accepted the time of diagnosis should be the initial time recorded and the time to the start of the anaesthetic procedure be the index time measured. Objective outcomes used to compare timing of surgery include early and late mortality, length of hospital stay, return to mobility, complications including chest infections and pressure sores, change of residence and other surgical complications. What has not been measured in the past is the pain and suffering experienced with prolonged

delay and what is the ethical time period the elderly, who are often very frail, should wait for treatment.

6.1.1 Review question

In patients with hip fractures what is the clinical and cost effectiveness of early surgery (within 24, 36 or 48 hours) on the incidence of complications such as mortality, pneumonia, pressure sores, cognitive dysfunction and increased length of hospital stay?

10 studies met the inclusion criteria for this question, with a total of 193,793 participants. Data are given for studies where outcomes have been adjusted for confounding factors such as comorbidity and age using logistic regression (7 studies). A separate subgroup is given which excludes patients who are unfit for surgery i.e. reason for delay is due to unavailability of staff, theatres or equipment (3 studies). Delay to surgery in the identified studies was from time to admission. All studies report surgical delay versus early surgery to investigate the harm of delaying surgery.

The cut-off for delay to surgery in this analysis is 24, 36 and 48 hours.

See evidence table 2, Appendix E and forest plots G2 to G22 in Appendix G.

6.1.1.1 Clinical evidence

Table 6-10: Late (>24h) versus early surgery for hip fracture – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality – In hospital[19,351]	2	Observational	No serious limitations	No serious inconsistency	No serious indirectness (b, d)	Serious imprecision (e)
Mortality – 30 days[30]	2	Observational	Serious limitations (a)	No serious inconsistency	No serious indirectness (a, b, d)	Serious imprecision (e)
Mortality – 3 months[351]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness (b)	Serious imprecision (e)
Mortality – 4 months[4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision (e)
Mortality – 1 year[351]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness (b)	Serious imprecision (e)
Return to independent living[4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision (e)
Pressure ulcers[4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	No serious imprecision
Major complications (c)[19]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness (d)	No serious imprecision

(a) *In Bottle and Aylin, 2006 [30] baseline data, such as age is given for the entire cohort and also stratified by type of surgery e.g. fixation, replacement, other procedure. No baseline data stratified by delay to surgery. Patients were all admitted from their own home.*

(b) *In Weller et al., 2005[351] baseline data, such as age is stratified per hospital.No baseline data stratified by delay to surgery.*

(c) *Severe complications were defined as cerebrovascular accident, cardiorespiratory complications, digestive complications except unspecific paralytic ileus, and dialysis.*

(d) *The comparison is 24-48h vs. 0-24 h time to surgery for Bergeron 2006[19]*

(e) *The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.*

Table 6-11: Late (>24 hours) versus early surgery for hip fracture - Clinical summary of findings

Outcome	Late surgery[(a)]	Early surgery [(a)]	Adjusted Odds Ratio	Absolute effect	Quality
Mortality – in hospital	325	523	0.88 (0.55 - 1.41)	N/A	Very low
Mortality – in hospital	25320	20303	1.17 (1.08 - 1.26)	N/A	Low
Mortality – 30 days	45862	69080	1.25 (1.19 - 1.31)	N/A	Very low
Mortality – 3 months	25320	20303	1.11 (1.05 - 1.17)	N/A	Very low
Mortality – 4 months	225	209	1.07 (0.67 - 1.70)	N/A	Very low
Mortality – 1 year	25320	20303	1.13 (1.05 - 1.22)	N/A	Very low
Return to independent living	225	209	0.86 (0.45 - 1.65)	N/A	Very low
Pressure ulcers	225	209	2.19 (1.21 - 3.96)	N/A	Low
Major complications	325	523	0.87 (0.58 - 1.29)	N/A	Low

(a) Numbers of patients in each study arm. No event data is given as the data provided is odds ratios adjusted using logistic regression for confounding factors.

Table 6-12: Late (>36h) versus early surgery for hip fracture – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality – in hospital [189]	1	Observational	No serious limitations (a)	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]
Minor complications [189]	1	Observational	No serious limitations (a)	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]
Major complications [189]	1	Observational	No serious limitations (a)	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]
Pressure ulcers [189]	1	Observational	No serious limitations (a)	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]
Mortality – 4 months [4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]
Pressure ulcers [4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	No serious imprecision
Return to independent living [4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision [(a)]

(a) Baseline data given for entire cohort not by time to surgery.
(b) Late surgery is between 24-48h with early surgery defined as <24h.
(a) The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.

Table 6-13: Late (>36 hours) versus early surgery for hip fracture - Clinical summary of findings

Outcome	Late surgery[(a)]	Early surgery[(a)]	Adjusted Odds Ratio	Absolute effect	Quality
Mortality – in hospital	264	245	0.82 (0.42 - 1.62)	N/A	Very low
Minor complications	264	245	1.53 (1.05 - 2.22)	N/A	Very low
Major complications	264	245	0.96 (0.52 - 1.75)	N/A	Very low
Pressure ulcers	264	245	1.23 (0.71 - 2.12)	N/A	Very low
Mortality – 4 months	194	550	1.5 (0.63 – 1.74)	N/A	Very low
Pressure ulcers	194	550	3.42 (1.94 – 6.03)	N/A	Low
Return to independent living	194	550	0.44 (0.21 – 0.91)	N/A	Very low

(a) Numbers of patients in each study arm. No event data is given as the data provided is odds ratios adjusted using logistic regression for confounding factors.

Table 6-14: Late (>48h) versus early surgery for hip fracture – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality – In hospital[19,189,351]	3	Observational	No serious limitations	No serious inconsistency	No serious indirectness [(b,d)]	Serious imprecision [(e)]
Mortality – 30 days [30,125]	2	Observational	Serious limitations [(a)]	No serious inconsistency	No serious indirectness	Serious imprecision [(e)]
Mortality – 3 months [351]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness [(b)]	No serious imprecision
Mortality – 4 months [4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision [(e)]
Mortality – 1 year [351]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness [(b)]	No serious imprecision
Return to independent living [4]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision [(e)]
Pressure ulcers[4,125,189]	3	Observational	No serious limitations	No serious inconsistency	No serious indirectness	No serious imprecision
Major complications [(c)19,189]	2	Observational	No serious limitations	No serious inconsistency	No serious indirectness [(d)]	Serious imprecision [(e)]
Minor complications [189]	1	Observational	No serious limitations	No serious inconsistency	No serious indirectness [(d)]	No serious imprecision

(a) *In Bottle and Aylin, 2006 [30] baseline data, such as age is given for the entire cohort and also stratified by type of surgery e.g. fixation, replacement, other procedure. No baseline data stratified by delay to surgery.Patients were all admitted from their own home.*
(b) *In Weller et al., 2005[351] baseline data, such as age is stratified per hospital.No baseline data stratified by delay to surgery.*
(c) *In Bergeron 2006[19], severe complications were defined as cerebrovascular accident, cardiorespiratory complications, digestive complications except unspecific paralytic ileus, and dialysis.*
(d) *The comparison is >48h vs. 0-24 h time to surgery*
(e) *The wide confidence intervals around the estimate make it difficult to determine the effect size for this outcome.*

Table 6-15: Late (>48 hours) versus early surgery for hip fracture - Clinical summary of findings

Outcome	Late surgery[(a)]	Early surgery[(a)]	Adjusted Odds Ratio	Absolute effect	Quality
Mortality – In hospital [19]	129	848	1.16 (0.64 - 2.13)	N/A	Very low
Mortality – in hospital [189]	98	509	0.93 (0.38 - 2.33)	N/A	Very low
Mortality – In hospital [351]	7314	20303	1.60 (1.42 - 1.80)	N/A	Low
Mortality – 30 days [30]	24391	90551	1.36 (1.29 - 1.43)	N/A	Very low
Mortality – 30 days [125]	3805	4578	0.71 (0.45 - 1.10)	N/A	Very low
Mortality – 3 months	7314	20303	1.40 (1.28 - 1.54)	N/A	Low
Mortality – 4 months	98	646	0.86 (0.44 - 1.69)	N/A	Very low
Mortality – 1 year	7314	20303	1.58 (1.26 - 1.99)	N/A	Low
Return to independent living	98	646	0.33 (0.14 - 0.78)	N/A	Very low
Pressure ulcers [4]	98	646	4.34 (2.34 - 8.04)	N/A	Low
Pressure ulcers [125]	3805	4578	1.20 (0.9 - 1.6)	N/A	Very low
Pressure ulcers [189]	98	509	2.29 (1.19 - 4.40)	N/A	Low
Major complications [19]	129	848	1.32 (0.79 - 2.20)	N/A	Very low
Major complications [189]	98	509	2.21 (1.01 - 4.34)	N/A	Very low
Minor complications	98	509	2.27 (1.38 - 3.72)	N/A	Low

(a) *Numbers of patients in each study arm. No event data is given as the data provided is odds ratios adjusted using logistic regression for confounding factors.*

Table 6-16: Late (>48h) versus early surgery for hip fracture (length of hospital stay outcomes)– Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Postoperative length of hospital stay[19]	1	Observational	No serious limitations [(a)]	No serious inconsistency	No serious indirectness	No serious imprecision
Postoperative length of hospital stay; without comorbidity[19]	1	Observational	No serious limitations [(a)]	No serious inconsistency	No serious indirectness	No serious imprecision
Postoperative length of hospital stay (including	1	Observational	No serious limitations [(a)]	No serious inconsistency	No serious indirectness	No serious imprecision

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
rehab)[308]						

(a) Mean and standard deviations are not provided, only median or mean and 95% confidence interval.

Table 6-17: Late (>48h) versus early surgery for hip fracture - Clinical summary of findings; length of hospital stay

Outcome	Late surgery[(c)]	Early surgery[(c)]	Median (days) Late surgery	Median (days) Early surgery	Quality
Postoperative length of hospital stay [(a)]	129	848	28	18	Low
Postoperative length of hospital stay; without comorbidity	30	248	20	16	Low
Postoperative length of hospital stay (including rehab)	174	3454	36.5 [(b)]	21.6 [(b)]	Low

(a) Data is unadjusted for co-morbidity, which is more frequent in the delayed surgery study arm.

(b) Mean number of days given, 95% confidence interval = 5.7 to 16.0, $p < 0.0001$.

(c) Numbers of patients in each study arm. No event data is given as the data provided is odds ratios adjusted using logistic regression for confounding factors.

Table 6-18: Late (>24h) versus early surgery for hip fracture (exclusion of patients unfit for surgery) – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality 30 days [215]	1	Observational	Serious limitations [a, b]	No serious inconsistency	No serious indirectness	Serious imprecision [c]
Mortality and needing total assistance in locomotion at 6 months [250]	1	Observational	Serious limitations [a]	No serious inconsistency	No serious indirectness	Serious imprecision [c]
Major postoperative complications [250]	1	Observational	Serious limitations [a]	No serious inconsistency	No serious indirectness	Serious imprecision [c]

(a) Baseline data not reported separately for the restricted cohort.

(b) No protocol for determining which patients were unfit for surgery and anaesthesia, therefore variation between clinicians.

(c) The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.

Table 6-19: Late (>24 hours) versus early surgery for hip fracture (exclusion of patients unfit for surgery) - Clinical summary of findings

Outcome	Late surgery	Early surgery	Risk Ratio	Absolute effect	Quality
Mortality 30 days	85/1166	85/982	0.84 (0.63 - 1.12)	N/A	Very low
Mortality and needing total assistance in locomotion at 6 months	509		0.62 (0.35 -1.08) [a]	N/A	Very low
Major postoperative complications	273		0.26 (0.07 – 0.95) [a]	N/A	Very low

(a) Adjusted odds ratio

Table 6-20: Late (>48h) versus early surgery for hip fracture (exclusion of patients unfit for surgery) – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality 30 days[215]	1	Observational	Serious limitations (a, b)	No serious inconsistency	No serious indirectness	Serious imprecision (c)
Mortality at 1 year[308]	1	Observational	Serious limitations (a)	No serious inconsistency	No serious indirectness	No serious imprecision
Change in residence (more dependent)[308]	1	Observational	Serious limitations (a)	No serious inconsistency	No serious indirectness	Serious imprecision (c)
Return to original residence[308]	1	Observational	Serious limitations (a)	No serious inconsistency	No serious indirectness	No serious imprecision

(a) Baseline data not reported separately for the restricted cohort.
(b) No protocol for determining which patients were unfit for surgery and anaesthesia, therefore variation between clinician decisions.
(c) The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.

Table 6-21: Late (>48 hours) versus early surgery for hip fracture (exclusion of patients unfit for surgery) - Clinical summary of findings

Outcome	Late surgery	Early surgery	Risk Ratio	Absolute effect	Quality
Mortality 30 days	36/497	134/1651	0.89 (0.63 – 1.27)	N/A	Very low
Mortality at 1 year	24/174	238/3454	0.5 (0.34 – 0.74)	N/A	Very low
Change in residence (more dependent)	22/174	240/3454	0.55 (0.37 – 0.83)	N/A	Very low
Return to original residence	128/174	2974/3454	1.17 (1.07 – 1.28)	N/A	Very low

6.1.1.2 Economic evidence

One study[304,304] was found which calculated the mean hospital costs for hip fracture patients who had received surgery at different points in time from admission. This study was excluded because of serious methodological limitations, as no reason was given as to why patients had faced delays before receiving surgery (whether it was because of medical or administrative reasons)

An original decision analytical model was developed to compare the cost-effectiveness of a strategy consisting in adding extra half-day operating lists to increase the proportion of patients operated within 48 hours from admission against a non-investment strategy. Please see Appendix H, section 20.5 for further details.

Table 6-22: Early versus late (>48h) surgery for hip fracture - Economic study characteristics

Study	Limitations	Applicability	Other Comments
NCGC decision model	Minor limitations (a)	Partial applicability (b)	

(a) Cost-effectiveness analysis based on a Markov model.

(b) *The findings of the model may not be generalized to the whole UK NHS because its treatment effects and cost data are based on evidence from two specific hospital settings. The addition of extra operating lists may not be feasible for those providers where no spare theatre capacity is available.*

Table 6-23: Early versus late (>48h) surgery for hip fracture - Economic summary of findings

Study	Incremental cost (£)	Incremental effects (QALYs)	ICER	Uncertainty
NCGC decision model	1) £1,000 for the first year of implementation of extra operating lists [(a)] 2) £ 800 for the second year of implementation of extra operating lists [(b)]	1) 0.0425 for the first year of implementation of extra operating lists 2) 0.094 for the second year of implementation of extra operating lists [(c)]	1) £22,542/QALY for the first year of implementation of extra operating lists 2) £8,933/QALY for the second year of implementation of extra operating lists	95% CI: cost saving – dominated (both in the first and in the second year of implementation of extra operating lists [(d)]

(a) *In the first year of implementation of extra operating lists, the mean costs for investment in extra operating lists early surgery were £47.4, and for the non-investment strategy £46.4.*

(b) *For the second year, the mean costs associated with the strategy of investment for early surgery were £47.3, and for the non-investment strategy £46.4.*

(c) *In the first year of implementation of extra operating lists, the mean effectiveness for the strategy of investment for early surgery was 2.3637, and for the non-investment strategy 2.3212. In the second year, they corresponded to 2.415 and 2.321 respectively.*

(d) *95% CI of ICERs calculated from the 10,000 Monte Carlo simulations. The high uncertainty of the model is due to all the types of variables, including the effectiveness of interventions. We have tested the uncertainty of all categories of inputs in the model (costs, utilities, relative risks), by making probabilistic one category at a time while keeping the others deterministic, and under all scenarios the findings showed great uncertainty, with a 95% CI cost saving – dominated".*

6.1.1.3 Evidence statement (s)

Clinical <u>All patients</u>

Early surgery (<24h) shows a statistically significant and clinically significant reduction in mortality (in 4 out of 7 studies) (VERY LOW QUALITY) and reduction in pressure ulcers (LOW QUALITY) with early surgery compared to late surgery. No statistically significant difference shown for return to independent living or major complications (LOW QUALITY).

Early surgery (<36h) – statistically significant and clinically significant reduction in pressure ulcers with early surgery compared to late surgery (LOW QUALITY). Statistically significant, but not clinically significant increased return to independent living (VERY LOW QUALITY). No statistically significant difference in mortality at 4 months (VERY LOW QUALITY).

Early surgery (<48h) shows a statistically significant and clinically significant reduction in mortality (in 4 out of 8 studies) (VERY LOW QUALITY), increased return to independent living (VERY LOW QUALITY), reduced pressure ulcers (LOW QUALITY), reduced major and minor complications with early surgery compared to late surgery (VERY LOW QUALITY).

<u>Exclusion of patients unfit for surgery</u>

Early surgery (<24h) – Statistically significant, but not clinically significant reduction in major postoperative complications with early surgery compared to late surgery. No statistically significant difference in mortality, with early surgery compared to late surgery. (VERY LOW QUALITY)

Early surgery (<48h) – Statistically significant, and clinically significant reduction in mortality at 1 year and patients changing residence (more dependent) and increased return to original residence (VERY LOW QUALITY). No statistically significant difference in mortality at 30 days with early surgery compared to late surgery. (VERY LOW QUALITY).

Economic Investing in adding extra operating lists as a way to increase the proportion of patients operated within 48 hours from admission is only marginally above the £20k/QALYs threshold in the first year of implementation, but becomes clearly cost-effective from the second year onwards.

This evidence has minor limitations and partial applicability.

6.1.2 Recommendations and link to evidence

Recommendation	**Perform surgery on the day of, or the day after, admission.**
Relative values of different outcomes	The GDG recognised that hip fracture surgery was often disproportionately delayed in comparison with other operations, and that this in part reflected a lack of sufficient priority afforded to this group of patients. On humanitarian criteria alone, initiatives to avoid delay were considered to be of high priority in developing the guidance. It was considered that surgery was the best form of pain relief, and that to spend more than one night in hospital without operation was generally unacceptable. Postponement of surgery carries increased risk of complications, as well as prolongation of pain, and the need for repeated preoperative fasting. Of the outcomes derived from the literature, mortality, return to independent living, occurrence of specific complications (notably pressure ulcers) and duration of hospital stay were all considered of parallel and inter-related importance as indicators of care standard and efficacy.
Trade off between clinical benefits and harms	There was no instance in the literature of any advantage in delaying surgery, nor of disadvantage in reducing delay. Although the range of studies utilised a range of arbitrary or pragmatic time thresholds (governed to some degree by service context and organisation), there was no definitive cut-off point (up to and including 24 hours) beyond which further reduction of delay ceased to confer measurable benefit in one or more outcomes. Therefore the GDG considered it could not be prescriptive about

the precise time threshold from the literature alone.

The trade off between early surgery and harms relate to the difficulties and infrastructure required to treat this population who present as emergencies. It is recognized surgery is the best form of analgesia and as over 30% present with cognitive impairment, it can be otherwise difficult to assess patients suffering. It is also considered humane not to leave this frail patient group waiting treatment (often being repeatedly starved). The potential harm of earlier surgery include the risks of not medically resuscitating and optimizing the patients health prior to a further surgical insult and ensuring the surgical team is experienced and available. A delay up to 36 hours allows for appropriate assessment and planning. It allows patients to be operated on in planned trauma lists and should allow most hospitals to cope with peaks in emergency admissions.

Only one study [4] looked at complications, return to independent living and pressure sores. Whilst this study did report a small benefit in protecting against pressure sores it did not demonstrate any additional benefits. Regarding mortality one study [351] showed a small difference in mortality at one year, though again the difference and numbers were small.

Alani et al., 2008[4] is the only study which looked at the 36 hour time frame. It failed to show improvement in mortality at four months yet showed a slight benefit in return to independent living and avoidance of pressure ulcers.

When comparing surgery at 48 hours, again the data is limited. The overall number of patients included is small and there is a reported decrease in mortality in two out of the five studies included[30,351]. Apart from the benefits already reported in Alani's study, other outcomes were either not reported or did not show any difference.

Economic considerations

To be able to offer surgery for hip fracture patients by an experienced surgical team, within the recommended time period, it is recognized there may have to be an investment in infrastructure, specifically planned trauma operating lists with experienced surgical, anaesthetic and theatre teams. Generally these should occur in the normal working day. As admission numbers, including peaks and troughs, cannot be always predicted then this capacity may not always be utilised.

The potential costs of reducing delay to surgery were recognised- such as additional theatre time, out-of-hours staffing (including senior staff), out of-hours lists and planned trauma lists.

These costs will be at least partially offset by potential savings from reduced length of stay, reduced complications and enhanced return to independent living.

There was no definitive health economic study for any time threshold in the literature. The guideline group therefore considered that an original decision model was crucial to inform the broad economic feasibility of any recommendation on reducing

surgical delay. As discussed in Appendix H, the GDG agreed that, out of the evidence included in the clinical review, the outcome data to undertake this analysis were adequate only to provide a model based on a 48hr threshold, and as a consequence this specific cut-off point was selected for the economic analysis.

The economic model demonstrates that investing to add extra operating lists in order to undertake surgery within 48 hours from admission is only marginally above the £20k/QALYs threshold in the first year of implementation, but becomes clearly cost-effective in the following years.

Furthermore, the implementation of extra operating lists will also achieve a more equitable distribution of health care resources in favour of patients that had previously been made to wait for surgery as other cases were given higher priority.

However, the model does not capture the possibility that the extra operating lists could potentially be used to treat cases in addition to hip fracture patients (thus resulting in an increase of activity for the hospital trust and subsequent QALYs gains for the patients treated).

In addition, our cost-effectiveness estimates are also conservative in that we do not look at the impact that early surgery has on the pain relief of our population.

Quality of evidence

The available clinical evidence covering this issue is of low quality, but in aggregate supports the avoidance of surgical delay.

For this reason there is an element of consensus in the wording of the recommendation which, in addition to the evidence of clinical benefit and NHS economic feasibility, also reflects a strong humanitarian case. The consensus was unanimous within the GDG.

The health economic analysis reported in Appendix H showed that surgery performed with 48 hours was cost effective.

Although the evidence base for this question is predominantly retrospective, cohort studies of low quality (all low or very low) it is not considered ethical to conduct an RCT to answer this question.

The main studies included were cohort studies that adjusted for confounding factors by logistic regression, which although were low quality were considered higher quality than cohort studies without any adjustment. The subgroup studies did not adjust for confounding factors, but were considered as similar quality to those studies using logistic regression as the population excluded those unfit for surgery.

Other considerations

The context of implementation has changed during guideline development in such a way as to highlight the relevance and feasibility of the recommendation, in that the Department of Health has introduced a Best Practice Tariff initiative to achieve hip fracture surgery within 36 hours of admission.

Recommendation	**Identify and treat correctable comorbidities immediately so that surgery is not delayed by:** • **anaemia** • **anticoagulation** • **volume depletion** • **electrolyte imbalance** • **uncontrolled diabetes** • **uncontrolled heart failure** • **correctable cardiac arrhythmia or ischaemia** • **acute chest infection** • **exacerbation of chronic chest conditions.**
Relative values of different outcomes	The most important outcomes considered here were mortality, length of stay in hospital and postoperative complications.
Trade off between clinical benefits and harms	Patients should not be delayed for routine tests which will not affect the surgical or anaesthetic procedure. It has been shown in the majority of patients that longer delay leads to an increase in complications and length of stay in those medically fit. A number of medical conditions that might pose a concern to the surgeon or the anaesthetist are so commonly encountered among patients presenting with hip fracture that their occurrence should be anticipated, and admission assessment and management protocols designed that will expedite their management and so prevent their delaying surgery. The process of pro-actively seeking to identify such conditions will also help in identifying other less common potential concerns that might need more individual assessment - by experienced physicians (often orthogeriatricians) or anaesthetists - when a medical delay may be required.
Economic considerations	The early identification and treatment of patients' comorbidities may require additional resources in terms of personnel's rounds and ad-hoc tests. These costs would be at least partially off-set by savings linked with a lower length of hospital stay associated with the possibility of performing surgery at an earlier stage.
Quality of evidence	The evidence included in this chapter did not cover treatment of comorbidities. The main studies adjusted for these factors and the subgroup excluded patients unfit for surgery.
Other considerations	There should be the availability of experienced orthogeriatricians / physicians and anaesthetists to assess patients who may require further optimization. Regular review and communication with the surgical team is essential.

6.2 Research recommendations on timing of surgery

6.2.1 Surgery within 36 hours

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of surgery within 36 hours of admission compared to surgery later than 36 hours from admission in mortality, morbidity and quality of life in patients with hip fracture?

Why this is important

Early and appropriate surgery for hip fractures is the most effective form of pain relief, potentially quickening the rehabilitation and reducing complications. Within the current literature no specific time interval threshold has been identified (up to 24hr) below which a reduction in delay has shown no benefit. In addition to the evidence of the cost effectiveness below 48hr, pragmatic, organisational and humanitarian considerations have been utilised to arrive at the recommendation to operate not later than the day after admission. A formal study within the NHS based on an arbitrary but realistic 36hr threshold would provide additional important data to that already available, in order to inform more precisely the forward clinical and cost-effectiveness of the strategy. For ethical reasons, the research design would be an observational cohort study, correcting for confounding variables, possibly set in the context of the National Hip Fracture Database and examining the effect of the time to surgery and its cost on key outcomes, including mortality, complications, length of stay, time taken to rehabilitate and qualitative aspects of the experiences of patients.

7 Analgesia

7.1 Introduction

Pain is a major component of the patient experience following a hip fracture. Fracture and postoperative pain, along with fracture and surgical site blood loss, constitute the major physiological stresses facing these patients. Fear of pain is a major concern to them and their relatives. The best form of analgesia is surgical repair, but there will usually be a period when assessment is taking place when some analgesia is needed. Prompt and adequate relief of pain has long been identified as a major priority in the management of hip fracture, and one that has not always historically been achieved.

Pain relief is obviously important for simple humanitarian reasons and for acute nursing care, but also improves patients' wellbeing, reduces the risk of delirium, and facilitates the return to mobility and independence.

It is often difficult to assess the need for analgesia when the patients are lying still. They may require more pain relief when moved passively for investigations, such as radiological procedures and subsequently for the active mobilisation essential to their successful recovery. Many patients with hip fracture may be unable to express their pain, either because of cognitive impairment, acute delirium or an underlying expressive dysphasia.

Systemic analgesics act through the bloodstream on the whole body rather than on a localised area or region. They are still the most widely used drugs for providing pain relief in acute painful situations. Systemic analgesics used for pain relief in hip fracture include simple analgesics such as paracetamol, and a wide range of opioids. Non-steroidal anti-inflammatory drugs are usually avoided or used with caution because of their side effects. These include upper gastrointestinal bleeding, nephrotoxicity and fluid retention – to all of which the older population and are well known to exhibit increased susceptibility.

The nerves supplying the proximal femur may also be blocked by injecting local anaesthetic around the femoral nerve. These injections are referred to as nerve blocks and are sometimes administered to patients to reduce pain if simple analgesics and opioids have not proven to be sufficient. They are also thought to improve pain scores and mobility and to help avoid excessive opioid usage.

The aim of this chapter is to identify optimal preoperative and postoperative analgesia including the use of nerve blocks as adjuncts or alternatives to simple analgesics such as paracetamol and opioids.

The use of nerve blocks as with anaesthesia is covered in Chapter 8 on regional compared to general anaesthesia.

7.2 Systemic analgesia

7.2.1 Review question

In patients who have or are suspected of having a hip fracture, what is the comparative effectiveness and cost effectiveness of systemic analgesics in providing adequate pain relief and reducing side effects and mortality?

7.2.1.1 Clinical evidence

No studies on the effectiveness of these drugs in hip fracture patients were identified.

7.2.1.2 Economic evidence

No relevant studies were identified. We conducted a cost analysis of a nerve block, non-opioids and other analgesics. We found that a nerve block would cost approximately £54.66. The average cost for opioids controlled drugs is £11.84 (where £1.34 is the average cost per dose of the drugs and £10.50 the personnel cost of two trained nurses required for the administration of the drugs). The price of opioids non-controlled drugs is estimated at £1.96 per doses. The cost of non-opioids analgesics is less than £0.1p per dose. Please see Appendix H section 20.1 for further details.

7.2.2 Recommendations and link to evidence

In order to present the recommendations in a logical manner and retain their sequential order, the recommendations for this section are presented below in section 7.3.2

7.3 Nerve blocks compared to systemic analgesia

7.3.1 Review question

In patients who have or are suspected of having a hip fracture, what is the clinical and cost effectiveness of nerve blocks compared to systemic analgesia in providing adequate pain relief and reducing side effects and mortality?

One systematic review [262] was identified including 17 RCTs with a total of 888 participants. See evidence table 3, Appendix E and forest plots G23 to G37 in Appendix G.

7.3.1.1 Clinical evidence

The review considered any nerve block that affects the nerves supplying the proximal femur. These include the subcostal nerve, the lateral cutaneous nerve of the thigh, the femoral nerve, psoas (lumbar plexus), fascia iliaca compartment block (FICB) and triple (femoral, obturator and sciatic) nerve.

The literature search retrieved one Cochrane review (Parker et al 2002)[262]. A further update search was then conducted to look for any papers that may have been published since the publication of this review. No additional studies were retrieved and therefore the clinical evidence presented in this chapter is based on the Parker et al results with the addition of the GRADE analysis.

Table 7-24: Nerve blocks versus systemic analgesia – Clinical study characteristics

Outcome	*Number of studies*	*Design(p)*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Pain[116,182,220]	3	RCT	Serious limitations(a)	No serious inconsistency	No serious indirectness	Serious imprecision(o)
Unsatisfactory pain control preoperatively or need for 'breakthrough' analgesia[51,98,116,182,220]	5	RCT	Serious limitations(b)	No serious inconsistency	No serious indirectness	No serious imprecision
Unsatisfactory pain control postoperatively[51, 62]	2	RCT	Serious limitations(c)	No serious inconsistency	No serious indirectness	Serious imprecision(o)

Outcome	Number of studies	Design[p]	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
Nausea and/or vomiting[62,98,116,220,318,331]	6	RCT	Serious limitations[(d)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Need for anti-emetics[331]	1	RCT	Serious limitations[(e)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Wound infection[99]	1	RCT	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Pneumonia[95,99,129,207,352]	5	RCT	No serious limitations	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Any cardiac complication[99,207]	2	RCT	Serious limitations[(f)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Myocardial infarction[207]	1	RCT	Serious limitations[(g)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Puritis[331]	1	RCT	Serious limitations[(h)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Pulmonary embolism[99,129]	2	RCT	No serious limitations	No serious inconsistency[(m)]	No serious indirectness	Serious imprecision[(o)]
Deep vein thrombosis[62,95,99,129,352]	5	RCT	Serious limitations[(i)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Mortality[62,95,99,129,153,165,207,352]	8	RCT	Serious limitations[(j)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]
Pressure sores[62,129,182]	3	RCT	Serious limitations[(k)]	No serious inconsistency[(n)]	No serious indirectness	Serious imprecision[(o)]
Confusional state[62,182,352]	3	RCT	Serious limitations[(l)]	No serious inconsistency	No serious indirectness	Serious imprecision[(o)]

(a) One study (Gille 2006)[116] did not state the method of randomisation. All 3 studies were not adequately blinded.

(b) High risk of bias due to lack of allocation concealment. 2 (GIlle 2006 and Chudinov 1999)[51,116] out of the 5 studies did not specify their method of randomisation.

(c) One study (Chudinov 1999)[51] did not clearly report its randomisation method and did not report any allocation concealment.

(d) Low risk of bias. 2 out of the 6 studies did not clearly report randomisation method and allocation concealment.

(e) High risk of bias due to unclear reporting of the method of randomisation

(f) One of the 2 studies (Matot 2003)[207] has a high risk of selection bias due to unclear methods of concealment and randomisation.

(g) This study has a high risk of selection bias due to unclear methods of concealment and randomisation

(h) This study has a high risk of selection bias due to unclear methods of concealment and randomisation. It also had a very short follow up (24 hours).

(i) One of the 5 studies (White 1980)[352] has a high risk of selection bias due to unclear methods of concealment and randomisation.

(j) Two of the studies (white and Hood)[153,352] had a high risk of selection bias due to unclear methods of concealment and randomisation. One study also had a high number of drop outs in one the trial arms.

(k) studies has a high risk of selection bias due to unclear methods of concealment and randomisation

(l) One of the studies (white 1980)[352] had a high risk of selection bias due to unclear methods of concealment and randomisation. One study also had a high number of drop outs in one the trial arms.

(m) There was some non statistically significant heterogeneity I^2 =31% p=0.23.

(n) There was some non statistically significant heterogeneity I^2 =30% p=0.23.

(o) The wide confidence intervals around the estimate make the result imprecise. Consequently, it is difficult to determine the true effect size for this outcome.

(p) The following studies included nerve blocks in conjunction with general anaesthesia: Foss et al (2005)[99], Tuncer et al (2003)[331], Spansberg et al (1996)[318], Hood et al (1991)[153], Jones et al (1985)[165], White at al (1980)[352].

Table 7-25: Nerve blocks versus systemic analgesia - Clinical summary of findings

Outcome	*Intervention*	*Control*	*Relative risk (95% confidence interval)*	*Absolute effect*	*Quality*
Pain	106	104	N/A	SMD -0.52 (-0.8 to -0.25)	Low
Unsatisfactory pain control preoperatively or need for 'breakthrough' analgesia	18/150 (12%)	47/148 (31.8%)	RR 0.37 (0.23-0.61)	200 fewer per 1000 (from 124 fewer to 245 fewer)	Low
Unsatisfactory pain control postoperatively	1/20 (5%)	10/20 (50%)	RR 0.1 (0.01-0.71)	549 fewer per 1000 (from 177 fewer to 604 fewer)	Low
	15/21 (71.5%)	15/21 (71.5%)	RR 1 (0.68-1.47)		
Nausea and/or vomiting	18/141 (12.8%)	25/159 (15.7%)	RR 1.05 (0.63-1.75)	8 more per 1000 (from 58 fewer to 118 more)	Moderate
Need for anti-emetics	0/20 (0%)	5/20 (25%)	RR 0.09 (0.01-1.54)	227 fewer per 1000 (from 248 fewer to 135 more)	Low
Wound infection	0/28 (0%)	2/27 (7.4%)	RR 0.019 (0.01-3.85)	60 fewer per 1000 (from 73 fewer to 164 more)	Moderate
Pneumonia	12/129 (9.3%)	25/130 (19.2%)	RR 0.49 (0.26-0.94)	98 fewer per 1000 (12 fewer to 142 fewer)	Moderate
Any cardiac complication	3/62 (4.8%)	12/62 (19.4%)	RR 0.25 (0.07-0.84)	145 fewer per 1000 (from 31 fewer to 180 fewer)	Low
Myocardial infarction	1/34 (3%)	4/34 (12%)	RR 0.25 (0.03-2.12)	88 fewer per 1000 (from 114 fewer to 132 more)	Low
Pruritis	0/20 (0%)	5/20 (25%)	RR 0.09 (0.01-1.54)	227 fewer per 1000 (from 248 fewer to 135 more)	Low
Pulmonary embolism	1/53 (1.9%)	2/52 (3.8%)	RR 0.66 (0.11-3.86)	13 fewer per 1000 (31 fewer to 110 more)	Low
Deep vein thrombosis	7/116 (6%)	7/137 (5.1%)	RR 1.12 (0.43-2.93)	6 more per 1000 (29 fewer to 99 more)	Low
Mortality	9/189 (4.8%)	19/205 (9.3%)	RR 0.59 (0.29-1.21)	38 fewer per 1000 (66 fewer to 99 more)	Low

Pressure sores	3/86 (3.5%)	9/106 (8.5%)	RR 0.51 (0.11-2.39)	42 fewer per 1000 (76 fewer to 118 more)	Low
Confusional state	15/77 (19.5%)	34/101 (33.7%)	RR 0.63 (0.37-1.06)	125 fewer per 1000 (212 fewer to 20 more)	Low

7.3.1.2 Economic evidence

No relevant studies were identified. We conducted a cost analysis of a nerve block, non-opioids and other analgesics. We found that a nerve block would cost approximately £54.66. The average cost for opioids controlled drugs is £11.84 (where £1.34 is the average cost per dose of the drugs and £10.50 the personnel cost of two trained nurses required for the administration of the drugs). The price of opioids non-controlled drugs is estimated at £1.96 per doses. The cost of non-opioids analgesics is less than £0.1p per dose. Please see Appendix H section 20.1 for further details.

7.3.1.3 Evidence statement (s)

Clinical There is a statistically significant but not clinically significant reduction in pain when using nerve blocks compared to systemic analgesia. (LOW QUALITY). There is a statistically significant but not clinically significant reduction in pneumonia when using nerve blocks compared to systemic analgesia (MODERATE QUALITY).

There is no statistically significant difference between nerve blocks and systemic analgesia in all other outcomes (LOW QUALITY).

Economic No studies on the cost-effectiveness of nerve blocks for hip fracture patients were identified.

7.3.2 Recommendations and link to evidence

Recommendation	**Assess the patient's pain:** • **immediately upon presentation at hospital and** • **within 30 minutes of administering initial analgesia and** • **hourly until settled on the ward and** • **regularly as part of routine nursing observations throughout admission.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events

outcomes to be important.

Trade off between clinical benefits and harms

Regular assessments mean that the patients benefit from analgesia that is tailored to their needs and ensure that the analgesic agents have taken effect. There are no identifiable harms associated with this.

Economic considerations

The GDG agrees that the additional costs linked with the staff time required for regular pain assessment are likely to be offset by the beneficial outcomes of ensuring adequate analgesia.

Quality of evidence

There have been no studies of this approach to achieving adequate analgesia. The recommendation is based on GDG consensus.

Other considerations

Satisfactory and timely pain relief can only be ensured by regular re-assessment.

To maintain an adequate level of pain relief, analgesia should be administered routinely and not 'on demand'. It is good practice to re-assess a patient in severe pain after 30 minutes, as analgesia will have taken effect in this time and the need (or not) for additional analgesia can be determined. The 30-minute interval also reflects the pharmacokinetic/pharmacodynamic profiles of morphine and its active metabolite morphine-6-glucuronide. Adequate analgesic response is usual by 15 minutes after administration and should invariably be achieved by 30 minutes. Upward dose titration is otherwise required. The duration of effect varies, ranging from 2 to 24 hours reflecting inter-individual variability in morphine-6-glucuronide clearance and response. If further analgesia is required, the need for subsequent hourly reassessment is justified not only by the need to ensure a satisfactory response, but also to assess any unwanted effects. This hourly interval is also partly pragmatic, consistent with safe, common good clinical practice, and in line with CEM recommendations. For these reasons, the GDG felt that the recommended 30-minute check to ascertain and achieve initial response, and hourly observation thereafter to determine its duration, together with any adverse effects, are appropriate. The same intervals apply to dosage switches.

Some patients may be unable to express their need for pain relief to health care professionals. Regular assessment of pain and tailoring of medication accordingly will reduce the risk of these patients suffering because of inadequate pain control.

The GDG also considered evidence on patient views. Two studies in which patients mentioned pain management were identified (Section 13.2). In one, pain management did not seem to be a problem[314]. However, in the other the patient had to keep asking for pain relief after surgery[274]. This highlights the importance of regular assessment.

Additional broad guidance on the assessment of pain in general in older people is given in a joint British Pain Society and British Geriatrics Society document to be found at: http://www.bgs.org.uk/Publications/Publication%20Downloads/Sep2007PainAssessment.pdf

Recommendation	**Offer immediate analgesia to patients presenting at hospital with suspected hip fracture, including people with cognitive impairment.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	Immediate pain control not only improves patients' wellbeing but may reduce the risk of delirium, and facilitate rehabilitation and a return to mobility and independence. The risks of pain relief are the side effects of the individual agents used to achieve it (see below).
Economic considerations	The GDG agrees that the costs of providing immediate and adequate analgesia are likely to be offset by the improvement in patients' wellbeing.
Quality of evidence	There have been no studies on the timing of analgesia on patient outcome. The evidence for efficacy is that of each agent. The recommendation is based on GDG consensus.
Other considerations	It is a humanitarian necessity that these patients receive adequate analgesia, even if cognitively impaired, or limited in their ability to express pain. Particular skill and sensitivity may be required in the management of pain in those who also show signs of delirium (see NICE delirium Guideline[224]) It must be remembered that patients may require more analgesia for investigations such as X Rays.

Recommendation	**Ensure analgesia is sufficient to allow movements necessary for investigations (as indicated by the ability to tolerate passive external rotation of the leg), and for nursing care and rehabilitation.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	Providing adequate levels of analgesia is essential in improving the patients' wellbeing and minimising their discomfort whilst clinical

	investigations are being carried out. Gentle rotation of the leg may be associated with some degree of pain but would not otherwise cause any additional harm to the patient. There are no other identifiable harms from carrying out this assessment.
Economic considerations	The beneficial outcomes of ensuring that adequate analgesia is provided to allow patients' movements are likely to offset the staff time required).
Quality of evidence	There have been no studies of this approach to achieving adequate analgesia. The recommendation is based on GDG consensus.
Other considerations	In both the pre and postoperative periods if the patient can tolerate passive rotation of the leg then this gives an indication they will be comfortable for preoperative radiographs as well as initial postoperative mobilisation. This procedure should adequately predict the adequacy of analgesia when patients subsequently have to be moved (e.g. on and off examination surfaces) for investigational procedures, such as X-rays.

Recommendation	**Offer paracetamol every 6 hours preoperatively unless contraindicated.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	Simple regular prescribed analgesia such as paracetamol is not associated with any significant harm or side effects. However, it should be avoided or used with caution in patients with known hypersensitivity to paracetamol and in liver and renal disease.
Economic considerations	The cost of paracetamol is minimal (Appendix H, section 8.1). The administration of paracetamol would be part of routine drug rounds, and therefore it will not involve additional staff or administrative costs.
Quality of evidence	There are no placebo-controlled trials of the efficacy of preoperative administration of paracetamol in hip fracture patients as these are unethical. In a randomised controlled trial, Cuvillion et al 2007[62] have shown that 2g of intravenous propacetamol (equivalent to 1g intravenous paracetamol) can be as effective as nerve blocks or morphine in the postoperative phase. There were no studies comparing paracetamol administered via the oral or rectal routes (which are associated with greater variation in bioavailability than than the intravenous route). Therefore, the recommendation for the use of paracetamol is supported by evidence of low to moderate quality with respect to intravenous use, but made on the basis of consensus with respect to oral or

rectal administration.

Other considerations

Complications are especially more likely to develop when stronger analgesia is administered in the elderly. Regular paracetamol is first-line unless contra-indicated.

This and subsequent recommendations follow a logical hierarchy for the use of analgesic agents as indicated in the World Health Organisation pain relief ladder.

Recommendation	**Offer additional opioids if paracetamol alone does not provide sufficient preoperative pain relief.**

Relative values of different outcomes

This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated or by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.

Trade off between clinical benefits and harms

Repeated use of opioids may cause dependence and tolerance. While this should be borne in mind, it should not deter the achievement of effective pain relief in the acute situation of hip fracture. In those for whom the fracture is an incident within the pathway of a terminal illness, the palliative context of that illness should also be an important consideration. In particular, if there is a history of previous opioid use, the existence of acquired tolerance may necessitate the use of higher doses to relieve hip fracture pain. Many older patients may have impaired respiratory function and opioids should be used with caution in these patients. Smaller doses may be required in older patients.

Harm may come from excessive opioid administration:

- Some patients may develop nausea and constipation from stronger opioids and codeine. Regular laxatives may need to be administered.
- Severe constipation may exacerbate other chronic conditions like diverticulitis.
- The significant sedation from even mild opioids in this vulnerable group may slow down their postoperative mobilisation, and upset their balance.

There is a trade off between using stronger analgesia with more side effects and the benefit of better pain relief. Elderly patients are more susceptible to the harmful effects of opioid analgesics.

Opioids and NSAIDs can both cause harm in elderly patients with comorbidities. Most elderly hip fracture patients do have multiple chronic conditions such as decreased renal function , hiatus hernia

	or previous gastric or duodenal erosions, vertigo, diverticulitis , or mild cognitive problems that may be exacerbated by these forms of analgesia.
Economic considerations	The administration of some opioids requires two trained nurses for approximately 15 minutes. Please see Appendix H section 20.1 for further details. The GDG agrees that the additional costs are likely to be offset by the beneficial outcomes of ensuring adequate analgesia (see Recommendation 1).
Quality of evidence	No studies on the effectiveness of opioids compared to placebo or to other drugs in hip fracture patients were identified.
Other considerations	None

Recommendation	**Consider adding nerve blocks if paracetamol and opioids do not provide sufficient preoperative pain relief, or to limit opioid dosage. Nerve blocks should be administered by trained personnel. Do not use nerve blocks as a substitute for early surgery.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important. Adequate pain relief is beneficial. Reduction in the required administration of opioids and the associated side effects may also be an important outcome.
Trade off between clinical benefits and harms	Local nerve blocks are effective and may serve as a means of reducing the need for, and side effects of, opioids and other analgesia. However, as there they are associated with a very rare incidence of nerve damage, administering them in a busy casualty department may require a rolling programme of training junior doctors or nurses to be competent with this technique.
Economic considerations	The additional cost of nerve blocks versus the cost of opioid drugs may be offset by savings in the resources that would be required to treat the side effects of opioids. The GDG agrees that the additional costs are likely to be offset by the beneficial outcomes of ensuring adequate analgesia.
Quality of evidence	There are a limited number of clinical trials that have examined the effectiveness of nerve blocks in conjunction with general anaesthesia. Some studies have looked at the impact of inserting nerve blocks before the surgical procedure, to see if this may reduce analgesic requirements and improve pain management. These studies show that nerve blocks reduce the degree of pain compared to systemic analgesia alone and that they may have fewer side effects compared to systemic analgesia.

Other considerations	Although studies have shown that nerve blocks are better than systemic analgesia at relieving pain, the GDG considered that this should not be the be first line treatment. The GDG wished to ensure that the administration of analgesics is done in a step wise approach as some patients may benefit from simple analgesics such as paracetamol and therefore avoid the more serious side effects of stronger analgesics.

Recommendation	**Offer paracetamol every 6 hours postoperatively unless contraindicated.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. It is also of central importance in achieving early mobilisation postoperatively. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	Paracetamol administered first-line and regularly in standard dosage at this frequency is commonly effective and lacks the unwanted effects of second-line systemic agents (see below). It should be avoided or used with caution in patients with known hypersensitivity to paracetamol and in liver and renal disease.
Economic considerations	The cost of paracetamol is minimal. The administration of paracetamol would be part of routine drug rounds, and therefore it will not involve additional staff or administrative costs. (Appendix H, section 8.1.
Quality of evidence	Cuvillion et al have shown that 2g intravenous propacetamol (equivalent to 1g paracetamol) is as effective as nerve blocks or morphine in the postoperative phase.
Other considerations	Paracetamol should be the first option as opioids often sedate patients when they need to be alert to understand and remember important instructions from the physiotherapist on early effective mobilisation. Also opioids may make patients feel dizzy and unconfident about their balance. Postoperatively active mobilisation may require additional pain relief. Pain may be a critical barrier to be overcome for effective early mobilisation.

Recommendation	**Offer additional opioids if paracetamol alone does not provide sufficient postoperative pain relief.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. It is also of central importance in achieving early mobilisation postoperatively. Therefore, the GDG considered pain relief (for example as indicated by Visual Analogue Scales or by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	Opioids do have significant side effects of sedation, nausea, dizziness and constipation. However, pain is also a significant barrier to early mobilisation. Getting the analgesia right at each step of the hip fracture pathway is a skilled judgement for each individual patient until they are discharged. Often opioids sedate patients when they need to be alert to understand and remember important instructions from the physiotherapist on early effective mobilisation. Also opioids may make patients feel dizzy and unconfident about their balance.
Economic considerations	The GDG believe that the side-effects of opioids and additional costs are likely to be offset by the benefits of pain relief.
Quality of evidence	No studies on the effectiveness of opioids compared to placebo or to other drugs in hip fracture patients were identified. This recommendation is based on GDG consensus.
Other considerations	None.

Recommendation	**Non steroidal anti-inflammatory drugs (NSAIDs) are not recommended.**
Relative values of different outcomes	This group of patients is most commonly elderly and frail and pain is one of the main physiological and psychological stresses they face. It is also of central importance in achieving early mobilisation postoperatively. Therefore, the GDG considered pain relief (for example as indicated by the need for 'breakthrough analgesia') to be the most important outcome. The GDG also considered adverse events outcomes to be important.
Trade off between clinical benefits and harms	The benefits of pain relief are outweighed by the potential side effects of these drugs particularly (but not exclusively) in the elderly population. There is a known age-related increase in susceptibility to the harmful effects of NSAIDs including upper gastrointestinal bleeding, nephrotoxicity and fluid retention.
Economic considerations	The use of NSAIDs is expected to result in a QALY loss, mainly associated with the side effects and adverse events of NSAIDs in

	our population. The incremental cost savings would have to be considerably high to outweigh these negative benefits, and given the recommended interventions this is highly unlikely.
Quality of evidence	No RCTs on the effectiveness of NSAIDs compared to placebo or to other drugs in hip fracture patients were identified. This recommendation is based on GDG consensus.
Other considerations	The side effects of these drugs are too great in the elderly. Therefore, the GDG decided that they should be avoided as there are other safer alternatives are available such as paracetamol and opioids. As discussed, many of these patients have comorbidities of hiatus hernia, gastric or duodenal erosions, or chronic renal impairment, which can all be made worse by regular use of NSAIDs.

7.4 Research recommendations on analgesia

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of preoperative and postoperative nerve blocks in reducing pain and achieving mobilisation and physiotherapy goals sooner in patients with hip fracture?

Why this is important

Nerve blocks may potentially find an important role in the management of hip fracture pain, both pre- and postoperatively, because of their potential to reduce the requirement for opioids and their associated unwanted effects. Economically there are considerations for staff training, but also for the potential benefits in terms of duration of stay and early mobilisation. It is not possible from the existing literature to determine this with any confidence and there is a pressing need for a definitive trial comparing these outcomes with nerve blocks against a defined protocol of systemic opioid use.

8 Regional (spinal or epidural) versus general anaesthesia

8.1 Introduction

Patients who have a proximal femoral fracture are usually offered surgery to treat the injury. The vast majority of these operations will require some type of anaesthesia. Anaesthesia may be general anaesthesia or regional anaesthesia.

General anaesthesia involves complete loss of consciousness. This may be achieved by either inhalational agents or intravenous anaesthetic agents. Regional anaesthesia is conducted by numbing the nerves that supply sensation to the lower limbs, with the injection of local anaesthetic solution into the fluid surrounding the spinal cord. There are two types of regional anaesthesia, spinal and epidural. During a spinal, local anaesthetic drugs, sometimes in combination with opioid painkillers are injected directly into the cerebro-spinal fluid of the spinal cord. The majority regional anaesthesia administered to hip fracture patients is spinal anaesthesia rather than epidural.

Hip fracture patients are generally elderly and have significant comorbidities. This increases the risks from all types of anaesthesia. At present both regional and general anaesthesia are administered but the eventual choice is the preference and experience of the anaesthetist in discussion with the patient and their carers.

The aim of this review is to identify whether regional anaesthesia confers any benefit compared to general anaesthesia with regards to reducing complications and improving patient outcomes after surgery.

8.2 Regional versus general anaesthesia

8.2.1 Review question

In patients undergoing surgical repair or replacement for hip fractures, what is the clinical and cost-effectiveness of regional (spinal/epidural) anaesthesia compared to general anaesthesia in reducing complications such as mortality, cognitive dysfunction, thromboembolic events, postoperative respiratory morbidity, renal failure and length of stay in hospital?

8.2.1.1 Clinical evidence

The literature search retrieved one Cochrane review (Parker et al 2004)[266] including 22 RCTs with a total of 2567 participants. A further update search was then conducted to search for any papers that may have been published since the publication of this review. No additional studies were retrieved and therefore the clinical evidence presented in this chapter is based on the Parker et al results with the addition of the GRADE analysis.

In addition, we conducted a systematic review on patient views to look for evidence on patient preference as this was one of the main outcomes.

See evidence table4, Appendix E, forest plots G38 to G49.

Table 8-26: General vs. regional anaesthesia – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality (early up to 1 month)[1,20,23,65,66,167,210,211,277,334,339]	11	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious Imprecision (c)
Mortality at 1 month[20,65,66,167,210,211,277,339]	8	RCT	Serious limitations (a), (b)	No serious inconsistency (d)	No serious indirectness	Serious Imprecision (c)
Length of stay in hospital[210,277]	2	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious imprecision
Vomiting[23,211]	2	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious Imprecision (c)
Acute confusional state[20,23,46,169,277]	5	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious imprecision (c)
Pneumonia[1,20,23,65,66,167,210,211,277]	9	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious Imprecision (c)
Myocardial infarction[65,66,167,210,211,277]	6	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious Imprecision (c)
Pulmonary embolism[1,20,23,36,65,66,210,211,277]	9	RCT	Serious limitations (a), (b)	No serious inconsistency (e)	No serious indirectness	Serious Imprecision (c)
Deep vein thrombosis[36,65,210,211]	4	RCT	Serious limitations (a), (b)	No serious inconsistency	No serious indirectness	Serious Imprecision (c)

(a) Some of the studies did not report definite allocation concealment
(b) None of the trials clearly stated whether it was an intention to treat analysis
(c) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.
(d) Pooling of the results showed some but not statistically significant heterogeneity: I^2 = 31% (p= 0.18)
(e) The results of pooling all pulmonary embolism events showed statistical heterogeneity I^2 = 47% (p= 0.06). The authors suggest this is mainly due to the significantly different in trials presenting results for fatal and non fatal pulmonary embolism. These were subsequently analysed in separate meta-analyses.

Table 8-27: General vs. regional anaesthesia - Clinical summary of findings

Outcome	*Intervention*	*Control*	*Relative risk (95% CI)*	*Absolute effect*	*Quality*
Mortality (early up to 1 month)	64/912 (7%)	93/966 (9.6%)	RR 0.73 (0.54-0.99)	26 fewer per 1000 (from 1 fewer to 44 fewer)	Low
Mortality at 1 month	56/811 (6.9%)	86/857 (10%)	RR 0.69 (0.50, 0.95)	31 fewer per 1000 (from 5 fewer to 50 fewer)	Low
Length of stay in hospital	108	110	N/A	Mean Difference 0.21 (-5.21-4.78)	Low
Vomiting	2/46 (4.3%)	3/49 (6.1%)	RR 0.7 (0.12-3.94)	18 fewer per 1000 (from 54 fewer to 179 more)	Low
Acute confusional state	11/117 (9.4%)	23/120 (19.2%)	RR 0.5 (0.26-0.95)	96 fewer per 1000 (from 10 fewer to 142 fewer)	Low
Pneumonia	21/574 (3.7%)	29/612 (4.7%)	RR 0.76 (0.44-1.3)	11 fewer per 1000 (from 26 fewer to 14 more)	Low
Myocardial infarction	5/502 (1%)	11/531 (2.1%)	RR 0.55 (0.22-1.37)	9 fewer per 1000 (from 16 fewer to 8 more)	Low
Pulmonary embolism	9/605 (1.5%)	13/640 (2%)	RR 0.88 (0.32-2.39)	2 fewer per 1000 (from 14 fewer to 28 more)	Low
Deep vein thrombosis	39/129 (30.2%)	61/130 (36.9%)	RR 0.64 (0.48-0.86)	169 fewer per 1000 (from 66 fewer to 244 fewer)	Low

8.2.1.2 Economic evidence

One study was identified. Chakladar 2010[48] is a cost study of general vs. spinal anaesthesia based on a survey. Please see Economic Evidence table 13 in Appendix F for further details.

Table 8-28: General anaesthesia vs regional anaesthesia- Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Chakladar 2010[48]	Potentially serious limitations (a)	Partially applicable (b)	Cost analysis of general anaesthesia vs. spinal anaesthesia.

(a) Not a full economic evaluation – costs but not health effects. Cost analysis based on responses to a questionnaire, not on a direct audit of equipment usage. Overhead costs and cost of treating side effects were not included. No sensitivity analysis.

(b) UK study but does not estimate QALYs.

Table 8-29: General anaesthesia vs regional anaesthesia - Economic summary of findings

Study	*Incremental cost (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Chakladar 2010[48]	76.77[(a)]	NA	NA	NR

(a) General anaesthesia more costly than regional anaesthesia (SD):£270.58 (44.68) vs 193.81 (44.68); p<0.0001

8.2.1.3 Evidence statement (s)

Clinical There is a statistically and clinically significant reduction in early mortality (up to 1 month) in patients having regional anaesthesia compared to those having general anaesthesia (LOW QUALITY).

There is a statistically significant but not clinically significant improvement in postoperative confusion and reduction in incidence of deep vein thrombosis in patients receiving regional compared to general anaesthesia (LOW QUALITY).

There were no statistically significant differences in length of stay in hospital, vomiting, pneumonia, myocardial infarction and pulmonary embolism (LOW QUALITY).

Economic One study found general anaesthesia to be more costly than spinal anaesthesia. This evidence has very serious limitations since it did not evaluate effectiveness and may not have included all important cost differences.

8.2.2 Recommendations and link to evidence

Recommendation	**Offer patients a choice of spinal or general anaesthesia after discussing the risks and benefits.**
Relative values of different outcomes	The GDG considered early mortality (up to 1 month) and patient preference to be the most important outcomes.
Trade off between clinical benefits and harms	Most clinical benefit was seen in patients undergoing regional anaesthesia. However, there is a small chance of nerve damage following regional anaesthesia. Potential benefits with regional also include, reduction in venous thromboembolic (VTE) complications but studies were conducted in patients not receiving VTE prophylaxis which may lead to some false positive results. However, this finding is supported by a more comprehensive review of DVT and PE across all surgical patients in the NICE guideline on venous thromboembolism prophylaxis[225]. A potential benefit of general anaesthesia includes lack of awareness throughout the surgical procedure. Indeed some patients perceive unconsciousness during general anaesthesia as a benefit. However, others fear the loss of control. A potential disadvantage of general anaesthesia is that recovery on the first postoperative day may be slower.

Economic considerations	The GDG felt that because of the potentially serious limitations of the study included as economic evidence there were insufficient data to claim that the overall costs of the general and regional anaesthesia are substantially different. However, there was agreement in acknowledging that spinal anaesthesia usually involves lower costs for drugs, anaesthesia equipment and airway equipment than general anaesthesia. Nevertheless, these lower costs of regional anaesthesia could be offset by its longer administration time. The GDG debated at length whether regional anaesthesia required more time to be administered compared to general anaesthesia, but no agreement was reached.
Quality of evidence	The studies comparing the two types of anaesthesia were mainly of low methodological quality. They included small numbers of participants and only reported a few outcome measures. These varied between studies making pooling of the data difficult. The studies lacked methodological rigour in particular regarding allocation concealment, assessor blinding and intention to treat analysis. The studies are now considered to be out of date and no longer relevant to current anaesthesia and perioperative care. In addition, they do not account for the advances in safety in the field of anaesthesia. For example in some of the studies patients allocated to general anaesthesia did not receive thrombo-prophylaxis as part of routine care. The economic evidence has very serious limitations, as it is based on responses to a questionnaire on a hypothetical anaesthetic technique, and not a direct audit of actual equipment usage. Moreover, the analysis did not look at whether there are any potential savings linked to a reduction in the cases of confusion when regional anaesthesia is used.
Other considerations	The GDG also considered the evidence for other outcomes such as length of stay in hospital and adverse events including vomiting, acute confusional state and respiratory and cardiac complications. In the absence of any strong evidence favouring one method over the other, the GDG decided that the choice of anaesthesia should be based on the patient preference after being given sufficient information about the options available and the expertise of the anaesthetist.

Recommendation	**Consider intraoperative nerve blocks for all patients undergoing surgery.**
Relative values of different outcomes	The GDG considered pain relief, postoperative mobility and reduction in opioid usage to be the main outcomes.

Trade off between clinical benefits and harms

As discussed in chapter 7 on using nerve blocks for hip fracture analgesia, local nerve blocks may serve as a means of reducing the need for, and side effects of, opioids and other analgesia. However, they are associated with a very rare incidence of nerve damage and must be admisitered by trained health care professionals.

Economic considerations

The GDG agreed this likely to be cost-effective because the administration of nerve blocks avoids the complications and side effects of opioids, and therefore might result in a reduced length of hospital stay. Please see the analgesia chapter for evidence on the cost-effectiveness of nerve blocks in general.

Quality of evidence

The evidence that nerve blocks reduce the degree of pain and the requirement for opioid analgesics compared to other forms of analgesia alone, and that they may have fewer side effects compared to systemic analgesia, is presented under Analgesia (Chapter 7). This includes several studies studies that have investigated the effectiveness of nerve blocks in conjunction with general anaesthesia to determine if this reduces the requirements for opioid analgesics and improve pain management. These studies show that nerve blocks reduce the degree of pain compared to systemic analgesia alone and that they may have fewer side effects compared to systemic analgesia. However, these studies could not be subgrouped in a meaningful way as they looked at different outcomes and differed in the way they reported them. Therefore, this recommendation was partly based on consensus.

Other considerations

Nerve blocks are often administered before a spinal anaesthetic, in order to position the patient. They are usually administered before a general anaesthetic and many are now conducted using ultrasound guidance. This reduces the chance of complications, such as an intraneural injection and also enables the dose of local anaesthetic administered to be lower. The use of nerve blocks in surgery has increased in recent years and has almost become routine practice. Therefore, studies to show any benefit may now be difficult to conduct, as withholding analgesia from such patients may be unethical. Administration of nerve blocks should not delay surgery.

8.3 Research recommendation on anaesthesia

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of regional versus general anaesthesia on postoperative morbidity in patients with hip fracture?

Why this is important

No recent randomised controlled trials were identified that fully address this question. The evidence is old and does not reflect current practice. In addition, in most of the studies the patients are sedated before regional anaesthesia is administered and this is not taken into account when analysing the results. The study design for the proposed research would be best addressed by a randomised controlled trial. This would ideally be a multi-centred trial including 3,000 participants in each arm. This is achievable if one considers that there are 70, 000 hip fractures a year in the UK[39]. The study should have three arms which look at spinal anaesthesia versus spinal anaesthesia plus sedation versus general anaesthesia, this would separate those with regional anaesthesia from those with regional anaesthesia plus sedation. The study would also need to control for surgery, especially type of fracture, prosthesis and grade of surgeon.

A qualitative research component would also be helpful to study patient preference for type of anaesthesia.

9 Surgeon seniority

9.1 Introduction

As a general observation of life one would conclude that to have a job completed thoroughly, effectively and efficiently it would be appropriate to give the task to somebody with adequate training and experience. Whether this can be extrapolated to the relationship of the management of hip fractures to the seniority of the surgeon involved is the purpose of this chapter.

The historical background of this question has to be considered in relation to the environment in which hip fracture patients were treated. In the United Kingdom hip fractures were commonly regarded as the surgical material for trainee surgeons to gain their experience. In the past much of this work would have been unsupervised, and in the main the trainees would have enjoyed the challenge and responsibility this gave them.

The operations were often performed outside of scheduled list times as extra or emergency cases. Under these circumstances it was more likely that the anaesthetist involved in the procedure would be more junior and the nursing scrub team not specifically from a trauma theatre.

Any variations in outcome which may be simply labelled as related to surgeon seniority may in fact have multiple underlying causes. A more senior surgeon is more likely to be

operating on a scheduled list, with more senior anaesthetists and a regular nursing scrub team.

9.2 Surgeon seniority

9.2.1 Review question

What is the clinical and cost effectiveness of surgeon seniority (consultant or equivalent) in reducing the incidence of mortality, the number of patients requiring reoperation, and poor outcome in terms of mobility, length of stay, wound infection and dislocation? (See evidence table 5, Appendix E and forest plots G50 and G51 in Appendix G).

9.2.2 Clinical evidence

No randomised evidence was identified. Three prospective cohorts including 2018 participants that adjusted for some confounding factors were identified.

Table 9-30: Junior/less senior surgeon vs. senior surgeon – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Reoperations (follow up 6 months)[256]	1	Cohort	serious limitations (a,b)	no serious inconsistency	serious indirectness (c,d, e)	serious imprecision (h)
Dislocation in hemiarthroplasty (follow up 0 to 10 years)[85]	1	Cohort	serious limitations (b)	no serious inconsistency	serious indirectness (f,g)	serious imprecision (h)
Dislocation in total hip replacement (follow up 0 to 11 years)[85]	1	Cohort	serious limitations (c)	no serious inconsistency	serious indirectness (f,g)	serious imprecision (h)

(a) *Senior surgeons operated on significantly more patients with a poor pre-fracture mobility score and performed significantly more arthroplasties and significantly fewer osteosyntheses.*
(b) *Only a limited number of confounders were included in the analysis. No adjustment or mention of the anaesthetists experience or grade.*
(c) *Surgeon seniority measured by years experience rather than the grade of surgeon. Experienced surgeons with more than 3 years orthopaedic surgical experience either performing surgery or supervising junior registrars were compared unsupervised orthopaedic junior registrars with less than 3 years orthopaedic surgical experience.*
(d) *Only the technically demanding fractures were included in the analysis, not all surgery for hip fractures.*
(e) *Reoperation rate only measured at 6 months, not longer.*
(f) *The focus of the study is on surgical approach therefore baseline data by surgeon seniority is not reported.*
(g) *Dislocation is not a primary outcome.*
(h) *The wide confidence intervals make the estimate of effect imprecise.*

Table 9-31: Junior/less senior surgeon vs senior surgeon – Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality

Reoperations (follow up 6 months)	16/56 (28.6%)	47/309 (15.2%)	multivariate odds ratio 2.01 (1.01 to 4.02)	289 more per 1000 (from 3 more to 864 more)	Very low
Dislocation in hemiarthroplasty (median follow up 4.3 (0 to 10) years)	37/404 (9.2%)	8/135 (5.9%)	multivariate odds ratio 1.3 (0.6 to 3)	18 more per 1000 (from 24 fewer to 118 more)	Very low
Dislocation in total hip replacement (median follow up 2.3 (0 to 11) years)	37/636 (5.8%)	8/77 (10.4%)	multivariate odds ratio 0.9 (0.3 to 2.8)	10 fewer per 1000 (from 73 fewer to 187 more)	Very low

9.2.2.1 Economic evidence

No studies were identified on the cost-effectiveness of junior/less senior surgeon vs. senior surgeon. However, we conducted a cost-analysis around the personnel cost of a planned trauma list compared to the personnel cost of a general emergency theatre. We found that a planned trauma list involves an additional cost per hour of £94, See Appendix H section 20.2for further details.

9.2.2.2 Evidence statement (s)

Clinical There is a statistically significant, but not clinically significant increased reoperation rate at 6 months with unsupervised junior orthopaedic registrars with less than 3 years experience than with experienced surgeons with more than 3 years experience. (VERY LOW QUALITY).

There is no statistically significant difference between Swedish post registrars and registrars in dislocation rate at a median follow up of 2.3 years after hemiarthroplasty in patients with hip fracture. (VERY LOW QUALITY).

There is no statistically significant difference between Swedish post registrars and registrars in dislocation rate at a median follow up of 2.3 years after total hip replacement in patients with hip fracture. (VERY LOW QUALITY).

There was no evidence identified for mortality, mobility, length of stay or wound infection.

Economic No studies were identified on the cost-effectiveness of junior/less senior surgeon vs. senior surgeon. However, we conducted a cost-analysis around the personnel cost of a planned trauma list compared to the personnel cost of a general emergency theatre. We found that a planned trauma list involves an additional cost per hour of £94, See Appendix H section 20.2for further details.

9.3 Recommendations and link to evidence

Recommendation	**Schedule hip fracture surgery on a planned trauma list**
Relative values of different outcomes	Mortality, reoperation rate, dislocations, length of stay in secondary care and wound infection were considered the main outcomes. Complications, pain and functional status were also considered.
Trade off between clinical benefits and harms	No RCTs were identified evaluating a planned trauma list. Evidence is extrapolated from the surgeon seniority data. This shows a significantly higher reoperation rate with unsupervised/junior orthopaedic surgeons with less than 3 years experience than senior more experienced surgeons. There was no statistically significant difference in dislocation rates. No other outcomes were reported.
Economic considerations	A planned trauma list consists of a period of time allocated to the surgical management of patients with unplanned admissions following musculoskeletal injury. For this period there will be an adequate operating theatre, with supporting equipment including an image intensifier. The responsible senior surgical, anaesthetic and theatre staff will have work plan allocating time to the list to carry out procedures or supervise their junior staff. Thus, a planned trauma list implies allocation and involvement of senior staff, who will either carry out the necessary procedures in the operating theatre or will adequately supervise the junior staff. The GDG suggested that a possible comparator for a planned trauma list could be a **general emergency theatre**, shared by many different specialities, often occurring outside of normal working hours and staffed by trainees. If we consider the case of a planned trauma list where operations are performed by a consultant surgeon and a consultant anaesthetist and if we take as comparator a general emergency theatre where both surgeon and anaesthetist are registrars, and we assume no other difference in the professional grade of the remaining staff involved in the operation, then the planned trauma list would result in an additional personnel cost per hour of £94 over the general emergency theatre. In particular, the personnel cost per hour for a planned trauma list with a consultant surgeon and consultant anaesthetist correspond to £337, and for a general emergency list with a registrar surgeon and a registrar anaesthetist (and with a consultant surgeon and consultant anaesthetist on call), to £243 (please see Appendix H section 20.2for further details). However, there is great uncertainty as to whether there are other differences in other categories of costs (e.g. overheads, diagnostic devices, etc) between a planned trauma list and a general emergency theatre,and therefore our estimate should be considered only as an approximation of the overall cost difference between a planned trauma list and a general emergency theatre. Furthermore, there is uncertainty around the right baseline

intervention as after the introduction of the BPT for hip fracture, senior staff should be performing the surgery. In particular, the GDG noted that it is not clear as to what we should consider as the usual alternative to a planned trauma list, as it is quite uncertain what could represent the "baseline" case for a hospital, and this can change depending on the type of hospital. It was also pointed out that since the introduction of the Best Practice Tariff (BpT) for hip fracture in April 2010 the hospitals that do not have planned trauma list in place on a daily basis would however have employed relevant senior staff (consultant surgeons and anaesthetist) to meet the tariff's requirements, and therefore senior staff are already part of the comparator.

Nevertheless, the GDG thinks that these potential additional personnel costs of a planned trauma list would be at least partially off-set by savings due to lower re-operation rates and by a higher number of patients operated per hour.

Quality of evidence

No RCTs were identified evaluating a planned trauma list. There is extrapolated evidence from surgeon seniority showed no evidence for the majority of the outcomes and only very low quality evidence from non-randomised studies for two outcomes: reoperation rate and dislocations. The recommendation is based on a consensus agreement within the GDG.

Other considerations

We have specified in the recommendation that surgery for hip fractures should occur on a planned trauma list. To establish a scheduled trauma list management and clinicians are required to provide adequate facilities and staff for it to run. For a planned list it is necessary to have a chain of responsibility to a consultant surgeon and consultant anaesthetist who have time in their programs to execute that responsibility. To run a planned trauma list requires ready access to an image intensifier and radiographer. The nursing team would need to be appropriate to the work planned for that theatre. The recommendation therefore recognises the need for adequate seniority of the surgeon but makes what we believe to be a reasonable assumption that this recognition should also apply to the rest of the operating theatre team caring for the hip fracture patient.

The GDG noted that there is high uncertainty regarding the implementation costs linked with this recommendation, as these costs will vary depending on the current set up and infrastructure of each hospital . For example, the GDG recognised that smaller hospitals may not currently provide this service at weekends.

This recommendation is in line with the British Orthopaedic Association's Advisory book on consultant trauma and orthopaedic services [38]. The GDG consider this recommendation a key priority for implementation.

Recommendation	**Consultants or senior staff should supervise trainee and junior members of the anaesthesia, surgical and theatre teams when they carry out hip fracture procedures.**
Relative values of different outcomes	Mortality, reoperation rate, dislocations, length of stay in secondary care and wound infection were considered the main outcomes. Complications, pain and functional status were also considered.
Trade off between clinical benefits and harms	There is a significantly higher reoperation rate with unsupervised/junior orthopaedic surgeons with less than 3 years experience than senior more experienced surgeons. There was no statistically significant difference in dislocation rates. No other outcomes were reported.
Economic considerations	Higher grade surgeons or those with more experience are likely to be entitled to a higher wage than junior surgeons. However, as their rate of re-operations is statistically significantly lower, having hip fracture patients operated on by experienced surgeons will plausibly result in cost savings and improved health outcomes. In addition, the GDG believe experienced surgeons use theatre time more efficiently allowing greater throughput of cases.
Quality of evidence	There is no evidence for the majority of the outcomes and only very low quality evidence from non-randomised studies for two outcomes: reoperation rate and dislocations.
Other considerations	The level of supervision required for a trainee or junior staff member for a particular case depends on two main factors: the junior's ability and the complexity of the case. It is therefore implicit that the senior staff responsible for the trauma list must have knowledge of both of these factors before determining the level of supervision required. Potential surgical, anaesthetic or nursing problems may be evident to an experienced surgeon, anaesthetist or nurse preoperatively. This gives the opportunity to both avoid the problem occurring and to enhance the training opportunity. An unsupervised list would therefore be one in which those responsible did not have adequate prior knowledge of the capabilities of the more junior members of the team and the specific problems they may encounter, or when they did not use this knowledge to provide adequate supervision.

10 Surgical procedures

10.1 Introduction

The options for hip fracture surgery depend on the type of fractures. They can be divided into two main groups according to their relationship to the capsular attachment of the hip joint. Those above the insertion of the capsule are termed intracapsular and those below are termed extracapsular. Extracapsular fractures can be further divided into three types: pertrochanteric (also called intertrochanteric), reverse oblique or subtrochanteric.

Broadly speaking there are two surgical options for treating hip fractures, replacement arthroplasty or internal fixation. Replacement arthroplasty involves removing part or all of the damaged bone and replacing it with a prosthesis which then functions in place of the removed bone. It may describe a hemiarthroplasty or a total hip arthroplasty. Both involve replacement of the femoral head with a metal implant, the stem of which is secured in the femoral shaft. A total hip arthroplasty involves, in addition, replacement of the socket. Both implants can be inserted with or without the use of cement. Internal fixation involves returning the bone fragments to an acceptable position and then holding that position with screws, plates or nails. This should allow healing of the facture fragments in an acceptable position for long term function and maintenance of patient function whilst that healing occurs.

10.2 Surgery with regard to early mobilisation

This section relates to the section on early mobilisation (chapter 11) as well as surgery. When embarking on any surgical procedure there should be a clear objective. In orthopaedic and trauma surgery it is easy to attach a rather bland aim of "safe restoration of function". Prior to any surgery commencing the surgeon should already know what his planned postoperative care of that patient is to be. Given the poor reserve functional capacity of many hip fracture patients any prescribed limits on mobility and weight-bearing may significantly alter and restrict their postoperative care. In particular unnecessary restriction of weight-bearing has the potential to compromise independence, discharge destination, general health and final level of function. As a consequence of these considerations, and as a result of the recommendation for early mobilisation (section 11.2.2) the GDG felt it appropriate to make a recommendation on postoperative weight-bearing status.

10.2.1 Recommendations and link to evidence

Recommendation	**Operate on patients with the aim to allow them to fully weight bear (without restriction) in the immediate postoperative period.**
Relative values of different outcomes	The aim of surgery and rehabilitation is for patients to regain their prefracture functional status. Early mobilisation with a physiotherapist appears safe and is effective in promoting early recovery. The most important outcomes considered by the GDG were functional status, mobility, pain and quality of life.
Trade off between clinical benefits and harms	The evidence from the early mobilisation question shows that the only outcome relating to harm or safety was mortality, which showed no statistically significant difference. If safety issues were a concern it is likely that they would be reflected in the overall functional outcomes, all of which improved or had no significant effect, therefore we don't believe that harm is caused harm from this evidence.
Economic considerations	See also early mobilisation section 8.2. One of the main aims of surgery is for patients to regain their pre-fracture functional status. As the GDG has agreed to consider early mobilisation strategy as a cost-effective intervention for our population, this recommendation is unlikely to result in extra costs.
Quality of evidence	There is no direct evidence relating to this recommendation, but the evidence from the early mobilisation review question is indirectly applicable, see Chapter 8.
Other considerations	Elderly patients may be physically frail, suffering from cognitive impairment or delirium and so cannot be expected to mobilise non-weight-bearing or partially weight-bearing. Postoperative instructions requesting non-or partial weight-bearing will frequently result in the patient not mobilising at all.

10.3 Displaced intracapsular fractures

In an intracapsular fracture the proximal fragment includes the femoral head alone or the femoral head with a small portion of neck. The size and shape of this fragment combined with the often soft nature cancellous bone of which it is constituted makes secure fixation difficult. This can potentially compromise early function. In addition, the blood supply of the femoral head may be disrupted, leading to poor healing or bone death.

The displacement of an intracapsular fracture is determined on the anteroposterior and lateral radiographs of the area. An undisplaced fracture may as its name suggests demonstrate no change in position from that it would have occupied prior to the injury. However it is also customary to include in the undisplaced group valgus impacted fractures. In this impacted group the harder bone of the femoral neck has been driven into the softer bone of the femoral head. In both of these these undisplaced fracture types there is

generally already inherent stability and little likelihood of damage to the blood supply. Fixation in situ is generally accepted

In practice a displaced fracture is one in which the preoperative radiographs demonstrate the fragments have moved in relation to each other to an unacceptable position for fixation in situ. The implication of this is that the fragments have moved in relation to each other to a greater extent. The particular anatomy of the region means that the blood supply to the femoral head is at risk. There will also be less inherent stability either as a consequence of fragmentation along the fracture line or difficulties in obtaining precise reduction.

In patients with these displaced intracapsular fractures a decision initially needs to be made as to whether to reduce the fracture and internally fix it or to carry out some form of replacement arthroplasty. Each has potential advantages and disadvantages. Internal fixation retains the patient's own tissues and is often a smaller procedure. However, it may require a more prescriptive postoperative regime to protect the healing bone. Should replacement arthroplasty be appropriate it is necessary to determine the indications for a hemiarthroplasty in which only the damaged bone of the proximal femur is replaced or a total hip replacement when both the femoral head and the hip socket are replaced.

10.3.1 Internal fixation versus hemiarthroplasty

10.3.1.1 Review question

In patients having treatment for displaced intracapsular hip fracture what is the clinical and cost effectiveness of internal fixation compared to hemiarthroplasty on mortality, number of reoperations, functional status, length of stay in hospital, total time to resettlement in the community, quality of life, pain and place of residence after hip fracture.

One systematic review[264] was identified and one additional RCT[102]. Overall, there were 13 RCTs with 2195 participants. See evidence table 7, Appendix E and forest plots G74 to G82 in Appendix G.

10.3.1.2 Clinical evidence

Table 10-32: Internal fixation vs hemiarthroplasty – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality at 1 month[102]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality at 3 to 6 months[27,102,161,174,267,276,317,324,341,343]	10	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality at 1 year[27,102,161,174,267,317,324,341,343]	9	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Mortality at 2 to 3 years[27,102,161,174,267,276,317,324,341,343]	10	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	no serious imprecision

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Total no. of reoperations (follow-up 1 to 5 years)[27,69,102,161,174,267,276,288,313,317,324,341,343]	13	RCT	serious limitations [(a)]	serious inconsistency [(c)]	no serious indirectness	no serious imprecision
Failure to return to same residence (follow-up 1 to 3 years)[161,267]	2	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Failure to regain mobility (follow-up 1 to 5 years)[27,161,267,288,317,341]	6	RCT	serious limitations [(a)]	serious inconsistency [(f)]	no serious indirectness	serious imprecision [(b)]
No. of patients reporting pain at 1 year[27,174,267]	3	RCT	serious limitations [(a)]	serious inconsistency [(d)]	no serious indirectness	serious imprecision [(b)]
Harris Hip Score (follow-up 1 year)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Harris Hip Score (follow-up 2 years)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Number of patients with Barthel Index Score of 95 or 100 (follow-up 1 year)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Number of patients with Barthel Index Score of 95 or 100 (follow-up 2 years)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Eq-5d (Euroqol) Index Score (follow-up 1 year)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Eq-5d (Euroqol) Index Score (follow-up 2 years)[102]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]
Length of hospital stay[102,174,267,341]	4	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(e)]

(a) *The studies with the most weight in the meta-analysis have inadequate or unclear allocation concealment.*

(b) *The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.*

(c) *There is significant unexplained statistical heterogeneity between the studies. This could be due to the different types of implant or arthroplasty and different follow up periods.*
(d) *There is significant statistical heterogeneity between the studies. This could be due to the different types of implant or arthroplasty.*
(e) *The wide confidence intervals around the estimate make the result imprecise. Consequently, it is difficult to determine the true effect size for this outcome.*
(f) *There is significant statistical heterogeneity between the studies. This Cochrane review reports this is likely to be due to the variation in the definition for this outcome.*

Table 10-33: Internal fixation vs hemiarthroplasty - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Mortality at 1 month	7/112 (6.3%)	10/110 (9.1%)	RR 0.69 (0.27 to 1.74)	28 fewer per 1,000 (from 66 fewer to 67 more)	Low
Mortality at 3 to 6 months	107/765 (14%)	122/709 (16.7%)	RR 0.81 (0.64 to 1.03)	32 fewer per 1,000 (from 60 fewer to 5 more)	Low
Mortality at 1 year	148/636 (23.3%)	143/584 (23.6%)	RR 0.93 (0.78 to 1.12)	17 fewer per 1,000 (from 52 fewer to 28 more)	Moderate
Mortality at 2 to 3 years	265/750 (35.3%)	254/683 (37.8%)	RR 0.96 (0.84 to 1.09)	15 fewer per 1,000 (from 60 fewer to 34 more)	Moderate
Total no. of reoperations (follow-up 1 to 5 years)	355/1001 (35.5%)	99/1033 (9.4%)	RR 3.59 (2.93 to 4.39)	243 more per 1,000 (from 181 more to 319 more)	Low
Failure to return to same residence (follow-up 1 to 3 years)	29/187 (15.5%)	34/185 (23.6%)	RR 0.84 (0.54 to 1.33)	38 fewer per 1,000 (from 109 fewer to 78 more)	Low
Failure to regain mobility (follow-up 1 to 5 years)	155/287 (54%)	165/306 (45.7%)	RR 1.02 (0.74 to 1.39)	9 more per 1,000 (from 119 fewer to 178 more)	Very low
No. of patients reporting pain at 1 year	126/280 (45%)	127/281 (44.2%)	RR 0.97 (0.66 to 1.44)	13 fewer per 1,000 (from 150 fewer to 194 more)	Very low
Harris Hip Score (follow-up 1 year)	87	74	N/A	MD -6.8 (-12 to -1.6)	Moderate
Harris Hip Score (follow-up 2 years)	71	68	N/A	MD -3.3 (-9.1 to 2.5)	Moderate
Number of patients with Barthel Index Score of 95 or 100 (follow-up 1 year)	31/87 (35.6%)	39/73 (53.4%)	RR 0.67 (0.47 to 0.95)	176 fewer per 1,000 (from 27 fewer to 283 more)	Moderate
Number of patients with Barthel Index Score of 95 or 100 (follow-up 2 years)	24/69 (34.8%)	26/68 (38.2%)	RR 0.91 (0.58 to 1.42)	34 fewer per 1,000 (from 160 fewer to 160 more)	Moderate
Eq-5d (Euroqol) Index Score (follow-up 1 year)	70	62	N/A	MD -0.09 (-0.2 to 0.02)	Moderate

Eq-5d (Euroqol) Index Score (follow-up 2 years)	52	52	N/A	MD -0.11 (-0.21 to -0.01)	Moderate
Length of hospital stay	486	478	N/A	MD -0.6 (-2.04 to 0.83)	Moderate

10.3.1.3 Economic evidence

Two economic studies were identified [173,291]. Rogmark et al (2003)[291] is a cost-consequence analysis based on a RCT but it was excluded because it does not distinguish patients on the basis of whether they received hemiarthroplasty or total hip replacement. Keating et al (2005)[173] compare internal fixation vs. hemiarthroplasty in a cost-consequence analysis based on a RCT. Please see Economic Evidence Table 14 in Appendix Ffor further details

Table 10-34: Internal Fixation vs Hemiarthroplasty - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Keating 2005 [173]	Minor limitations [(a)]	Partially applicable [(b)]	Costs not discounted because mainly incurred within 1 year of injury

(a) Small number of patients.

(b) UK study, but does a CUA.

Table 10-35: Internal Fixation vs Hemiarthroplasty - Economic summary of findings

Study	*Incremental cost per patient (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Keating 2005 [173]	£2726(a)	Various (b)	N/A	Two-way sensitivity analysis showed that the direction of change in cost did not change when cost of prostheses and cost of readmission were varied over a range from -50% to +100% around the baseline values.

(a) The mean cost per patient for internal fixation was £12,623 (95% CI: 10,768 – 14,478) and for £9,897 (95% CI: 8,062 – 11,732) for hemiarthroplasty (2001 GBP)

(b) Several outcomes were reported. Internal fixation entailed lower mortality at 4 and 12 months from the operation than hemiarthroplasty (3% vs. 5%; 8% vs. 10%) and slightly higher EQ-5D scores at 24 months (0.55 vs 0.53); (all effects were not statistically significant). Hemiarthroplasty involved a significantly lower number of patients needing further surgery at 12 and 24 months (31% vs. 5% and 39% vs. 5%), and higher EQ-5D scores at 4 and 12 months (0.56 vs. 0.61 and 0.58 vs.0.64; difference not statistically significant).

10.3.1.4 Evidence statement (s)

Clinical There is a statistically and clinically significant decrease in patients who require reoperations with hemiarthroplasty than with internal fixation. The follow up varied between 1 and 5 years. (LOW QUALITY)

There is a statistically significant, but not clinically significant, increase in patients who have a Barthel Index Score of 95 or 100 at 1 year with

hemiarthroplasty compared to internal fixation but there is no statistically significant difference at 2 years (MODERATE QUALITY)

There is a statistically significant, but not clinically significant, increase in patients who have a higher Harris Hip Score at 1 year with hemiarthroplasty compared to internal fixation but there is no statistically significant difference at 2 years (MODERATE QUALITY)

There is a statistically significant, but not clinically significant, increase in patients who have a higher Eq-5d (Euroqol) score at 2 years with hemiarthroplasty compared to internal fixation but there is no statistically significant difference at 1 year (MODERATE QUALITY)

There is no statistically significant difference between internal fixation and hemiarthroplasty in mortality at 1 months (LOW QUALITY), 3 to 6 months (LOW QUALITY) or 1 to 2 years (MODERATE QUALITY), the number of patients reporting pain at 1 year (VERY LOW QUALITY), the number of patients failing to return to the same residence at 1 to 3 years (LOW QUALITY), failure to regain mobility at 1 to 5 years and length of hospital stay (MODERATE QUALITY).

No RCT evidince was identified reporting on total time to resettlement in the community.

Economic Hemiarthroplasty is cost saving with respect to internal fixation. This evidence has minor limitations and partial applicability.

10.3.2 Internal fixation versus total hip replacement

10.3.2.1 Review question

In patients having treatment for intracapsular hip fracture what is the clinical and cost effectiveness of internal fixation compared to total hip replacement on mortality, number of reoperations, functional status, length of stay in hospital, total time to resettlement in the community, quality of life, pain and place of residence after hip fracture.

One systematic review[264] was identified. Overall, there were 6 RCTs with 888 participants were included. See evidence table 7, Appendix E and forest plots G83 to 86 in Appendix G.

10.3.2.2 Clinical evidence

Table 10-36: Internal fixation vs. total hip replacement – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality at 2 to 4 months[162,174,239,327]	4	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality at 12 to 18 months)[162,174,239]	3	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality at 2 years[162,166,174,327]	4	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
Reoperations – any (follow-up 1 to 13 years)[162,166,174,239,313,327]	6	RCT	serious limitations [(a)]	serious inconsistency [(c)]	no serious indirectness	no serious imprecision
Number of patients reporting pain at 1 year[166,174]	2	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Length of hospital stay[174]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(d)]

(a) *The studies with the most weight in the meta-analysis have inadequate or unclear allocation concealment.*

(b) *The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.*

(c) *There is significant statistical heterogeneity between the studies. This could be due to the different types of implant or arthroplasty and different follow up periods. One study had a 13 year follow up whereas the others varied between 1 and 4 years.*

(d) *The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.*

Table 10-37: Internal fixation vs total hip replacement - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Mortality at 2 to 4 months	15/210 (7.1%)	6/196 (3.7%)	RR 2.21 (0.91 to 5.4)	45 more per 1,000 (from 3 fewer to 163 more)	Low
Mortality at 12 to 18 months)	25/157 (15.9%)	21/147 (10%)	RR 1.08 (0.64 to 1.82)	8 more per 1,000 (from 36 fewer to 82 more)	Low
Mortality at 2 years	44/224 (19.6%)	34/209 (11.6%)	RR 1.18 (0.79 to 1.75)	21 more per 1,000 (from 24 fewer to 87 more)	Low
Reoperations – any (follow-up 1 to 13 years)	126/325 (38.8%)	44/308 (9.4%)	RR 2.70 (1.99 to 3.67)	160 more per 1,000 (from 93 more to 251 more)	Low
Number of patients reporting pain at 1 year	47/78 (60.3%)	34/79 (37.7%)	RR 1.4 (1.02 to 1.9)	150 more per 1,000 (from 8 more to 339 more)	Moderate
Length of hospital stay	69	69	-	MD -1.7 (-4.45 to 1.05)	Moderate

10.3.2.3 Economic evidence

Three economic studies were identified [163,173,291]. Rogmark et al (2003)[291] is a cost-consequence analysis based on a RCT which was excluded because it does not distinguish patients on the basis of whether they received hemiarthroplasty or total hip replacement.

Keating et al (2005)[173] compare Internal Fixation vs Total Hip Replacement in a cost-consequences analysis included in a Health Technology Assessment based on a RCT. Johansson et al (2006)[163] is a cost-consequence analysis based on a RCT. Please see Economic Evidence Tables 14 in Appendix F for further details.

Table 10-38: Internal fixation vs total hip replacement - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Keating 2005 [173]	Minor limitations [(a)]	Partial applicability [(b)]	Costs not discounted because mainly incurred within 1 year of injury
Johansson 2006 [163]	Potentially serious limitations [(c)]	Partial applicability [(d)]	

(a) Small number of patients.
(b) Study set in the UK, but not a CUA.
(c) Costs were derived from just one hospital. No sensitivity analysis was conducted.
(d) Study set in Sweden.

Table 10-39: Internal fixation vs total hip replacement - Economic summary of findings

Study	*Incremental cost per patient (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Keating 2005 [173]	£3224 [(a)]	THR has higher EQ-5D scores at 4, 12 and 24 months by 0.08; 0.12 and 0.14 respectively [(b)]	THR dominant	Two-way sensitivity analysis showed that the direction of change in cost did not change when cost of prostheses and cost of readmission were varied over a range from -50% to +100% around the baseline values.
Johansson 2006 [163]	£265	More patients with good/fair Harris hip score at 1 and 2 years in THR group [(c)]	THR dominant	NR

(a) The mean cost per patient included cost of hospital admission (inpatient and day case), theatre costs, prosthesis and profile of hardware. The mean cost per patient for internal fixation was £12,623 (95% CI: 10,768 – 14,478) and £9,399 (95% CI: 8,265-10,532) for THR.
(b) THR had better outcomes than internal fixation: lower number of deaths within 4, 12 and 24 months from operation: (3% vs. 4%; 8% vs. 6% and 15% vs. 9%; p value not significant). Lower number of patients requiring further surgery within 4, 12 and 24 months from operation: 22% vs. 7%; 31% vs. 9% and 39% vs. 9%; p value not reported). Higher mean EQ-5D scores at 4, 12 and 24 months from operation: 0.56 vs 0.68 (p value not significant); 0.58 vs 0.70 (p = 0.04); 0.55 vs 0.69 (p value not significant).
(c) Percentage of patients with a Harris hip score excellent or good/fair or poor at 1 year: 12.5% vs. 100% (p value: <0.0001); at 2 years: 14.29% vs.95.23% (p value: <0.001)

10.3.2.4 Evidence statement (s)

Clinical There is a statistically and clinically significant decrease in patients who require reoperations with total hip replacement than with internal fixation. The follow up varied between 1 and 13 years. (LOW QUALITY)

There is a statistically significant, but not clinically significant, increase in patients who reported pain at 1 year with internal fixation compared to total hip replacement (MODERATE QUALITY).

There is no statistically significant difference in mortality at 2 to 4 months, 12 to 18 months or 2 years (LOW QUALITY) and length of hospital stay (MODERATE QUALITY) between internal fixation and total hip replacement.

No RCT evidence was identified reporting functional status, quality of life, total time to resettlement in the community and place of residence after hip fracture.

Economic THR is the dominant strategy with respect to internal fixation (less costly and more effective). This evidence has minor limitations and partial applicability.

10.3.3 Hemiarthroplasty versus total hip replacement

10.3.3.1 Review question

In patients having treatment for intracapsular hip fracture what is the clinical and cost effectiveness hemiarthroplasty versus total hip replacement on mortality, number of reoperations, functional status, length of stay in hospital, total time to resettlement in the community, quality of life, pain and place of residence after hip fracture.

One systematic review[265] was identified. From this, 7 RCTs with 734 participants met the inclusion criteria. See evidence table 7, Appendix E and forest plots G87 to G95 in Appendix G.

10.3.3.2 Clinical evidence

Table 10-40: Hemiarthoplasty vs total hip replacement – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality (follow up 3-6 months)[174,197,313]	3	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality (follow up 1 year)[26,218,313]	4	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Mortality (follow up 2-4 years)[11,174,197,218]	4	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Total no. of reoperations (follow-up 8 to 48 months)[11,26,73,174,218,313]	6	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
No. of patients reporting pain at 1 years[174,313]	2	RCT	no serious limitations	serious inconsistency [(d)]	no serious indirectness	serious imprecision [(b)]

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Harris Hip Score for pain - 12 months[26]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Failure to regain mobility (follow-up 1 to 4 years)[73,313]	2	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(b)]
Oxford Hip Score - mean of 40 months[11]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Barthel score - one year[218]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Barthel score - four years[218]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Hip rating questionnaire - 24 months[174]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Harris Hip Score - total score - 12 months[26,218]	2	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Harris Hip Score - total score - four years[218]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Harris Hip Score for function - 12 months[26]	1	RCT	serious limitations [(a)]	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Short form 36 physical score - mean of 40 months[11]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Self reported walking distance (kilometres) - mean of 40 months[11]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
EuroQol (EQ-5d) questionnaire - 24 months[174]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]
Length of hospital stay[174]	4	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(c)]

(a) The studies with the most weight in the meta-analysis have inadequate or unclear allocation concealment.

(b) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.

(c) The wide confidence intervals around the measurement make the result imprecise. This makes it difficult to know the true effect size for this outcome.

(d) There is significant heterogeneity between the studies which maybe due to the types of arthroplasty used.

Table 10-41: Hemiarthroplasty vs total hip replacement - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality

Mortality (follow up 3-6 months)	25/192 (13%)	11/166 (6.6%)	RR 1.88 (0.96 to 3.68)	57 more per 1,000 (from 3 fewer to 174 more)	Low
Mortality (follow up 1 year)	42/272 (15.4%)	32/252 (10.3%)	RR 1.15 (0.76 to 1.74)	15 more per 1,000 (from 25 fewer to 76 more)	Low
Mortality (follow up 2-4 years)	38/176 (21.6%)	29/169 (19.1%)	RR 1.23 (0.8 to 1.87)	44 more per 1,000 (from 38 fewer to 166 more)	Low
Total no. or reoperations (follow-up 8 to 48 months)	42/350 (12%)	36/331 (10.6%)	RR 1.06 (0.7 to 1.6)	6 more per 1,000 (from 32 fewer to 64 more)	Low
No. of patients reporting pain (follow-up 1 years)	50/133 (37.6%)	29/123 (23.8%)	RR 1.68 (1.16 to 2.42)	161 more per 1,000 (from 38 more to 338 more)	Low
Harris Hip Score for pain - 12 months	55	56	N/A	MD -4 (-6.33 to -1.67)	Low
Failure to regain mobility (follow-up 1 to 4 years)	17/110 (15.5%)	20/101 (19.5%)	RR 0.78 (0.43 to 1.4)	43 fewer per 1,000 (from 111 fewer to 78 more)	Low
Oxford Hip Score - mean of 40 months	33	36	N/A	MD 3.50 (0.34 to 6.66)	Moderate
Barthel score - one year	30	33	N/A	MD -8 (-13.61 to -2.39)	Low
Barthel score - four years	20	23	N/A	MD -5.7 (-11.19 to -0.21)	Low
Hip rating questionnaire – 2 years	50	56	N/A	MD -6.1 (-12.38 to 0.18)	Moderate
Harris Hip Score - total score at 1 year	85	89	N/A	MD -5.47 (-8.39 to -2.55)	Low
Harris Hip Score - total score at 4 years	20	23	N/A	MD -4.2 (-7.66 to -0.74)	Low
Harris Hip Score for function - 12 months	55	56	N/A	MD -3.7 (-7.13 to -0.27)	Low
Short form 36 physical score - mean of 40 months	33	36	N/A	MD -2.43 (-7.56 to 2.7)	Moderate
Self reported walking distance (kilometres) - mean of 40 months	33	36	N/A	MD -1.7 (-3.28 to -0.12)	Moderate
EuroQol (EQ-5d) questionnaire at 2 years	65	66	N/A	MD -0.16 (-0.28 to -0.04)	Moderate
Length of hospital stay	69	69	N/A	MD -0.80 (-3.82 to 2.22)	Moderate

10.3.3.3 Economic evidence

Two studies were identified. Rogmark et al (2003)[291] is a cost-consequence analysis based on a RCT which was excluded because it does not distinguish patients on the basis of whether they received hemiarthroplasty or total hip replacement. A cost-consequence analysis comparing internal fixation vs. total hip replacement by Keating et al (2005)[173] was included. (Economic Evidence Table 14 in Appendix F)

Table 10-42: Hemiarthroplasty vs total hip replacement - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Keating 2005 [173]	Minor limitations [(a)]	Partially applicability [(b)]	Costs not discounted because mainly incurred within 1 year of injury

(a) Small number of patients.

(b) UK study but did not a CUA.

Table 10-43: Hemiarthroplasty vs total hip replacement - Economic summary of findings

Study	*Incremental cost per patient (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Keating 2005 [173]	£498 [(b)]	Hemiarthroplasty has lower EQ-5D scores at 4, 12 and 24 months [(b)]	NA	Two-way sensitivity analysis showed that the direction of change in cost did not change when cost of prostheses and cost of readmission were varied over a range from -50% to +100% around the baseline values.

(a) The mean cost per patient for hemiarthroplasty was 9,897 (95% CI: 8,062 – 11,732) and £9,399 (95% CI: 8,265-10,532) for THR.

(b) Hemiarthroplast had higher number of deaths within 4, 12 and 24 months from operation than THR: 5% vs.4%; 10% vs. 6% and 16% vs. 9%; (p values not significant), but lower reoperation rates at 4, 12 and 24 months: 5% vs. 7%; 5% vs 9%; and 5% vs. 9% (p value NR). THR had higher mean EQ-5D scores at 4, 12 and 24 months: 0.61 vs. 0.68 (not significant); 0.64 vs. 0.70 (not significant); 0.53 vs 0.69 (p=0.008).

10.3.3.4 Evidence statement (s)

Clinical There is a statistically significant, but not clinically significant, decrease in patients who reported pain and had a lower Harris Hip score for pain (indicating better function) at 1 year with total hip replacement compared to hemiarthroplasty (LOW QUALITY).

There is a statistically significant, but not clinically significant, increase in patients who have a lower Oxford Hip Score at 40 months (indicating better function) with total hip replacement compared to hemiarthroplasty (MODERATE QUALITY).

There is a statistically significant, but not clinically significant, increase in patients who have a higher Barthel Score (indicating better function) at 1 and 4 years (LOW QUALITY), a higher total Harris Hip Score at 1 and 4 years (LOW QUALITY), a higher Harris Hip Score for function at 1 year (LOW QUALITY)and a longer self reported walking distance at 40 months (MODERATE QUALITY)

with total hip replacement compared to hemiarthroplasty.

There is a statistically significant, but not clinically significant, increase in patients who have a higher Eq-5d (Euroqol) score at 2 years with total hip replacement compared to hemiarthroplasty (MODERATE QUALITY).

There is no statistically significant difference in mortality at 2 to 4 months (LOW QUALITY), 6 months (MODERATE QUALITY), 1 year (LOW QUALITY) or 2 to 4 years (LOW QUALITY), the number of reoperation at 8 to 48 months (LOW QUALITY), the number of patients who fail to regain mobility at 1 to 4 years (LOW QUALITY), the Hip Rating Questionnaire Score at 2 years (MODERATE QUALITY), the Short Form 36 (SF 36) score (MODERATE QUALITY) and length of hospital stay (MODERATE QUALITY) between hemiarthroplasty and total hip replacement.

No RCT evidence was identified reporting total time to resettlement or place of residence after hip fracture for studies comparing total hip replacement and hemiarthroplasty.

Economic THR is dominant compared to hemiarthroplasty. This evidence has minor limitations and partial applicability.

10.3.4 Recommendations and link to evidence

Recommendation	**Perform replacement arthroplasty (hemiarthroplasty or total hip replacement) in patients with a displaced intracapsular fracture.**
Relative values of different outcomes	The number of reoperations, functional status, pain and quality of life were considered the important outcomes with the number of reoperations being the most important. The interventions were not anticipated to have a significant impact on mortality so this was considered to be less important. Place of residence after hip fracture was also considered to be less important as it is a surrogate measurement for functional status.
Trade off between clinical benefits and harms	Compared to internal fixation there was a significantly lower reoperation rate with both hemiarthroplasty and total hip replacement, less patient reported pain with total hip replacement and better functional or quality of life scores with hemiarthroplasty. There was no significant difference for mortality, length of stay, failure to return to the same place of residence and failure to regain mobility. None of the reported outcomes showed any advantage of internal fixation over arthroplasty.
Economic considerations	Evidence partially applicable to the UK with only minor limitations was available on the cost-effectiveness of internal fixation vs. hemiarthroplasty and internal fixation vs. total hip replacement. The evidence shows that hemiarthroplasty is cost saving compared to internal fixation. In particular, hemiarthroplasty involved a significantly lower number of patients needing further surgery at 12 and 24 months compared to internal fixation. Similarly, THR required a lower rate of re-operation than internal

	fixation, albeit not statistically significant.
Quality of evidence	The evidence was of low or moderate quality. Most outcomes were downgraded due to poor or uncertain allocation concealment. Several results were imprecise as the confidence intervals were near to one, making it difficult to determine the true effect size. Some studies were also heterogenous that could be due to the different types of arthroplasty. Overall, the GDG felt that despite some of the results being of low quality and data not being available for some outcomes where there is a difference it shows arthroplasty being better than internal fixation. Consequently arthroplasty is recommended.
Other considerations	There maybe rare circumstances where reduction and internal fixation is appropriate for displaced intracapsular fragility fractures. People with cognitive impairment were excluded from a lot of the studies. However, the GDG felt there is no reason for this group of patients should be excluded from equal treatment to others. All patients should be allowed to be mobilised full weight bearing after hip fracture surgery (see section 10.2). All modern implants are designed to be load sharing devices to facilitate this. The GDG consider this recommendation a key priority for implementation.

Recommendation	**Offer total hip replacement to patients with a displaced intracapsular fracture who:** • **were able to walk independently out of doors with no more than the use of a stick and** • **are not cognitively impaired and** • **are medically fit for anaesthesia and the procedure.**
Relative values of different outcomes	The number of reoperations, functional status, pain and quality of life were considered the important outcomes with the number of reoperations being the most important. The interventions were not anticipated to have a significant impact on mortality so this was considered to be less important. Place of residence after hip fracture was also considered to be less important as it is a surrogate measurement for functional status.
Trade off between clinical benefits and harms	There was a significantly less patient reported pain and a better Oxford Hip Score, Barthel Score, Harris Hip Score, self reported walking distance and quality of life score (Eq-5d) with total hip replacement compared to hemiarthroplasty. There was no significant difference for mortality, length of stay, failure to return to the same place of residence and failure to regain mobility. None of the reported outcomes showed any advantage of

	hemiarthroplasty over total hip replacement in the selected patient group.
Economic considerations	The cost-effectiveness evidence shows that THR replacement was cost-saving compared to both hemiarthroplasty and internal fixation.
Quality of evidence	The evidence was of low or moderate quality. Most outcomes were downgraded due to poor or uncertain allocation concealment. Several results were imprecise as the confidence intervals were near to one making it difficult to determine the true effect size. Some studies were also heterogenous that could be due to the different types of arthroplasty. Overall, the GDG felt that despite some of the results being of low quality and data not being available for some outcomes where there is a difference it all shows total hip replacement being better than hemiarthroplasty in the selected patient group. Consequently total hip replacement is recommended for that group.
Other considerations	All but one of the studies excluded patients who were not medically fit, were not independently mobile before the fracture and were cognitively impaired. Consequently this recommendation does not include these groups. All the studies included in this review used a small head size for total hip replacement. Modern total hip replacements use a larger head which can reduce the risk of dislocation. All patients should be allowed to be mobilised full weight bearing after hip fracture surgery (see section 10.2). All modern implants are designed to be load sharing devices to facilitate this. The GDG consider this recommendation a key priortiy for implementation.

Recommendation	**Use a proven femoral stem design rather than Austin Moore or Thompson stems for arthroplasties. Suitable designs include those with an Orthopaedic Data Evaluation Panel rating of 10A, 10B, 10C, 7A, 7B, 5A, 5B, 3A or 3B.**
Relative values of different outcomes	The number of reoperations, functional status, pain and quality of life were considered the important outcomes. The interventions were not believed to have a significant impact on mortality so this was considered to be less important. Place of residence after hip fracture was also considered to be less important.
Trade off between clinical benefits and harms	Stem designs recommended here have a revision rate less than other stem designs. A higher failure rate would lead to a lower quality of life for patients.
Economic considerations	No economic evidence was found. Stems with a higher failure rate would require more reoperations and consequently, increased

costs and a lower quality of life for patients. Data supplied by an expert advisor reported the cost of an Exeter Trauma stem (ETS) monoblock as an example of a proven femoral stem design as £249 at 2008 prices.

Quality of evidence

No randomised evidence comparing modern stems with older stems was found.

Other considerations

There is a move towards modern style cemented stems. The Orthopaedic Data Evaluation Panel (OEDP) was set up in response to the NICE guidance on selection of prosthesis for primary total hip replacement[226]. The ratings used relate to the revision rate of stems and cups in arthroplasty. The results are available via the NHS Supply Chain website (http://www.supplychain.nhs.uk/portal/page/portal/Communities/Orthopaedics/ODEP%20database). A rating of 10A, 10B or 10C relates to devices with a failure rate of arthroplasty of 10% or less at 10 years. A rating of 7A and 7B relate to a failure rate of 7% or less at 7 years. A rating of 5A and 5B relate to a failure rate of 5% or less at 5 years. A rating of 3A and 3B relate to a failure rate of 3% or less at 3 years.

This recommendation was based on NICE guidance on selection of prosthesis for pirmary total hip replacement and expert opinion. In the light of such good evidence being available for the adequacy of femoral stem designs for patients with degenerative change it was thought that specific research in the fracture group would not be appropriate.

All patients should be allowed to be mobilised full weight bearing after hip fracture surgery (see section 10.2). All modern implants are designed to be load sharing devices to facilitate this.

Patients with hip fracture, particularly older patients have been treated by methods which have evolved very little over the last 50 years. This has led to a perception that they may be receiving second-class treatment. An example is the difference in the design of hip replacement implants used in patients with fractures compared with those used in patients with degenerative change. Many of those used in the fracture patients now appear archaic and their equivalents in the elective orthopaedic patients were superseded many years ago.

Long-term follow-up studies to identify function and durability of a replacement component in a fracture patient are difficult to carry out as so many of the patients are frail and their life expectancy is limited. However such studies are easier in patients with degenerative change and there is a well recognised system of assessing the adequacy of the design of a femoral stem for these patients.

10.3.5 Research recommendations on displaced intracapsular fractures

10.3.5.1 Large head total hip replacement versus hemiarthroplasty

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of large-head total hip replacement versus hemiarthroplasty on functional status, reoperations and quality of life in patients with displaced intracapsular hip fracture?

Why this is important

Large-head total hip replacement is a development of traditional total hip replacement, where a larger head makes the joint more stable and hence reduces the risks of dislocation. Three small trials have shown traditional small-head total hip replacement to have better outcomes and function, albeit with an increased dislocation rate in selected groups of patients. The drawback with large-head arthroplasty is the additional implant cost and theatre time. This cost can account for up to 20% of current NHS tariff (up to £2000) and the study aims to address whether this translates to improved patient outcome. The study design for the proposed research would be best addressed by a randomised controlled trial. This would have two arms to compare current standard care (using hemiarthroplasty) with using large-head total hip replacement for patients sustaining displaced intracapsular hip fractures. The primary outcome would be patient mobility at 1 year and secondary outcomes would include functional outcomes, quality of life and cost effectiveness of the intervention.

It would be expected that a sample size of approximately 500 patients would be required to show a significant difference in the mobility, hip function and quality of life (assuming 80% power, $p < 0.05$). By recruiting through a trauma research network it is estimated that 10 centres would be able to recruit 20 patients per month (from 45 eligible patients) giving a recruitment period of 25 months.

10.4 Use of cement in arthroplasty

The cement used in securing a hip replacement is not an adhesive but a grout, that is it is used to fill the gaps between the metal prosthesis and the bone. Thus, a component fixed with cement may be more secure resulting in less pain after surgery and decreased need for surgical revision due to loosening of the prosthesis. However, it has been suggested that cementing may induce side effects including cardiac arrhythmias and cardiorespiratory collapse, both of which may be fatal. NPSA data reports 26 deaths and six cases of severe harm when bone cement was used during hip surgery between October 2003 and October 2008. Data from the MHRA reports 20 deaths and four cases of severe harm with bone cement between 2000 and 2008. The NPSA published advice on cementing techniques to reduce such risk. However, patients undergoing surgery for proximal femoral fractures are often elderly and frequently have multiple comorbidities, often severe. Therefore some intraoperative deaths may occur and be unrelated to the use of cement.

10.4.1 Use of cement in original Thompson and Austin Moore designs of arthroplasty

10.4.1.1 Review question

In patients having replacement arthroplasty for hip fracture what is the clinical and cost effectiveness of a cemented stem versus an uncemented stem on mortality, number of reoperations, wound healing complications, functional status, length of stay in hospital and total time to resettlement in the community, quality of life, pain and place of residence after hip fracture?

One systematic review[265] including 6 RCTs with 899 participants was identified. See Evidence Table 7 and forest plots G52 to G66 in Appendix G.

10.4.1.2 Clinical evidence

Table 10-44: Cemented vs. uncemented stem (original Thompson and Austin Moore designs of arthroplasty) – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Perioperative mortality[136,260]	2	RCT	no serious limitations [(b)]	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up <1 month)[81,260]	2	RCT	no serious limitations	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up 3 months)[81,136,260,316]	4	RCT	no serious limitations	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up 1 year)[34,81,136,260,298]	5	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision [(g)]

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
Failure to regain mobility (follow-up 12 to 17 months)[81,260,316]	4	RCT	no serious limitations	serious inconsistency (i,j)	no serious indirectness	serious imprecision (k)
Change in mobility score (follow-up 12 months; better indicated by less)[260]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness (a,l)	serious imprecision (l)
Length of hospital stay[81,136,260,298]	4	RCT	serious limitations (d,e)	no serious inconsistency	no serious indirectness	serious imprecision (b)
Failure to return home (follow up 1.5 to 5 years)[81,260]	2	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision (b)
Pain (follow up 3 months)[260,316]	2	RCT	no serious limitations	no serious inconsistency	serious indirectness (a,m)	serious imprecision (b)
Pain (follow up 1-2 years)[81,260,316]	3	RCT	no serious limitations	no serious inconsistency	serious indirectness (b)	no serious imprecision
Pain score (follow up 6 months)[260]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness (a,m)	serious imprecision (b)
Reoperations (follow-up 8 to 20 months)[34,260]	2	RCT	no serious limitations	no serious inconsistency	serious indirectness (a)	serious imprecision (b)
Deep Sepsis (follow-up 1 to 5 years)[136,260,298,316]	4	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision (b)
Wound haematoma (follow-up 1 to 5 years)[260]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious imprecision (b)

(a) Data only available for unipolar hemiarthroplasty

(b) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.

(c) The result is calculated using only one of the two studies with no allocation concealment or blinding of the intervention. However, the effect size is similar between the two studies, the second study is larger and does not having any serious limitations in design. There fore the evidence has not been downgraded on the basis of study quality.

(d) Unclear or no allocation concealment in 2 of the 4 studies which account for over 75% of the weight of the result.

(e) Randomisation method by odd or even hospital number in 1 of the 4 studies, and by alternate days in another of the 4 studies. These 2 of the 4 studies account for over 75% of the weight of the result.

(f) The estimate of effect is derived from the data relating to unipolar hemiarthroplasty. There is a small study relating to bipolar arthroplasty, this has little impact on the overall result.

(g) The confidence intervals around the estimate of effect are wide enough to suggest some uncertainty in the estimate of the effect. A larger number of patients may show a statistically significant difference in the outcome.

(h) The estimate of effect is calculated with the better quality studies having more weight than the lower quality studies. Consequently, the result has not been downgraded for quality.

(i) There is significant statistical heterogeneity in the results: there is no statistical for unipolar hemiarthroplasty; Significantly more patients failed to regain mobility with uncemented bipolar hemiarthroplasty than cemented bipolar hemiarthroplasty.

(j) The definition for failure to regain mobility is different in the studies. The two studies, one showing no statistical difference the other favouring cement, measure the number of people with a change in their walking status. The third study showing no statistical difference measures the number of people unable to walk properly (this includes walking without a limp) .

(k) The confidence intervals around the estimate of effect are wide enough to suggest some uncertainty in the estimate of the effect.

(l) Definition of mobility score not given. Unable to determine if it is a valid measurement for mobility or if the estimate of effect is clinically significant.

(m) How pain was measured is not reported for the study with the most weight in the meta-analysis. Unable to determine if it is a valid measurement or if the estimate of effect is clinically significant.

Table 10-45: Cemented vs uncemented stem (original Thompson and Austin Moore designs of arthroplasty) - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Perioperative mortality	1/277 (0.4%)	0/266 (0%)	RR 2.58 (0.11 to 62.21)	0 fewer per 1,000 (from 0 fewer to 0 more)	Low
Mortality (follow up <1 month)	11/227 (4.8%)	13/226 (6.6%)	RR 0.84 (0.38 to 1.84)	10 fewer per 1,000 (from 28 fewer to 54 more)	Low
Mortality (follow up 3 months)	49/359 (13.6%)	49/349 (13%)	RR 0.98 (0.68 to 1.41)	3 fewer per 1000 (from 45 fewer to 57 more)	Low
Mortality (follow up 1 year)	101/395 (25.6%)	113/398 (26.4%)	RR 0.9 (0.71 to 1.13)	28 fewer per 1000 (from 82 fewer to 37 more)	Moderate
Failure to regain mobility (follow-up 12 to 17 months)	117/196 (59.7%)	124/182 (68.1%)	RR 0.84 (0.64 to 1.11)	109 fewer per 1000 (from 245 fewer to 75 more)	Low
Change in mobility score (follow-up 12 months; better indicated by less)	150	144	N/A	MD -0.8 (-1.23 to -0.37)	Low
Length of hospital stay	354	342	N/A	MD -1.42 (-3.15 to 0.32)	Low
Failure to return home (follow up 1.5 to 5 years)	16/219 (7.3%)	26/220 (11.8%)	RR 0.62 (0.34 to 1.12)	45 fewer per 1000 (from 78 fewer to 14 more)	Moderate
Pain (follow up 3 months)	67/192 (34.9%)	84/183 (45.9%)	RR 0.77 (0.6 to 0.98)	106 fewer per 1000 (from 9 fewer to 184 fewer)	Low
Pain (follow up 1-2 years)	44/193 (22.8%)	73/176 (41.5%)	RR 0.55 (0.4 to 0.75)	187 fewer per 1000 (from 104 fewer to 249 fewer)	Moderate
Pain score (follow up 6 months)	147	142	-	MD -0.6 (-0.9 to -0.3)	Low

Reoperations (follow-up 8 to 60 months)	10/238 (4.2%)	19/253 (7.5%)	RR 0.55 (0.27 to 1.14)	34 fewer per 1000 (from 55 fewer to 11 more)	Low
Deep sepsis (follow up 1 to 5 years)	8/385 (2.1%)	6/376 (1.6%)	RR 1.25 (0.48 to 3.24)	4 more per 1000 (from 8 fewer to 36 more)	Moderate
Wound Haematoma (follow up 2 to 5 years)	2/200 (1%)	1/200 (0.5%)	RR 2.01 (0.18 to 22.35)	5 more per 1000 (from 4 fewer to 107 more)	Moderate

10.4.1.3 Economic evidence

Two economic studies were identified. Santini (2005)[298] is a cost-consequence analysis based on a RCT included in our clinical review (see 10.3.3.2). See evidence table 15 in Appendix F for additional details. Marinelli (2008) [206] was excluded because of poor methodology.

Table 10-46: Cemented vs. uncemented hemiarthroplasty - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Santini 2005[298]	Potentially serious limitations (a)	Partially applicable (b)	Based on RCT included in our clinical review (see 10.3.3.2).

(a) Surgical time not included in cost calculation although it was significantly different (patients in the uncemented hemiarthroplasty group had shorter operating time). The only difference considered was the cost of prostheses.

(b) Not a cost-utility analysis. Study conducted in Italy.

Table 10-47: Cemented vs. uncemented hemiarthroplasty - Economic summary of findings

Study	*Incremental cost per patient (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Santini 2005[298]	Cost saving (-£710) (b)	(b)	N/R	N/R

(a) Cost of medical and nursing staff, drugs, diagnostic procedures, prostheses, blood transfusion and hospital sta. Converted into GBP from 2001 euro using the Purchasing Power Parities.

(b) Different outcomes were reported but none of them were significantly different.

10.4.1.4 Evidence statement (s)

Clinical There is a statistically significant, but not clinically significant, increase in patients who have a lower reduction in mobility score (less loss of mobility) at 12 months (LOW QUALITY).

There is a statistically significant, but not clinically significant, decrease in patients who reported pain at 3 months (LOW QUALITY) and 1 to 2 years (MODERATE QUALITY). However, there was no significant difference in a pain score at 6 months (LOW QUALITY).

There is no statistically significant difference in perioperative mortality (LOW QUALITY), mortality at 3 months (LOW QUALITY) or 1 year (MODERATE QUALITY), failure to return home (MODERATE QUALITY), length of hospital stay (LOW QUALITY), number of patients requiring reoperations (LOW

QUALITY), number of patients failing to regain mobility (LOW QUALITY), deep sepsis (MODERATE QUALITY), wound haematoma (MODERATE QUALITY) and all medical complications combined (VERY LOW QUALITY).

No RCT evidence was identified reporting quality of life, total length of stay to community resettlement or place of residence after hip fracture

No RCT evidence was identified to suggest there is a safety issue with using cement.

Economic Cemented hemiarthroplasty is cost saving compared to uncemented hemiarthroplasty. This evidence has potentially serious limitations and partial applicability.

10.4.2 Use of cement in newer designs of arthroplasty

10.4.2.1 Review question

In patients having replacement arthroplasty for hip fracture what is the clinical and cost effectiveness of a cemented stem versus an uncemented stem on mortality, number of reoperations, wound healing complications, functional status, length of stay in hospital and total time to resettlement in the community, quality of life, pain and place of residence after hip fracture.

One RCT[94] including 220 participants was identified. See Evidence Table 7 and forest plots G67 to G73 in Appendix G.

10.4.2.2 Clinical evidence

Table 10-48: Cemented vs. uncemented stem (newer designs of arthroplasty) – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality (follow up 30 days)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up 90 days)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up 1 year)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(b)]	serious imprecision [(b)]
Mortality (follow up 2 years)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Total number of reoperations (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Need for pain medication (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Unable to walk without aids (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Barthel score of less than 19 (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Harris Hip Score (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Eq-5d index score (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Eq-5d visual analogue score (follow up 12 months)[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(b)]
Length of hospital stay[94]	1	RCT	no serious limitations	no serious inconsistency	serious indirectness [(a)]	serious imprecision [(c)]

(a) Data only available for bipolar hemiarthroplasty

(b) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.

(c) The effect size is uncertain as the confidence intervals suggest the length of stay could be over 2 days shorter or over 1 day longer with cemented hemiarthroplasty.

Table 10-49: Cemented vs uncemented stem - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Mortality (follow up 30 days)	8/142 (5.6%)	10/153 (6.5%)	RR 0.47 (0.15 to 1.57)	35 fewer per 1000 (from 56 fewer to 37 more)	Low quality
Mortality (follow up 90 days)	13/108 (12%)	15/105 (14.3%)	RR 0.84 (0.42 to 1.68)	23 fewer per 1000 (from 83 fewer to 97 more)	Low quality
Mortality (follow up 1 year)	34/142 (23.9%)	46/153 (30.1%)	RR 0.65 (0.39 to 1.07)	105 fewer per 1000 (from 183 fewer to 21 more)	Low quality
Mortality (follow up 2 years)	32/108 (29.6%)	36/105 (34.3%)	RR 0.86 (0.58 to 1.28)	48 fewer per 1000 (from 144 fewer to 96 more)	Low quality
Total number of reoperations (follow up 12 months)	7/112 (6.3%)	8/108 (7.4%)	RR 0.84 (0.32 to 2.25)	12 fewer per 1000 (from 50 fewer to 93 more)	Low quality
Need for pain medication (follow up 12 months)	23/91 (25.3%)	14/77 (18.2%)	RR 1.39 (0.77 to 2.51)	71 more per 1000 (from 42 fewer to 275 more)	Low quality
Unable to walk without aids (follow up 12 months)	4/91 (4.4%)	6/77 (7.8%)	RR 0.56 (0.17 to 1.93)	34 fewer per 1000 (from 65 fewer to 72 more)	Low quality
Barthel score of less than 19 (follow up 12 months)	46/91 (50.5%)	29/77 (37.7%)	RR 1.34 (0.94 to 1.91)	128 more per 1000 (from 23 fewer to 343 more)	Low quality

Harris Hip Score (follow up 12 months)	90	77	N/A	MD 0.9 lower (6 lower to 4.2 higher)	Low quality
Eq-5d index score (follow up 12 months)	56	57	N/A	MD 0.07 higher (0.03 lower to 0.17 higher)	Low quality
Eq-5d visual analogue score (follow up 12 months)	61	60	N/A	MD 4 lower (10.75 lower to 2.75 higher)	Low quality
Length of hospital stay	109	106	N/A	MD 0.6 lower (2.48 lower to 1.28 higher)	

10.4.2.3 Economic evidence

No cost-effectiveness evidence was identified. A cost analysis was conducted based on the resources used in the Figved study[94] and on GDG expert opinion. Please see section 20.8 of Appendix H of this guideline for further details.

Table 10-50: Cemented stems versus uncemented stems (newer designs of arthroplasty) – Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
NCGC cost analysis	Minor limitations [(a)]	Partially applicable [(b)]	Cost analysis based on resources reported in Figved (2009)[94] and on GDG's expert opinion

(a) No sensitivity analysis.

(b) Cost analysis based on one study alone by Figved[94] and on GDG's expert opinon. The study by Figved[94] is not UK based and therefore may not completely reflect current NHS practice.

Table 10-51: Cemented stems versus uncemented stems (newer designs of arthroplasty) – Economic summary of findings

Study	*Incremental cost (£)*	*Incremental effects*	*ICER*	*Uncertainty*
NCGC cost analysis	£171.79[(a)] (cost saving)	N/A	N/A	N/R

(a) The following cost categories were considered in the cost analysis: cost of implants; length of hospital stay; cost of cement accessorises; theatre time costs; re-operation costs. The costs of length of stay and re-operation were considered in the analysis even if in the RCT by Figved[94] there was not statistically significant difference between the two groups for these outcomes. The total cost for the new design cemented stems was estimated to correspond to £2751.64 and that for the new design uncemented stems to £2923.43. The estimate for the total cost for the cemented stems could increase up to £2859.75 when a more thorough set of accessories are assumed to be used in the operation, in which case the incremental savings associated with using cemented stems would amount to £63.68. See Appendix H section 20.8 for further details.

10.4.2.4 Evidence statement (s)

Clinical There is no statistically significant difference in mortality at 30 days, 90 days, 1 year or 2 years (LOW QUALITY).

There is no statistically significant difference at 1 year in the number of patients requiring reoperations, number of patients pain requiring medication, number of patients unable to walk without aids, Barthel Score of less than 19, Harris Hip Score, Eq-5d index score and visual analogue score, deep wound sepsis, any wound infection, length of hospital stay (LOW QUALITY).

No RCT evidence was identified reporting total time to resettlement in the community and place of residence after hip fracture

No RCT evidence was identified to suggest there is a safety issue with using cement.

Economic No studies were identified on the cost-effectiveness of cemented vs. uncemented stem (newer designs of arthroplasty). An NCGC cost analysis found that cemented stems are £171.79 cheaper than the newer design uncemented stems. This evidence has minor limitation and partial applicability.

10.4.3 Recommendations and link to evidence

Recommendation	**Use cemented implants in patients undergoing surgery with arthroplasty**
Relative values of different outcomes	The outcomes considered were mortality, functional status, quality of life, pain, requirement for reoperation, non-healing and requirement for surgical revision, total length of stay (i.e. the time in hospital plus any time spent in rehabilitation). Mortality was of particular importance because of reported deaths by the NPSA.
Trade off between clinical benefits and harms	There is no significant difference in mortality. There is evidence of less pain at 3 months and 1 to 2 years and better mobility score at 12 months with the older designs of cemented hemiarthroplasties. There was no significant difference for length of stay, failure to return to the same place of residence and failure to regain mobility. None of the reported outcomes showed any advantage of uncemented arthroplasty over cemented. More evidence is available for older designs than newer designs of arthroplasty. Only one study was identified in newer designs. This showed no statistical difference for any reported outcomes. The direction of effect varies depending on the outcome: cemented implants are favoured for mortality, number of reoperations, length of stay, ability to walk unaided at 12 months; uncemented for need for pain medication at 12 months and Barthel index. The Eq-5d visual analogue score also favours uncemented. However, the Eq-5d index score shows no difference with tight confidence intervals. In light of this uncertainty in newer designs, the increased costs and lack of evidence or clinical reason to suggest a difference between the use of cement in newer and older stem

designs the GDG considered that cemented implants should be recommended for all arthroplasties.

There is no direct evidence comparing the use of cemented and uncemented stems in total hip replacement for displaced intracapsular fractures. However, the GDG did not consider there would be a difference in the performance of cemented stems between outcomes for total hip replacement and hemiarthroplasty. Also, all the studies which looked at total hip replacements in other comparisons (section 10.3.2) used cemented femoral stems for total hip replacement.

No RCT evidence was found to raise concerns about the safety of the use of cement.

Economic considerations

One study with potentially serious limitations and partial applicability found that the older cemented hemiarthroplasty are cost saving compared to uncemented hemiarthroplasty.

The NCGC cost analysis on cemented stems versus uncemented stems for newer designs of arthroplasty has considered several cost components, such as the cost of the implants, length of stay in hospital, rate of re-operations, accessories costs for the cemented implants.

As the clinical evidence did not show any advantage of uncemented over cemented arthroplasty in the newer design, and as the cost of new designs of cemented implants was shown to be lower than that of uncemented implants, the GDG consider cemented implants cost-effective based on the outcomes reported though these are not statistically significant.

One outcome reported in Figved showed a higher level of blood loss with cemented hemiratrhoplasty. However, the GDG did not consider the higher level of blood loss reported in Figved et al (2009)[94] for patients receiving cemented implants (89mL) to be significant in terms of both patients' outcomes and costs.

Quality of evidence

The evidence was of low or moderate quality. All but one of the studies comparing older arthroplasty designs used a Thompson or Austin Moore hemiarthroplasty (these are the first generation of implants to be used). The other study used an unspecified bipolar hemiarthroplasty. The evidence for modern stem designs is low quality mainly due to the lack of certainty around the effect size and only evidence being identified in bipolar hemiarthroplasty.

Overall, the GDG felt there was sufficient evidence to recommend the use of cemented arthroplasties over uncemented.

Other considerations

All studies comparing the effectiveness of internal fixation with THR and hemiarthroplasty with THR used cemented THR (see section 10.3.2)

All patients should be allowed to be mobilised full weight bearing after hip fracture surgery (see section 10.2). All modern implants are designed to be load sharing devices to facilitate this.

10.5 Surgical approach to hemiarthroplasty

Hemiarthroplasties are usually inserted using one of two approaches, either an anterolateral or a posterior approach. The choice of surgical approach for a surgeon is often dictated by local custom and practice and personal experience. This review looks at the evidence to see if one is better than the other. RCTs and cohorts adjusted for confounders were included.

10.5.1.1 Review question

In patients having surgical treatment for intracapsular hip fracture with hemiarthroplasty what is the clinical and cost effectiveness of anterolateral compared to posterior surgical approach on mortality, number of reoperations, dislocation, functional status, length of hospital stay, quality of life and pain.

One systematic review[269] including 1 RCT with 114 participants and one cohort study involving 720 participants were identified. See Evidence Table 9, Appendix E.

10.5.1.2 Clinical evidence

Table 10-52: Posterior vs. anterolateral approach to hemiarthroplasty – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality[309]	1	RCT	serious limitations [(a, b)]	Unable to assess this [(f)]	serious indirectness [(c)]	serious imprecision [(d)]
Number of patients with impairment of mobility at 6 months compared to prefracture[309]	1	RCT	serious limitations [(a, b)]	no serious inconsistency	serious indirectness [(c)]	serious imprecision [(d)]
Dislocation at 0 to 2 years[309]	1	RCT	Very serious limitations [(a, b)]	no serious inconsistency	serious indirectness [(c)]	serious imprecision [(d)]
Dislocation at 0 to 10 years[85]	1	Cohort	serious limitations [(e)]	no serious inconsistency	no serious indirectness	no serious imprecision
Pain at 1 month[309]	1	RCT	serious limitations [(a)]	no serious inconsistency	serious indirectness [(c)]	serious imprecision [(d)]

(a) Unclear allocation concealment and randomisation method
(b) Patients allocated to the posterior approach were nursed flat in bed for two weeks after surgery as a precaution against dislocation.
(c) Most operations performed by surgical trainees
(d) The wide confidence intervals make the estimate of effect imprecise.
(e) Only a limited number of confounders were included in the analysis. No adjustment or mention of the anaesthetists experience or grade.
(f) Actual event rates were not provided for this, mortality was given as percentages in a graph. The percentages were estimated usingthis. Mortality was significantly higher at three months, six

months, 12 months and two years in the posterior group _p<0.05. The rate was around double for all these time points.

Table 10-53: Posterior vs. anterolateral approach to hemiarthroplasty - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Mortality at 6 months, 12 months & 2 years	Not reported	Not reported	Significantly higher in posterior group (p<0.05)	Not estimable	Very low
Number of patients with impairment of mobility at 6 months compared to prefracture	5/34 (14.7%)	15/41 (36.6%)	RR 0.40 (0.16 to 0.99)	220 fewer per 1000 (from 4 fewer to 307 fewer)	Very Low
Dislocation at 0 to 2 years	1/57 (1.8%)	1/57 (1.8%)	RR 1.00 (0.06 to 15.60)	0 fewer per 1000 (from 16 fewer to 256 more)	Very Low
Dislocation at 0 to 10 years (posterior approach with posterior repair)	15/176 (8.5%)	13/431 (3%)	multivariate odds ratio 3.9 (1.6 to 9.8)	87 more per 1000 (from 18 more to 265 more)	Very Low
Dislocation at 0 to 10 years (posterior approach without posterior repair)	17/129 (13.2%)	13/431 (3%)	multivariate odds ratio 6.9 (2.6 to 19)	178 more per 1000 (from 48 more to 543 more)	Very Low
Pain at 1 month	2/55 (3.6%)	6/55 (10.9%)	RR 3.0 (0.63, 14.22)	218 more per 1000 (from 40 fewer to 1442 more)	Very low

10.5.1.3 Economic evidence

No cost-effectiveness evidence was identified.

10.5.1.4 Evidence statement (s)

Clinical

Two studies of different designs showed different effects for dislocation rates. One old RCT showed no statistically significant difference in dislocation rate between approaches. (VERY LOW QUALITY). One recent cohort which adjusted for confounders showed a statistically and clinically significant higher dislocation rate with the posterior approach compared to the anterolateral approach. (VERY LOW QUALITY)

Significantly fewer patients had impaired mobility at 6 months with a posterior approach to hemiarthroplasty compared to an anterior approach when the procedure was performed by surgical trainees. (VERY LOW QUALITY)

One study reported a significantly higher mortality with a posterior approach at 6 months, 12 months and two years but did not provide the event rates. (VERY LOW QUALITY]

Economic	No evidence was identified regarding the cost-effectiveness of posterior vs. anterolateral approach to hemiarthroplasty.

10.5.2 Recommendations and link to evidence

Recommendation	**Consider an anterolateral approach in favour of a posterior approach when inserting a hemiarthroplasty.**
Relative values of different outcomes	Functional status, reoperation rate, and quality of life were considered the main outcomes. Pain, wound infection, dislocations, length of stay in secondary care and mortality were also considered.
Trade off between clinical benefits and harms	The cohort study showed a significantly higher dislocation rate with a large effect size with the posterior approach compared to the anterolateral approach. This reduces the potential complications of re-operation or revision surgery. An old RCT data showed a significantly lower impaired mobility at 6 months with a posterior approach, a doubling of mortality and no difference in dislocations compared to an anterolateral approach. However, the operations had been carried out by trainees with varying degrees of experience. Also, the group operated on with an antrolateral approach were allowed to mobilise straight away and the group operated on with a posterior approach had two weeks postoperatively bed rest. None of the other outcomes were reported.
Economic considerations	An anterolateral approach is likely to result in cost savings because of their lower dislocation rates, and hence less revision surgery.
Quality of evidence	Both the studies available are of very low quality. The RCT is an old study where the operations were mostly carried out by surgical trainees. This RCT also treated patients differently, with those receiving a posterior approach being nursed flat in bed for two weeks after surgery as a precaution against dislocation and had a much higher mortality in the posterior group. The cohort study, which adjusted for important factors in their results, is a recent study and shows a large effect size in favour of an anterolateral approach.
Other considerations	The GDG considered this evidence along with the GDG opinions and decided the recent evidence is more relevant. They therefore recommend the anterolateral approach over the posterior. It is also recognized that the posterior approach may well be as safe in preventing dislocation in those surgeons with a large experience of using it. However, the GDG believe the majority of surgeons who perform the surgery do not regularly perform posterior approaches. It is also noted that all the RCTs comparing hemiarthroplasty and total hip replacement utilized the

anterolateral approach in all of the studies.

10.6 Extracapsular fracture fixation

In the extracapsular fractures the femoral head blood supply is unaffected and the proximal fragment large enough to allow secure fixation, therefore internal fixation is the norm. The surgical decision in this group is which of the various available methods of fracture fixation is most effective for each pattern. When treating the extracapsular fractures around the trochanter it is necessary to stabilise the intact femoral head and neck onto the shaft of the femur. The head portion is stabilised by one or more screws up the neck and into the head. This screw is attached to either a plate on the outside of the bone (called extramedullary fixation) or a metal rod which is inserted down the middle of the femoral shaft (intramedullary fixation). The rod can either be short, spanning approximately a third of the length of the femur, or long spanning the whole length of the femur. The generic term for the plate and screw used for the extramedullary fixation is a sliding hip screw and the term for the intramedullary fixation is the intramedullary nail.

Extracapsular fractures are split into pertochanteric (also called intertrochanteric), reverse oblique and subtrochanteric (see Introduction, Figure 1).

10.6.1 Intramedullary versus extramedullary implants for fixation of trochanteric extracapsular fractures

There are numerous studies comparing intramedullary and extramedullary results. The intramedullary nails can vary in size and shape, with most evolving from the initial nail design which was changed due to an increase in per-and postoperative fractures of the femur. When reviewing the evidence, the trochanteric fractures were divided into stable fractures, (those with an intact lesser trochanter – AO/ OTA A1), unstable fractures (those with a fracture between the trochanters with displacement of the lesser trochanter – AO/OTA A2 fractures) and reverse oblique fractures (AO/OTA A3). Historically and presently there have been numerous implants used to treat these and we have divided them into intramedullary (those which have a rod down the shaft of the bone) and extramedullary where the device sits on the outside of the bone. Commonly these are called intramedullary nails and sliding hip screws respectively. The intramedullary nails can come in various designs from different manufacturers. Their size and shape have evolved over the last twenty years. The design of the sliding hip screw has not changed over the last thirty years and sliding hip screws are generally very similar between the different manufacturers.

10.6.1.1 Review question

In patients undergoing repair for trochanteric extracapsular hip fractures what is the clinical and cost effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?

21 studies met the inclusion criteria for this review question with a total of 4,336 patients. See evidence table 5.8, Appendix E and forest plots G96 to G106 in Appendix G.

10.6.1.2 Clinical evidence

Table 10-54: Intramedullary vs. extramedullary implants for trochanteric extracapsular fracture – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality – 30 days[14,37,128,137,191,195,244,279,337]	9	RCT	no serious limitations (a,b)	no serious inconsistency	no serious indirectness	no serious imprecision
Mortality – 3 months[128,134,251]	3	RCT	serious limitations (d,e)	no serious inconsistency	no serious indirectness	serious imprecision (c)
Mortality – 1 year[3,14,37,77,134,191,195,251,294,300,337]	11	RCT	no serious limitations (f)	no serious inconsistency	no serious indirectness	no serious imprecision
Reoperation – within follow up period of study[9,14,77,128,134,147,191,195,214,244,251,254,279,294,300,337]	16	RCT	no serious limitations	no serious inconsistency	no serious indirectness (h)	no serious imprecision
Operative or postoperative fracture - within follow up period of study[3,9,37,77,128,134,137,147,191,214,244,251,258,279,300,337,364]	17	RCT	no serious limitations (h, j)	no serious inconsistency	serious indirectness (k)	no serious imprecision
Cut-out (at latest follow up)[9,14,37,77,128,134,137,147,191,195,214,244,251,254,258,279,294,300,337,364]	20	RCT	no serious limitations (l)	no serious inconsistency	no serious indirectness	serious imprecision (c)
Infection (deep infection or requires reoperation)[128,134,147,191,195,214,244,251,254,258,279,294,300,337]	14	RCT	no serious limitations (m)	no serious inconsistency	no serious indirectness (n)	serious imprecision (c)
Non-union (at latest follow up)[77,137,191,251,258,279,294,300,364]	9	RCT	no serious limitations (o)	no serious inconsistency	no serious indirectness (p)	serious imprecision (c)
Pain (at latest follow up)[134,147,191,337]	4	RCT	no serious limitations	no serious inconsistency	serious indirectness (q)	no serious imprecision
Length of stay in hospital[137,147,191,244,251,254,294,300]	8	RCT	no serious limitations	serious (g)	no serious indirectness	serious imprecision (c)
Mean mobility (Parker – Palmer score. At 1 year)[134,294,300,337]	4	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision

(a) Unclear allocation concealment in 4 out of 9 studies.
(b) Loss to follow up not reported or more than 5% in 4 out of 9 studies
(c) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.
(d) Unclear allocation concealment in 2 out of 3 studies.
(e) Loss to follow of not reported or more than 5%, in 2 out os 3 studies.
(f) Unclear allocation concealment in 3 out of 11 studies.
(g) There is significant statistical heterogeneity in the results
(h) The definition of reoperation varies between studies to include minor or major revisions.
(i) Unclear allocation concealment in 7 out of 15 studies.
(j) Loss to follow up not reported more than 5% in 8 out of 16 studies.
(k) All fractures of the femur that were reported have been combined.
(l) Loss to follow up not reported or more than 5% in 8 out 19 studies.
(m) Loss to follow up not reported or more than 5% in 5 out of 15 studies
(n) Inclusion of reported infection varied between studies and included deep infection and infection that required reoperation.
(o) Loss to follow up not reported or more than 5% in 4 out of 10 cases.
(p) All cases of non-union were combined using data at latest follow up.
(q) Different definitions of patient reported pain combined.

Table 10-55: Intramedullary vs. extramedullary implants for trochanteric extracapsular fracture - Clinical summary of findings

Outcome	Intramedullary	Extramedullary	Relative risk	Absolute effect	Quality
Mortality – 30 days	78/712 (11%)	56/729 (7.7%)	RR 1.44 (1.04 to 1.99)	34 more per 1000 (from 3 more to 76 more)	High
Mortality – 3 months	19/173 (11%)	21/173 (10%)	RR 0.9 (0.52 to 1.59)	12 fewer per 1000 (from 58 fewer to 72 more)	Low
Mortality – 1 year	186/1005 (18.5%)	175/1021 (17.1%)	RR 1.09 (0.91 to 1.31)	15 more per 1000 (from 15 fewer to 53 more)	High
Reoperation – within follow up period of study	69/1261 (5.5%)	50/1312 (3.8%)	RR 1.39 (0.87 to 2.23)	15 more per 1000 (from 5 fewer to 47 more)	High
Operative or postoperative fracture - within follow up period of study	54/1334 (4%)	5/1380 (0%)	RR 5.61 (2.98 to 10.59)	16 more per 1000 (from 7 more to 33 more)	Low
Cut-out (at latest follow up)	39/1446 (2.7%)	42/1508 (2.8%)	RR 0.95 (0.63 to 1.45)	1 fewer per 1000 (from 10 fewer to 13 more)	Moderate
Infection (deep infection or requires reoperation)	8/922 (0.9%)	10/943 (1%)	RR 0.86 (0.38 to 1.93)	1 fewer per 1000 (from 7 fewer to 10 more)	Moderate
Non-union (at latest follow up)	3/610 (0.5%)	3/621 (0.5%)	RR 1.01 (0.3 to 3.46)	0 more per 1000 (from 3 fewer to 12 more)	Moderate
Pain (at latest follow up)	90/278 (32.4%)	90/285 (25.9%)	RR 1.03 (0.81 to 1.30)	9 more per 1000 (from 60 fewer to 95 more)	Low
Length of stay in hospital	474	482	N/A	MD 0.54 lower (1.93 lower to 0.84 higher)	Moderate
Mean mobility (Parker – Palmer score. At 1 year)	274	281	N/A	MD 0.17 higher (0.17 lower to 0.51 higher)	High

10.6.1.3 Economic evidence

Three economic studies were indentified [110,114,179]. All these studies have been excluded. [114] is a cost-consequence analysis based on a retrospective cohort study set in the US comparing trochanteric fixation nail with sliding hip screw. This study was excluded due to poor methodological design and to the limited applicability to the UK NHS. [179] compared proximal femoral nail with long-stem cementless calcar-replacement prosthesis which was not an included intervention. Another study [110] was excluded as no cost figures were reported.

The GDG was informed of the prices of implants produced by all major orthopaedic suppliers in the UK. At 2010 prices, the average cost for a sliding hip screw was estimated at £252.51, of a short intramedullary nail at £760.08, and of a long intramedullary nail at £1,175.40. Please see section 20.3 in Appendix H for further details.

10.6.1.4 Evidence statement (s)

Clinical There is a statistically significant and clinically significant increase in operative or postoperative fracture of the femur with intramedullary implants compared to extramedullary implants for fixation of trochanteric extracapsular fractures. (LOW QUALITY)

There is no statistically significant difference in mortality, reoperation, and mean mobility score with intramedullary implants compared to extramedullary implants for fixation of trochanteric extracapsular fractures. (HIGH QUALITY)

There is no statistically significant difference in cut-out, infection, non-union and length of hospital stay with intramedullary implants compared to extramedullary implants for fixation of trochanteric extracapsular fractures. (MODERATE QUALITY)

There is no statistically significant difference in pain, with intramedullary implants compared to extramedullary implants for fixation of trochanteric extracapsular fractures. (LOW QUALITY)

No studies were identified investigating reverse oblique trochanteric extracapsular fractures.

Economic -No applicable evidence was identified regarding the cost-effectiveness of Intramedullary vs. extramedullary implants.

10.6.1.5 Recommendations and link to evidence

Recommendation	**Use extramedullary implants such as a sliding hip screw in preference to an intramedullary nail in patients with trochanteric fractures above and including the lesser trochanter (AO classification types A1 and A2).**
Relative values of different outcomes	The most important outcomes considered by the GDG include early and late mortality, re-operation, postoperative fracture, length of hospital stay and post fracture mobility.
Trade off between clinical benefits and harms	None of the studies reported have shown any advantage of intramedullary devices over extramedullary devices. Intramedullary devices had been shown to have a higher re-operation rate due to an increased incidence of periprosthetic fracture both in the perioperative period and the postoperative period (risk ratio 5.61). This may be due to the inclusion of studies with original nail designs no longer implanted. All other outcomes have been reported as similar. An additional meta-analysis is

included in Appendix G, page 503. By grouping studies using a cut off of publication after 2000, no changes to the existing evidence statement are made.

Economic considerations

In patients with trochanteric fractures above and including the lesser trochanter (AO classification types A1 and A2) the price of intramedullary fixation devices varies but on average is three times the price of sliding hip screws for short nails and five times the price for long nails. As pointed out in the clinical evidence statement, no significant benefit has been proven of the advantages of intramedullary devices over extramedullary devices, so that the GDG agreed to consider extramedullary implants cost-effective for hip fracture patients.

Quality of evidence

The level of evidence is high with numerous studies producing very similar findings.

Other considerations

All patients should be allowed to be mobilised full weight bearing after hip fracture surgery (see section 10.2). All modern implants are designed to be load sharing devices to facilitate this. Full weight bearing allows early mobilisation and rehabilitation.

The GDG highlighted this recommendation as a key priority for implementation.

10.6.2 Intramedullary versus extramedullary implants for fixation of reverse oblique trochanteric extracapsular fractures

In the reverse oblique fractures, which lie anatomically between the trochanteric and the subtrochanteric fractures there is loss of this lateral stabilizing cortical buttress. Such fractures are difficult to adequately reduce and fix at the time of the surgery. It is then the more unpredictable as to whether that adequate reduction will be retained during the healing process whilst allowing early mobilisation of the patient

10.6.2.1 Review question

In patients undergoing repair for reverse oblique trochanteric extracapsular hip fractures what is the clinical and cost effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?

10.6.2.2 Clinical evidence

No RCT evidence was identified.

10.6.2.3 Economic evidence

No cost-effectiveness evidence was identified.

10.6.2.4 Research recommendations

Intramedullary versus extramedullary fixation

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of intramedullary versus extramedullary fixation on mortality, functional status and quality of life in patients with reverse oblique trochanteric hip fracture?

Why this is important

Reverse oblique trochanteric fractures account for approximately 5 % of all trochanteric hip fractures. This means it affects approximately over 1000 patients per year in the UK. Presently there is little evidence as to which is the preferable implant (which can be either extramedullary – outside the bone, or intramedullary - inside the bone). The potential biomechanical advantage of intramedullary advantage may be offset by increased cost (which can be over £1000 more expensive). A randomised trial comparing the two implants using patient mobility, function and re-operation would allow a more informed choice of treatment for this injury.

10.6.3 Intramedullary versus extramedullary implants for fixation of subtrochanteric extracapsular fractures

Subtrochanteric fractures involve the shaft of the femur somewhere between the base of the lesser trochanter and a point 5 cm distal to this. They may extend proximally or distally. They have been considered as a separate group for practical purposes. Many of the implants available for treating a standard trochanteric fracture are not long enough to reach the intact bone distal to a subtrochanteric fracture. Thus whilst the general principles of extra and intramedullary fixation described earlier still apply a different inventory of implants to deal with these fractures is required.

It is noted that subtrochanteric fractures can often occur as a result of a metastatic pathological deposit affecting the strength of the bone. The presence of pathological deposits may not be obvious on the initial radiographs.

10.6.3.1 Review question

In patients undergoing repair for subtrochanteric extracapsular hip fractures, what is the clinical and cost effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?

Four studies met the inclusion criteria for this review question with a total of 149 patients. See evidence table 5.8, Appendix E and forest plots G107 to G111 in Appendix G.

10.6.3.2 Clinical evidence

Table 10-56: Intramedullary vs. extramedullary implants for subtrochanteric extracapsular fracture – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality – 1 year[77,281]	2	RCT	no serious limitations	serious [(c)]	serious [(b)]	serious [(a)]
Reoperation – within follow up period of study[9,77,214,281]	4	RCT	no serious limitations	serious [(c)]	no serious indirectness	serious [(a)]
Cut-out (at latest follow up)[77]	1	RCT	serious [(d)]	no serious inconsistency	no serious indirectness	serious [(a)]
Infection (deep infection or requires reoperation)[214,281]	2	RCT	no serious limitations	no serious inconsistency	serious [(b)]	serious [(a)]
Non-union (at latest follow up)[77,281]	2	RCT	no serious limitations	no serious inconsistency	serious [(b)]	no serious imprecision

(a) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.

(b) These studies are comparing intramedullary nailing to a Medoff sliding plate or fixed angle blade plate.

(c) There is significant statistical heterogeneity in the results.

(d) Only one study with a small sample size.

Table 10-57: Intramedullary vs. extramedullary implants for subtrochanteric extracapsular fracture - Clinical summary of findings

Outcome	Intramedullary	Extramedullary	Relative risk	Absolute effect	Quality
Mortality – 1 year	7/48 (14.6%)	5/42 (15%)	RR 0.93 (0.08 to 11.52)	10 fewer per 1,000 (from 138 fewer to 1578 more)	Very low
Reoperation – within follow up period of study	4/78 (5.1%)	11/71 (12.5%)	RR 0.56 (0.06 to 5.47)	55 fewer per 1,000 (from 117 fewer to 559 more)	Low
Cut-out (at latest follow up)	1/19 (5.3%)	1/13 (7.7%)	RR 0.68 (0.05 to 9.98)	25 fewer per 1,000 (from 73 fewer to 691 more)	Low
Infection (deep infection or requires reoperation)	3/45 (6.7%)	2/41 (5.9%)	RR 1.27 (0.28 to 5.88)	16 more per 1,000 (from 42 fewer to 288 more)	Low
Non-union (at latest follow up)	1/48 (2.1%)	9/42 (17.6%)	RR 0.15 (0.03 to 0.82)	150 fewer per 1,000 (from 32 fewer to 171 fewer)	Moderate

10.6.3.3 Economic evidence

No economic evidence was identified.

10.6.3.4 Evidence statement (s)

Clinical There is a statistically significant and clinically significant decrease in non-union with intramedullary implants compared to extramedullary implants for fixation of subtrochanteric extracapsular fractures. (MODERATE QUALITY)

There is no statistically significant difference in reoperation, cut-out and infection with intramedullary implants compared to extramedullary implants for fixation of subtrochanteric extracapsular fractures. (LOW QUALITY)

There is no statistically significant difference in mortality, with intramedullary implants compared to extramedullary implants for fixation of subtrochanteric extracapsular fractures. (VERY LOW QUALITY)

Economic No economic evidence was identified.

10.6.3.5 Recommendations and link to evidence

Recommendation	**Use an intramedullary nail to treat patients with a subtrochanteric fracture.**
Relative values of different outcomes	The GDG considered the most important outcomes to be functional status, pain, requirement for reoperations and wound healing complications.
Trade off between clinical benefits and harms	There was no evidence of a difference except for non-union of fracture. It is accepted by expert opinion that the treatment of choice is intramedullary fixation which allows splinting of the whole of the femoral shaft.
Economic considerations	Although intramedullary nails are more expensive than extramedullary implants, the latter lead to more patients with non-union of fracture, which would require more re-operation.
Quality of evidence	There were few studies investigating this type of fracture. Several studies were excluded as the population was from road traffic accidents, therefore high energy trauma fractures, which were excluded from the scope. The reported outcomes were predominantly of low quality.
Other considerations	Surgeons should use a technique where they are happy for the patient to mobilise fully weight bearing (see section 10.2). When patients suffer from subtrochanteric fractures it is advised to consider whether there is a pathological process which would increase the fracture risk (suck as a metastatic deposit). As noted in the introduction subtrochanteric fractures may occur as a result of a pathological process in the bone such as metastatic disease. This pre-existing pathology may not always be recognised

on the initial radiographs. It is considered to be an additional advantage of using a long intramedullary device that it provides mechanical protection to a potentially diseased bone.

11 Mobilisation strategies

11.1 Introduction

Mobilisation is the process of re-establishing the ability to move between postures (for example sit to stand), maintain an upright posture, and to ambulate with increasing levels of complexity (speed, changes of direction, dual and multi-tasking).

Early restoration of mobility after surgery for hip fracture has been suggested as an essential part of high quality care since the early 1980s[309,310]. The suggested benefits are minimisation of hospital stay, avoiding complications of prolonged bed confinement, and re-establishing people into their normal environments[168,168].

Early restoration of mobility is an aspiration of many clinical services, although guidance on the optimal time to re-mobilise patients and strategies that can be used to accelerate and optimise recovery of mobility are less clear. Good quality clinical care, in particular effective pain management should be considered essential components of early mobilisation and a rehabilitation programme, as discussed in Chapter 7.

Specific therapeutic procedures, such as those implemented by physiotherapists and occupational therapists have the potential to accelerate the recovery of mobility. Timing of the intervention examined evidence about early (within 48 hours of surgery) mobilisation and physiotherapy assessment, as opposed to later mobilisation (> 48 hours). Within the type of intervention the GDG considered regimes that tested protocols delivering more than one short session of physiotherapy per day (the benchmark for usual care), or more intensive protocols than would comprise usual care. These protocols included intensive strength training regimes (characterised by prescription and progression using recognised American College of Sports Medicine criteria), intensive weight bearing exercise regimes (supplemented by treadmill training), and increased numbers of physiotherapy usual care sessions. Usual care was taken to be prescription of walking aids, gait re-education, and bed exercises[247,247].

Mobility can be measured in a range of different ways. The most simple and basic mobility indicators, are the ability to transfer independently. This is usually taken to be between a bed and a chair, but not all investigators report the exact definition they have used. Chair

rise ability and time to complete chair rises, along with timed tests of walking and balance have a long established history for measuring mobility. In addition, the GDG considered muscle strength, length of stay, discharge destination, independence in activity of daily living (such as washing, bathing) and more complex tasks (for example, meal preparation), and mortality as outcomes. Measurement of falls, and time to first fall are considered good safety indicators for interventions like early mobilisation, but no studies reported these outcomes.

11.2 Early vs. delayed mobilisation

11.2.1 Review question

In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of early mobilisation (<48 hours after surgery) compared to late mobilisation on functional status, mortality, place of residence/discharge, pain and quality of life?

See Evidence Table 10, Appendix E and forests G123 to 126).

11.2.1.1 Clinical evidence

Only one, small randomised controlled trial was identified with 60 patients.

Table 11-58: Early vs. delayed mobilisation – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Independent to transfer at day 7 [247]	1	RCT	Serious limitations [(b)]	no serious inconsistency	no serious indirectness	no serious imprecision
Independent to step at day 7 [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	no serious imprecision
Discharged to home [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	Serious imprecision[(a)]
Discharged to fast stream rehab [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	Serious imprecision[(a)]
Discharged to slow stream rehab [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	Serious imprecision[(a)]
Discharged to nursing home [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	Serious imprecision [(a)]
Mortality [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	Serious imprecision [(a)]
Mean walking distance [247]	1	RCT	Serious limitations[(b)]	no serious inconsistency	no serious indirectness	-[(c)]

(a) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.

(b) Unclear blinding and allocation concealment, also the small sample size makes it difficult to know the true effect size for this outcome.

(c) The data is a mean with a range and therefore no relative risk was calculated. The wide range around the mean indicates that the result may be imprecise.

Table 11-59: Early vs. delayed mobilisation - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Independent to transfer at day 7	16/29 (55.2%)	4/31 (12.9%)	RR 4.28 (1.62 to 11.3)	423 more per 1000 (from 80 more to 1329 more)	Moderate
Independent to step at day 7	10/29 (34.5%)	23/31 (74.2%)	RR 0.46 (0.27 to 0.8)	401 fewer per 1000 (from 148 fewer to 542 fewer)	Moderate
Discharged to home	5/29 (17.2%)	1/31 (3.2%)	RR 5.34 (0.66 to 43.06)	140 more per 1000 (from 11 fewer to 1357 more)	Low
Discharged to fast stream rehab	8/29 (27.6%)	14/31 (45.2%)	RR 0.61 (0.3 to 1.24)	176 fewer per 1000 (from 316 fewer to 108 more)	Low
Discharged to slow stream rehab	14/29 (48.3%)	16/31 (51.6%)	RR 0.94 (0.56 to 1.55)	31 fewer per 1000 (from 227 fewer to 284 more)	Low
Discharged to nursing home	1/29 (3.4%)	0/31 (0%)	RR 3.2 (0.14 to 75.55)	0 more per 1000 (from 0 fewer to 0 more)	Low
Mortality	1/29 (3.4%)	0/31 (0%)	RR 3.2 (0.14 to 75.55)	0 more per 1000 (from 0 fewer to 0 more)	Low
Mean walking distance, metres	82.55 (0.5-400)	34.7 (5-103)	N/A	-[(a)]	Moderate

(a) An absolute effect could not be calculated as the study did not provide a mean, only a range.

11.2.1.2 Economic evidence

No studies were identified.

The GDG was informed of the hourly cost of physiotherapy in a hospital setting for England and Wales, which corresponds to £23 [61]. Physiotherapist sessions delivered during the weekends and during public holidays would be paid at an enhanced rate of pay of time and a third (BMA contract, 2008).

11.2.1.3 Evidence statement (s)

Clinical There is a statistically significant and clinically significant increase in independence to transfer at day 7 for patients who had early mobilisation compared to delayed mobilisation. (MODERATE QUALITY)

There is a doubling in the distance walked at day 7 for patients who had early mobilisation compared to delayed mobilisation. (MODERATE QUALITY)

There is no statistically significant difference between early versus delayed mobilisation for discharge destination or mortality. (LOW QUALITY)

There is a statistically significant and clinically significant decrease in

independence to step at day 7 for patients who had early mobilisation compared to delayed mobilisation. (MODERATE QUALITY)

Economic No studies were identified on the cost-effectiveness of early vs. delayed mobilisation.

11.2.2 Recommendations and link to evidence

Recommendation	**Offer patients a physiotherapy assessment and, unless medically or surgically contraindicated, mobilisation on the day after surgery.**
Relative values of different outcomes	Early mobilisation with a physiotherapist appears safe and is effective in promoting early recovery of ability to transfer without help of a person or walking aid. These outcomes are important markers of early recovery of mobility. See also, chapter 10 section 10.2 where the recommendation is made that surgeons should operate on patients with the aim to allow them to fully weight bear (without restriction) in the immediate postoperative period.
Trade off between clinical benefits and harms	The only outcome relating to harm or safety was mortality, which showed no statistically significant difference. If safety issues were a concern it is likely that they would be reflected in the overall functional outcomes, all of which improved or had no significant effect, therefore the GDG do not believe that harm is caused in relation to this evidence. If any attempt at mobilisation is supervised by a physiotherapist it should in any case be sensitive to limitations imposed by individuals' pre-fracture abilities and postoperative pain and fatigue. Thus a policy of early mobilisation with a physiotherapist should be seen as beneficial, and delayed only when individuals' clinical circumstances indicate this as appropriate.
Economic considerations	Evidence on the cost effectiveness of early mobilisation treatments is lacking. The GDG acknowledged that early mobilisation strategies will generally involve higher personnel costs (linked to the provision of physiotherapy sessions over the entire week, thus also during weekends and public holidays). However, the GDG considered the cost-savings associated with an earlier recovery of ability to transfer and step without help of a person or walking aid, and agreed that early mobilisation strategy represent a cost-effective intervention for our population.
Quality of evidence	There is only one RCT of low to moderate quality with a relatively small sample size (n = 60) and therefore the findings were interpreted with caution by the GDG.
Other considerations	Early mobilisation protocols may require new service delivery models for weekend or 7 day physiotherapy services. The GDG also noted that albeit the intervention should be overseen by physiotherapists it is also important for nurses to re-

enforce and encourage patients' mobility at all other times, under the guidance of the physiotherapist.

The GDG highlighted this recommendation as a key priority for implementation

11.3 Intensity of physiotherapy

11.3.1 Review question

In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of intensive physiotherapy compared to non intensive physiotherapy on functional status, mortality, place of residence/discharge, pain and quality of life?

See evidence table 5.10, Appendix E and forest plots G127 to G139.

11.3.1.1 Clinical evidence

Three randomised studies were found with a total of 288 patients, comparing three different types of intensive physiotherapy/physical medicine programme. Hauer et al (2002)[139,140] investigated intensive, progressive strength training. Moseley et al (2009)[216,216] tested an intensive weight bearing exercise programme supplemented by treadmill gait re-training programme, and Karumo (1977)[171,171] investigated twice daily physiotherapy (of one hours duration) in comparison to usual care (<=30 mins, once daily).

Table 11-60: Intensive exercise or physiotherapy vs. usual care – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
<u>Intensive physiotherapy (strength training)</u>						
Leg-press strength fractured side (kg) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Leg extensor strength fractured side (Newtons) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Ankle plantar flexion strength fractured side (Newtons) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Walking speed – 3 months [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Tinetti's POMA[(d)] – overall [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Tinetti's POMA – part 1 (balance) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
Tinetti's POMA – part 2 (gait) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Timed up-and-go (seconds) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Chair rise (seconds) [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Barthel's ADL [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Lawton's IADL [140]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Intensive physiotherapy (weight bearing exercise and treadmill training)						
Knee extensor strength – 4 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious [(b)]
Knee extensor strength – 16 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
Walking speed – 4 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Walking speed – 8 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Sit-to-stand test at 4 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Sit-to-stand test at 16 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Quality of life – 4 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Quality of life – 16 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Pain – 4 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Pain – 16 weeks [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Length of hospital stay [216]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
Intensive (more frequent) physiotherapy						
Adductor muscle strength (kp) at 9 weeks [171]	1	RCT	serious[(c)]	no serious inconsistency	no serious indirectness	serious[(b)]
Length of hospital stay [171]	1	RCT	serious[(c)]	no serious inconsistency	no serious indirectness	serious[(b)]

(a) Low number of subjects in each arm (N = 24) therefore the study may be underpowered.
(b) The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.
(c) Method of randomisation, blinding and allocation concealment is unclear.
(d) POMA: Tinetti's performance oriented mobility assessment

Table 11-61: Intensive exercise or physiotherapy vs. usual care - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Intensive physiotherapy (strength training)					

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Leg-press strength fractured side (kg)	12	12	N/A	MD 21 higher (2.09 lower to 44.09 higher)	Low
Leg extensor strength fractured side (Newtons)	12	12	N/A	MD 17 higher (2.54 to 31.46 higher)	Moderate
Ankle plantar flexion strength fractured side (Newtons)	12	12	N/A	MD 23 higher (2.23 lower to 48.23 higher)	Low
Walking speed – 3 months	12	12	N/A	MD 0.23 higher (0.05 to 0.41 higher)	Moderate
Tinetti's POMA - overall	12	12	N/A	MD 3 higher (0.41 lower to 6.41 higher)	Moderate
Tinetti's POMA – part 1 (balance)	12	12	N/A	MD 1.3 higher (0.54 lower to 3.14 higher)	Moderate
Tinetti's POMA – part 2 (gait)	12	12	N/A	MD 1.7 higher (0.15 lower to 3.55 higher)	Moderate
Timed up-and-go (seconds)	12	12	N/A	MD 0.8 lower (12.3 lower to 10.7 higher)	Low
Chair rise (seconds)	12	12	N/A	MD 1.8 lower (6.61 lower to 3.01 higher)	Low
Barthel's ADL	12	12	N/A	MD 3.1 lower (9.66 lower to 3.46 higher)	Low
Lawton's IADL	12	12	N/A	MD 0.4 higher (0.68 lower to 1.48 higher)	Moderate
Intensive physiotherapy (weight bearing exercise and treadmill training)					
Knee extensor strength – 4 weeks	80	80	N/A	MD 0.1 higher (1.12 lower to 1.32 higher)	Moderate
Knee extensor strength – 16 weeks	80	80	N/A	MD 1 higher (0.46 lower to 2.46 higher)	Moderate
Walking speed – 4 weeks	80	80	N/A	MD 0.05 higher (0.02 lower to 0.12 higher)	High
Walking speed – 8 weeks	80	80	N/A	MD 0.03 higher (0.07 lower to 0.13 higher)	High
Sit-to-stand test at 4 weeks	80	80	N/A	MD 0.05 higher (0.01 to 0.09 higher)	High
Sit-to-stand test at 16 weeks	80	80	N/A	MD 0.04 higher (0 to 0.08 higher)	High
Quality of life – 4 weeks	80	80	N/A	MD 0 higher (0.08 lower to	High

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
				0.08 higher)	
Quality of life – 16 weeks	80	80	N/A	MD 0 higher (0.09 lower to 0.09 higher)	High
Pain – 4 weeks	44/80 (55%)	41/80 (51.3%)	RR 1.07 (0.8 to 1.44)	36 more per 1000 (from 102 fewer to 226 more)	High
Pain – 16 weeks	30/80 (37.5%)	29/80 (36.3%)	RR 1.03 (0.69 to 1.55)	11 more per 1000 (from 112 fewer to 199 more)	High
Length of hospital stay (Moseley)	80	80	N/A	MD 3 higher (1.5 lower to 7.5 higher)	Moderate
Intensive (more frequent) physiotherapy					
Adductor muscle strength (kp) at 9 weeks	38	49	N/A	MD 0.76 lower (2.42 lower to 0.9 higher)	Low
Length of hospital stay	39	39	N/A	MD 2.8 lower (12.09 lower to 6.49 higher)	Low

11.3.1.2 Economic evidence

No studies were identified. A cost analysis was conducted based on the resources used in the studies included in the clinical review, which is reported in section 20.4of Appendix Hof this guideline.

Table 11-62: Intensive exercise or physiotherapy vs. usual care – Economic study characteristics

Study	Limitations	Applicability	Other Comments
NCGC cost analysis	Minor limitations [(a)]	Partially applicable [(b)]	Cost analysis based on resources used in the studies included in the clinical review [140,171,216]

(c) No sensitivity analysis.

(d) UK study but does not estimate QALYs. One study[171] quite outdated. All studies not UK based and therefore may not reflect current NHS practice.

Table 11-63: Intensive exercise or physiotherapy vs. usual care - Economic summary of findings

Study	*Incremental cost (£)*	*Incremental effects*	*ICER*	*Uncertainty*
NCGC cost analysis	- £12 (strength training programme vs. usual care [140]) [(a)] - £180.18 (more intensive physiotherapy vs usual care [171]) [(b)] - £827.62 (inpatient-based part of the weight bearing and treadmill exercise programme [216]) [(c)]	N/A	N/A	N/R

(b) Intervention group slightly more costly than the control group because of the use of ad-hoc exercise equipment.

(c) Intervention group more costly because of longer physiotherapy sessions

(d) It was not possible to estimate the outpatient costs of the rehabilitation programme as insufficient information was given in the study.

Evidence statement (s)

Clinical

Strength training

Additional, progressive strength training produces a statistically significant and clinically significant increase in leg extensor power, hip flexor strength and walking speed compared to placebo motor training (control) at 3 months after surgery. (HIGH QUALITY)

There is no statistically significant difference in basic or extended activities of daily living or gait and balance as measure by the Performance Orientated Mobility Assessment with strength training compared to placebo motor training (control) at 3 months after surgery. (HIGH QUALITY)

There is no statistically significant difference in timed up and go test and chair rises with strength training compared to placebo motor training (control) at 3 months after surgery. (MODERATE QUALITY)

Weight bearing exercise and treadmill training

There is no statistically significant difference in functional performance tests, quality of life, walking speed or pain with weight bearing exercise and treadmill gait training compared to the control. (HIGH QUALITY)

There is no statistically significant difference in length of hospital stay with weight bearing exercise and treadmill gait training compared to the control. (MODERATE QUALITY)

Intensive (more frequent) physiotherapy

There is no statistically significant difference in knee extensor strength adductor muscle strength or length of stay in hospital with an increased number of physiotherapy sessions per day compared to the control. (LOW QUALITY)

Economic All intensive exercise and physiotherapy programmes are more expensive than usual care, albeit the strength programme is only slightly more costly compared to usual care.

This evidence has minor limitations and partial applicability.

11.3.2 Recommendations and link to evidence

Recommendation	**Offer patients mobilisation at least once a day and ensure regular physiotherapy review.**
Relative values of different outcomes	The outcomes considered most important were mobility, functional status, pain, quality of life and length of hospital stay. There is evidence of training effects in muscle strength and other variables which are known to be important determinants of ability to walk, and hence live independently. Further research is needed to confirm effects on outcomes including return to independent living, quality of life, health service resource, and time to discharge. The evidence shows that there was no difference in once a day or twice a day physiotherapy for length of hospital stay and adductor muscle strength[171], and thus the GDG are recommending at least once a day mobilisation.
Trade off between clinical benefits and harms	GDG consensus was that mobilisation at least once a day has potential benefits of improved mobility and balance, increased independence, and reduced need for institutional and social care. The included studies failed to show improvements for these outcomes, but are all small low quality studies. There is no evidence of harm from mobilisation once a day. There is potential to exacerbate pain and induce excessive fatigue, and training should be prescribed and overseen by a physiotherapist. There is insufficient evidence to suggest what the exact dosing of physiotherapy should be, and this will vary according to the physical capabilities of each patient. Those who are very ill will not tolerate as much physical activity as those who are progressing well. The dosing should be based on a physiotherapist assessment. Hence the issue is one of professional judgement as we have no evidence to guide us any further. However, an additional observation is that the principles of management should not be any different for people with dementia, than those without.
Economic considerations	The GDG acknowledged the lack of cost-effective evidence on this question, and agreed that intensive rehabilitation sessions are likely to be more expensive than usual care. The GDG also noted that intensive rehabilitation can bring some benefits in terms of strength and on other factors affecting the ability to walk and live independently. The GDG agreed that daily mobilisation sessions and regular physiotherapy review represent a cost-effective intervention for our patients.
Quality of evidence	Although 3 RCTs were included, the interventions were not

	comparable and could not be combined in a meta-analysis. The studies were all considered individually and the evidence base is limited. The quality of the evidence ranged from low to high, but due to few studies being identified the GDG considered the overall quality to be poor. The economic evidence is based on the resources described in the programmes in the three RCTs included in the clinical review. Only the costs of the interventions and of the usual care programme were considered. The analysis is also only partially applicable in that, even current NHS unit costs were used, the actual level of resources reported in the trials may not reflect the current practice in the UK NHS.
Other considerations	GDG expert opinion indicates that patients may benefit from more intensive protocols of rehabilitation therapy (including occupational and physiotherapy), but that more evidence is needed. The GDG highlighted this recommendation as a key priority for implementation

11.3.3 Research recommendations on mobilisation

11.3.3.1 Frequency of physiotherapy

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of additional intensive physiotherapy and/or occupational therapy (for example progressive resistance training) after hip fracture?

Why this is important

The rapid restoration of physical and self care functions is critical to recovery from hip fracture, particularly where the goal is to return the patient to preoperative levels of function and residence. Approaches that are worthy of future development and investigation include progressive resistance training, progressive balance and gait training, supported treadmill gait re-training, dual task training, and activities of daily living training. The optimal time point at which these interventions should be started requires clarification.

The ideal study design is a randomised controlled trial. Initial studies may have to focus on proof of concept and be mindful of costs. A phase III randomised controlled trial is required to determine clinical effectiveness and cost-effectiveness. The ideal sample size will be around, 400 to 500 patients, and the primary outcome should be physical function and health related quality of life. Outcomes should also include falls. A formal sample size calculation will need to be undertaken. Outcomes should be followed over a minimum of 1 year, and compare if possible, either the recovery curve for restoration of function or time to attainment of functional goals.

12 Multidisciplinary management

12.1 Introduction

Multidisciplinary care is central to the management of frail older people with multiple medical, psychological and social problems. Since these are the people who typically suffer hip fracture every Trauma Unit will provide some form of multidisciplinary care. Although the prevalence of comorbidity is generally lower in younger patients, the key principles of multidisciplinary intervention are applicable across the adult age spectrum and the same skills and organisational approaches derived within the development of a focus on the older population should be provided irrespective of chronological age.

In this chapter the evidence for the different models of enhanced inpatient and community management were considered that have evolved to meet the specific needs of patients with hip fracture.

Secondary prevention of fracture by means of the assessment and management of both osteoporosis[234-236] and risk of falling [227] are covered in separate NICE guidance. It is, however, important in practice that the elements of multidisciplinary management covered in this guidance relate in an organized manner closely and reliably with these secondary prevention programmes to deliver all the elements of comprehensive care required by each patient. The precise organizational approach to this differs amongst centres. In some there is considerable overlap and/or cross-representation between the secondary prevention programmes and the service models covered in this guideline.

Units across the UK have adopted a variety of multidisciplinary service models, but most have at least some form of access to geriatrician input into the care of these patients. Local circumstances and expertise have determined the precise model developed in different centres, but in general these are variations on the following four approaches.

The traditional model of orthopaedic care - 'usual care'.

- The patient with hip fracture is admitted to a trauma ward where the orthopaedic surgical team lead both their surgical care and subsequent rehabilitation. Geriatrician input to such wards may be limited, with referrals and medical queries being dealt with on a consultative basis by the on-call medical registrar or on occasional geriatrician visits, but without a proactive geriatrician lead to the multidisciplinary team.

A more collaborative model of trauma ward working is formal 'orthogeriatric' care - with trauma patients admitted to a specialised ward under the joint care of both geriatricians

and orthopaedic surgeons. Surgical and geriatrician ward rounds may happen independently, or be combined in multidisciplinary ward rounds.

- This collaborative model is particularly relevant to hip fracture patients. Such joint working can thus lead to the development of a formal 'Hip Fracture Programme' (HFP), with the geriatric medical team contributing to joint preoperative patient assessment, and increasingly taking the lead for postoperative medical care, multidisciplinary rehabilitation (MDR) and discharge planning.

Both 'traditional' and 'orthogeriatric' models of the acute trauma ward may continue to care for patients throughout their recovery and rehabilitation following hip fracture, or each may be followed by a transfer of some patients to other models of rehabilitation.

- In some centres, surgical care and initial mobilisation is followed by early postoperative transfer to a 'Geriatric Orthopaedic Rehabilitation Unit' (GORU) - a separate geriatrician-led rehabilitation ward. The extent of surgical input to the GORU varies, depending on how early patients are moved from the acute trauma wards.

- In other centres, similar patients would be transferred to a generic 'Mixed Assessment and Rehabilitation Unit' (MARU), able to accept patients with a variety of medical, surgical and orthopaedic conditions.

A further service model is some form of community rehabilitation.

- One approach is 'Early Supported Discharge' (ESD) or ‘Intermediate Care' at home. Patients are discharged home from the acute trauma ward, or in some cases a rehabilitation ward within the hospital, with a supported 4-6 week rehabilitation package. This may include patients living in care homes but in many parts of the country is limited to patients returning to live independently in their own homes.

- Alternatively, patients with more complex needs may be moved for rehabilitation to an Intermediate Care facility outside the hospital setting, such as a care home, or a community hospital. Again this will vary depending on the provision of services available locally.

12.2 Hospital-based multidisciplinary rehabilitation versus usual care

Multidisciplinary rehabilitation (MDR) after hip fracture has been taken by the GDG to incorporate medicine, nursing, physiotherapy, occupational therapy and social care as core components of assessment and management. Additional components may include dietetics, pharmacy and clinical psychology.

The GDG also assumes:

- The required degree of relevant specialist expertise in each case.
- Formal arrangements for co-ordination/teamwork, and
- Regular on-going multidisciplinary assessment.

'Usual care' will be taken to imply the traditional model, with *ad hoc* or selective referral to some or all of the separate MDR components listed above, but without formal arrangements for co-ordinated multidisciplinary teamwork.

In contrast, the different models of 'orthogeriatric care' all assume the involvement of a geriatrician, in addition to the orthopaedic surgical team, in the development and supervision of a formal process of coordinated multidisciplinary care.

Such orthogeriatric models have been sub-divided into:

- Those focused predominantly or exclusively on the acute trauma ward; typified by the HFP model[43].
- Those provided in a subsequent inpatient rehabilitation setting (with GORU and MARU having been combined because no evidence has addressed a comparison of these models).
- Those with a community focus (the focus of Section 12.4).

12.2.1 Review questions

In this section two review questions were combined as the evidence overlapped and could not be separated in a useful way. The questions were:

In patients with hip fracture what is the clinical and cost effectiveness of hospital-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?

All the published studies included in the analysis of hospital-based MDR are of models that include geriatrician input. The results of a collective analysis of all such studies therefore reflect both the effectiveness of hospital-based MDR, and the overall value of orthogeriatrician involvement in hip fracture care.

In addition, the benefits of different models of hospital-based MDR can be considered by comparing 'usual care' with the two general sub-types of orthogeriatric care:

- Hip Fracture Programme (HFP)

- Geriatric Orthopaedic Rehabilitation Unit (GORU), or near equivalents such as a Mixed Assessment and Rehabilitation Unit (MARU).

In patients with hip fracture what is the clinical and cost effectiveness of orthogeriatrician involvement in the whole pathway of assessment, peri-operative care and rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?

The geriatrician is increasingly seen as having a key role in the integration of initial assessment and peri-operative care with the coordinated MDR (in whatever setting) which follows it.

The usefulness of this early element of orthogeriatric input has been assessed; an element that it is central to the first of the two models (HFP), but lacking from the second (GORU/MARU). In the absence of trials directly comparing the two models the impact of early geriatrician involvement can only be inferred from any differences that might be apparent when each is compared to 'usual care'.

11 studies met the inclusion criteria for this question, with a total of 2214 patients. See Evidence Table 11, Appendix E and forest plots G129 to 138 in Appendix G.

12.2.1.1 Clinical evidence

Table 12-64: Hospital based multidisciplinary rehabilitation vs. usual care – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality at 6 months – GORU/MARU[113,222]	2	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Mortality at 12 months – GORU/MARU[107,158,176,319]	4	RCT	serious[a, b, c]	no serious inconsistency	no serious indirectness[d]	no serious imprecision
Mortality at 12 months – HFP[44,305,325,344]	4	RCT	serious[e, f]	no serious inconsistency	no serious indirectness	no serious imprecision
Mortality (at discharge) – GORU/MARU[107,113,158,176,222,319]	6	RCT	serious[a, b, c, g]	no serious inconsistency	no serious indirectness[d]	no serious imprecision
Mortality (at discharge) – HFP[325,344]	2	RCT	no serious limitations[f]	serious[h]	no serious indirectness	serious[h]
Non-recovery/decline in walking at 6 months – GORU/MARU[222]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Decline in transfers (bed to chair etc) at – GORU/MARU[222]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
More dependent (based on Katz index) at 1 year – GORU/MARU[176,319]	2	RCT	serious[b, g]	no serious inconsistency	no serious indirectness[d]	serious[k]
Non-recovery in activities of daily living (ADL) at 1 year – GORU/MARU[319]	1	RCT	no serious limitations[g]	no serious inconsistency	no serious indirectness	serious[k]
Non-recovery of ADL/decline in walking at 1 year – HFP[305,344]	2	RCT	no serious limitations[e, f]	no serious inconsistency	no serious indirectness	serious[k]
Chinese Barthel Index at 6 months - HFP[305]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[k]
Modified Barthel Index at 6 months – HFP[325]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[k]

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
Length of hospital stay - GORU/MARU[107,113,176,222,319]	5	RCT	no serious limitations	serious[(l, j)]	no serious indirectness[(d)]	serious[(k)]
Length of hospital stay - HFP[44,305,325]	3	RCT	no serious limitations	serious[(l)]	no serious indirectness	serious[(h)]
Pressure sores[344]	1	RCT	no serious limitations[(f)]	no serious inconsistency	no serious indirectness	no serious imprecision
Heart failure[344]	1	RCT	no serious limitations[(f)]	no serious inconsistency	no serious indirectness	serious[(k)]
Pneumonia[344]	1	RCT	no serious limitations[(f)]	no serious inconsistency	no serious indirectness	serious[(h)]
Confusion[344]	1	RCT	no serious limitations[(f)]	no serious inconsistency	no serious indirectness	no serious imprecision
Chest infection, cardiac problem, bedsore[325]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(k)]
Stroke, emboli[325]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(h)]
Delirium[203]	1	RCT	no serious limitations	no serious inconsistency	serious[(m)]	serious[(k)]
Severe delirium[203]	1	RCT	no serious limitations	no serious inconsistency	serious[(m)]	serious[(k)]
Readmitted to hospital during follow-up – GORU/MARU[107,319]	2	RCT	serious[(c, g)]	serious[(n)]	no serious indirectness	no serious imprecision
Readmitted to hospital during follow-up – HFP[44,305,325,344]	4	RCT	serious[(f, g)]	no serious inconsistency	no serious indirectness	no serious imprecision

(a) *Intervention group in Huusko 2002*[157,158] *had greater number of patients with dementia (32/120 vs. 20/123); fewer were functionally independent in ADL before hip fracture (41 vs. 66).*

(b) *Kennie 1988*[176,176]*: difference in age mental state. Control group average age higher and with more moderate and severe impairment.*

(c) *In Galvard 1995*[107,107]*, the intervention group were older than usual care (79.1 vs. 73.6), and there were a higher proportion of patients with subtrochanteric fractures, which often require longer rehab (12% vs. 4%).*

(d) *Kennie 1988*[176,176] *is an all female population.*

(e) *In Shyu 2008*[305] *the patient's insurance policy determined the number of physiotherapy sessions in the control group.*

(f) *In Vidan 2005*[344,344] *there is potential for contamination bias given both groups were on the same ward and had the same staff.*

(g) *In Stenvall 2007a*[319,320]*, outpatient rehabilitation was not standardised.*

(h) *The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome.*

(i) *Galvard 2002*[107,107]*, author's note that geriatric department had less experience with hip fracture patients than the orthopaedic ward, which may have contributed to increased length of stay in intervention group.*

(j) *The intervention in Naglie 2002*[222,222] *was expected to increase the length of stay in hospital.*

(k) *The wide confidence intervals around the estimate make it difficult to determine and effect size for this outcome.*
(l) *There is significant statistical heterogeneity between the studies. This could be due to the variation in intervention and country of study.*
(m) *The intervention in Marcantonio 2001[203,203] does not examine multidisciplinary rehabilitation in the form of an HFP, but focuses on the value of early comprehensive geriatric assessment and targeted intervention.*
(n) *There is significant statistical heterogeneity between the studies. However, this could be due to differences in access to hospital services and follow up procedures.*

Table 12-65: Hospital based multidisciplinary rehabilitation vs. Usual care - Clinical summary of findings

Outcome	*Intervention*	*Control*	*Relative risk*	*Absolute effect*	*Quality*
Mortality at 6 months – GORU/MARU	31/238 (13%)	44/263 (16.8%)	RR 0.79 (0.52 to 1.21)	35 fewer per 1,000 (from 80 fewer to 35 more)	High
Mortality at 12 months – GORU/MARU	89/455 (19.6%)	96/466 (19.7%)	RR 0.95 (0.74 to 1.23)	10 fewer per 1000 (from 54 fewer to 47 more)	Moderate
Mortality at 12 months – HFP	72/400 (18%)	90/404 (21%)	RR 0.81 (0.61 to 1.06)	42 fewer per 1000 (from 87 fewer to 13 more)	Moderate
Mortality (at discharge) – GORU/MARU	46/693 (6.6%)	62/729 (8.4%)	RR 0.78 (0.54 to 1.13)	19 fewer per 1000 (from 39 fewer to 11 more)	Moderate
Mortality (at discharge) – HFP	3/193 (1.6%)	11/197 (5.8%)	RR 0.27 (0.07 to 0.96)	41 fewer per 1000 (from 2 fewer to 52 fewer)	Low
Non-recovery/decline in walking at 6 months – GORU/MARU	59/124 (47.6%)	56/117 (47.9%)	RR 0.99 (0.76 to 1.29)	5 fewer per 1000 (from 115 fewer to 139 more)	Moderate
Decline in transfers (bed to chair etc) at – GORU/MARU	45/124 (36.3%)	44/117 (37.6%)	RR 0.96 (0.69 to 1.34)	15 fewer per 1000 (from 117 fewer to 128 more)	Moderate
More dependent (based on Katz index) at 1 year – GORU/MARU	57/127 (44.9%)	77/111 (72.2%)	RR 0.64 (0.51 to 0.81)	250 fewer per 1000 (from 132 fewer to 340 fewer)	Low
Non-recovery in activities of daily living (ADL) at 1 year - GORU/MARU	51/84 (60.7%)	59/76 (77.6%)	RR 0.78 (0.63 to 0.96)	171 fewer per 1000 (from 31 fewer to 287 fewer)	Moderate
Non-recovery in ADL/decline in walking at 1 year – HFP	86/207 (41.5%)	108/207 (52.2%)	RR 0.79 (0.65 to 0.97)	171 fewer per 1000 (from 31 fewer to 287 fewer)	Moderate
Chinese Barthel Index at 6 months - HFP	73	75	N/A	MD 6.17 (0.86 to 13.2)	Moderate

Modified Barthel Index at 6 months – HFP	33	27	N/A	MD 6.3 (0.53 to 13.13)	Moderate
Length of hospital stay - GORU/MARU	572	606	N/A	MD 1.32 (-12.83 to 15.47)	Low
Length of hospital stay - HFP	245	240	N/A	MD -6.06 (-14.5 to 2.38)	Low
Pressure sores	8/155 (5.2%)	27/164 (16.5%)	RR 0.31 (0.15 to 0.67)	114 fewer per 1000 (from 54 fewer to 140 fewer)	High
Heart failure	12/155 (7.7%)	5/164 (3.1%)	RR 2.54 (0.92 to 7.04)	47 more per 1000 (from 2 fewer to 184 more)	Moderate
Pneumonia	6/155 (3.9%)	6/164 (3.7%)	RR 1.06 (0.35 to 3.21)	2 more per 1000 (from 24 fewer to 81 more)	Moderate
Confusion	53/155 (34.2%)	67/164 (40.9%)	RR 0.84 (0.63 to 1.11)	65 fewer per 1000 (from 151 fewer to 45 more)	High
Chest infection, cardiac problem, bedsore	6/38 (15.8%)	13/33 (39.4%)	RR 0.4 (0.17 to 0.94)	236 fewer per 1000 (from 24 fewer to 327 fewer)	Moderate
stroke, emboli	4/38 (10.5%)	1/33 (3%)	RR 3.47 (0.41 to 29.56)	75 more per 1000 (from 18 fewer to 865 more)	Moderate
Delirium	20/62 (32.3%)	32/64 (50%)	RR 0.65 (0.42 to 1)	175 fewer per 1000 (from 290 fewer to 0 more)	Low
Severe delirium	7/62 (11.3%)	18/64 (28.1%)	RR 0.4 (0.18 to 0.89)	169 fewer per 1000 (from 31 fewer to 231 fewer)	Low
Readmitted to hospital during follow-up - GORU/MARU	74/256 (28.9%)	87/262 (33.2%)	RR 0.86 (0.67 to 1.12)	46 fewer per 1000 (from 110 fewer to 40 more)	Low
Readmitted to hospital during follow-up – HFP	86/373 (23.1%)	78/378 (17%)	RR 1.14 (0.87 to 1.48)	29 more per 1000 (from 27 fewer to 99 more)	Moderate

12.2.1.2 Economic evidence

The included studies for hospital-based MDR consisted of Cameron (1994)[42,45], Galvard (1995)[107,107], Farnworth (1994)[91,91] and Huusko (2002)[157,158]. Further details on the studies are available in Evidence Table 16 of Appendix F. An HTA by Cameron (2000)[41] was excluded because the studies were grouped in a different way to that considered for our clinical review, and therefore its cost analysis was not applicable for our review question.

An original decision analysis has been conducted comparing the cost-effectiveness of the HFP vs. GORU/MARU vs. usual care. A Markov model was developed, adopting a life-time horizon.

An indirect comparison between the HFP and GORU/MARU models of care was made as no evidence was available which compares directly the two rehabilitation programmes. The usual care arms in the trials of HFP vs. usual care and of GORU/MARU vs. usual care were combined for this purpose.

Treatment effects were based on the findings of the clinical review and applied only up to 1 year from follow-up. Resource use was determined from the NHS and PSS perspective. Effectiveness was measured in QALYs. Costs and QALYs were discounted at a rate of 3.5%. Please see section 8.6 of Appendix H for further details.

Table 12-66: Hospital based multidisciplinary rehabilitation vs. usual care - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Cameron 1994 [45] **– HFP**	Potentially serious limitations [(a)]	Partial applicability [(b)]	Accelerated rehab was compared to usual care. The follow up time was 4 months.
Farnworth 1994[91] **– HFP**	Potentially serious limitations [(c)]	Partial applicability [(b)]	Fractured Hip Management Program (FHMP) was compared to usual care. The follow up time was 6 months.
Galvard 1995[107] **- GORU**	Potentially serious limitations [(d)]	Partial applicability [(e)]	Rehabilitation in a geriatric department was compared to usual care. The follow up time was 1 year.
Huusko (2002)[158] **- MARU**	Potentially serious limitations [(f)]	Partial applicability [(g)]	Intensive multidisciplinary geriatric team rehabilitation versus usual care. Follow up was 1 year.
NCGC economic model	Minor limitations [(h)]	Direct applicability	Cost-effectiveness analysis of HFP vs. GORU/MARU vs. usual care based on the meta-analysis of the trails included in the clinical review of this guideline

(a) Patients in the intervention and control group treated in the same ward, so that results could be biased due to an underestimation of the cost effectiveness of accelerated rehab.

(b) Study conducted in Australia. Not a CUA.

(c) The year in which cost date were collected is not clear. The duration of follow up is not clear. HRQoL not calculated. The statistical significance of the outcome and cost measures between the two groups was not reported. Outcome at 1 year was not known for 12% of the intervention and 14% of the control group.

(d) No sensitivity analysis was performed to test robustness of findings. HRQoL not calculated. The source used to estimate the unit cost of resources was unclear.

(e) Study conducted in Sweden. Not a CUA.

(f) Not a cost-effectiveness analysis. No sensitivity analysis was performed. 38 patients were lost during follow up. The year(s) at which cost data refer to is not clear. Imbalance of baseline characteristics. Intervention group had a more patients with dementia (32/120 vs. 20/123, and fewer who were functionally independent in ADL before hip fracture (41 vs. 66).

(g) Study conducted in Finland. Not a CUA.

***(h)** Treatment effects from meta-analysis of clinical trials available up to 1 year from follow-up.*

Table 12-67: Hospital based multidisciplinary rehabilitation vs. usual care - Economic summary of findings

Study	*Incremental cost per patient (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Cameron 1994 – HFP	-£956[(a)]	Several outcomes were reported [(b)]	Accelerated rehabilitation is the dominant strategy (less costly and more effective)	Threshold sensitivity analysis: results not sensitive to changes in % of patients recovering nor to the definition of recovery. Accelerated rehab becomes more costly than usual care when difference in LOS less than 1.5-2 days and when cost of treatment more than 40% per bed day.
Farnworth 1994 – HFP	£784 [(c)]	Several outcomes were reported [(d)]	N/A	Deterministic sensitivity analysis showed that results were robust to changes in the time spent to get patients to surgery more quickly; to the proportion of nursing home patients and to the average cost of the final days of a patient's stay
Galvard 1995 - GORU	-£665 [(e)]	Several outcomes were reported [(f)]	N/A	N/R
Huusko 2002 - MARU	£1310[(g)]	Several outcomes were reported [(h)]	N/A	N/R
NCGC economic model – HFP vs. GORU/MARU vs. usual care (Appendix H)	-£ 2,000 (HFP vs. GORU/MARU) -£25,000 (HFP vs. usual care) [(i)]	-0.13 QALYs (HFP vs. GORU/MARU) -1.01 QALYs (HFP vs. usual care) [(j)]	HFP is the dominant strategy compared to both GORU/MARU and usual care	Deterministic sensitivity analysis showed that results were sensitive to changes in the proportion of patients discharged to their own home following rehabilitation. A probabilistic sensitivity analysis showed that there is no uncertainty that hospital MDR is better than usual care. However, there is some uncertainty over the cost-effectiveness of HFP vs. GORU/MARU.[(k)] 95% CI (HFP vs usual care and GORU/MARU vs usual care): usual care dominated. 95% CI (HFP vs. GORU/MARU): HFP dominant – GORU dominant.

(a) Accelerated rehab is cost saving. A$ converted using the PPP of 1990. p=0.186. The cost components estimated were: inpatients hospital costs, readmissions, community support services, institutional care.

(b) *No. of patients recovered at 4 months from surgery (mean Barthel index score): 63 (49.6%) vs. 52 (41.6%); 95% CI (-3% to 21%). Median length of stay (days, interquartile range): 13 (7-25) vs. 15 (8-44).*
(c) *Fractured Hip Management Program (FHMP) is cost saving.*
(d) *FHMP entails lower mortality and readmission at 1 year, and lower length of stay.*
(e) *Swedish Krona (SEK) converted using the PPP of 1989; Rehabilitation in geriatric department more expensive than usual care (£665 per patient)*
(f) *The intervention had a lower level of readmissions to hospital than usual care (36 vs. 57; p value NR) but it had a higher mortality at 1 year (45 vs. 40, p value NR) and a higher mean length of stay in hospital (53.3 vs. 28 days, p value NR).*
(g) *The study expressed costs in Euros (values of 1999). T he intervention is more costly than usual care (p value NR).*
(h) *Intervention did not statistically differ from usual care in terms of mortality at 12 months (15% vs. 16%); mortality at discharge (5 vs. 5) and length of stay in hospital during 1 year (80 vs. 80 days), and number of patients reporting complications (51% vs. 46%, p=0.4). Patients in the intervention group regained their independency in the IADL functions faster (p=0.005) than usual care at 3 months (but after 1 year there was no significant difference between the two groups).*
(i) *The mean costs associated with HFP were estimated to be £34,000, for GORU/MARU £36,000 and for usual care £59,000.*
(j) *The mean effectiveness corresponded to 3.74 QALYs for HFP, 3.61 QALYs for GORU/MARU and 2.73 QALYs for usual care.*
(k) *Usual care was never the most cost-effective strategy. At a willingness to pay of £20k per incremental QALY, HFP was found to be the most cost-effective option in 70% of the 10,000 simulations run in the PSA, while GORU/MARU was the most cost-effective option in 30% of the simulations. At a willingness to pay of £30K per incremental QALY, HFP was found to be the most cost-effective option in 80% of the 10,000 simulations run in the PSA, while GORU/MARU was the most cost-effective option in 20% of simulations.*

12.2.2 Evidence statement (s)

Clinical

Hospital-based MDR (GORU/MARU)

There is a statistically significant and clinically significant reduction in pressure sores with hospital-based MDR (GORU/MARU) compared to usual care. (HIGH QUALITY)

There is a statistically significant, but not clinically significant improvement in recovery of activities of daily living at 1 year with hospital-based MDR (GORU/MARU) compared to usual care. (MODERATE QUALITY)

There is a statistically significant, but not clinically significant improvement in transfers (bed to chair) and being more dependent (Katz index) at 1 year with hospital-based MDR (GORU/MARU) compared to usual care. (LOW QUALITY)

There is a statistically significant, but not and clinically significant reduction in severe delirium with hospital-based MDR (GORU/MARU) compared to usual care. (LOW QUALITY)

There is no statistically significant difference in mortality at 6 months and functional outcomes at 6 months between hospital-based MDR (GORU/MARU) and usual care. (MODERATE QUALITY)

There is no statistically significant difference in mortality at 12 months and mortality at discharge between hospital-based MDR (GORU/MARU) and usual

	care. (MODERATE QUALITY) There is no statistically significant difference in length of hospital stay and readmission to hospital between hospital-based MDR (GORU/MARU) and usual care. (LOW QUALITY) <u>Hip fracture programme (HFP)</u> There is a statistically significant and clinically significant improvement in functional outcomes at 1 year with HFP compared to usual care. (MODERATE QUALITY) There is a statistically significant and clinically significant reduction in mortality at discharge between HFP and usual care. (LOW QUALITY) There is no statistically significant difference in mortality at 12 months and readmission to hospital, between HFP and usual care. (MODERATE QUALITY) There is no statistically significant difference in length of hospital stay, between HFP and usual care. (LOW QUALITY)
Economic	HFP is the dominant strategy (less costly and more effective) than both GORU/MARU and usual care as a hospital based multidisciplinary rehabilitation of hip fracture patients. This evidence has minor limitations and direct applicability.

12.2.3 Recommendations and link to evidence

Recommendation	**From admission, offer patients a formal, acute orthogeriatric or orthopaedic ward-based Hip Fracture Programme that includes all of the following:** • **orthogeriatric assessment** • **rapid optimisation of fitness for surgery** • **early identification of individual goals for multidisciplinary rehabilitation to recover mobility and independence, and to facilitate return to prefracture residence and long-term wellbeing.** • **continued, coordinated, orthogeriatric and multidisciplinary review** • **liaison or integration with related services, particularly mental health, falls prevention, bone health, primary care and social services.** • **clinical and service governance responsibility for all stages of the pathway of care and rehabilitation, including those delivered in the community.**
Relative values of different outcomes	Patients, clinical staff and health services share the objective of safely returning patients to their original functional state and residence as quickly as possible. However, these objectives are often in conflict – for instance earlier discharge may be at the

expense of functional improvement, while length of stay may increases if mortality is prevented among frailer individuals.

Therefore the most important outcomes considered by the GDG were functional status, length of stay, discharge destination and mortality. All these outcomes were incorporated into an original economic decision analysis.

Trade off between clinical benefits and harms

Studies of MDR show no significant evidence of harm and a trend towards improved outcomes across all outcomes. There is no suggestion of harm resulting from orthogeriatric collaboration in the HFP literature.

Evidence to support the effectiveness of coordinated hospital-based orthogeriatric MDR is derived from studies of both HFP and GORU/MARU models.

Taken together these studies suggest:

- improvement in functional outcome at 1 year, though this has not been shown to lead to greater success in achieving patients' objective of returning to their original residence.
- trend toward reduced mortality at discharge, 1, 6 and 12 months, which must reflect an effect in reducing medical and/or surgical complications (problems with diagnosis, definition and ascertainment leave this issue unclear).
- reduced hospital length of stay, though some studies only examined orthopaedic ward length of stay, so the preferred measure of 'super-spell' (the total time until return home) was inconsistently characterised.

Additional evidence supporting the effectiveness of a hospital-based model incorporating continuous orthogeriatrician supervision is derived from studies of Hip Fracture Programmes which suggest:

- reduced patient mortality at discharge and follow-up
- improved functional outcomes
- reduced hospital LOS
- reduced risk of delirium[203].

Both HFP and GORU/MARU proved markedly more cost-effective than usual care, although HFP emerged as the dominant strategy. The GDG took the view that HFP approach is also preferable because of its provision of a more extensive programme of multidisciplinary care that:

- supports admission assessment and peri-operative care, in addition to rehabilitation, discharge planning and follow-up
- addresses the needs of all patients, including those who might be viewed as inappropriate for a GORU/MARU (because of ongoing orthopaedic, medical or psychiatric problems)
- provides a coordinated multidisciplinary structure that will

support other recommendations in this guideline (eg. early operation).

Economic considerations

There were no published economic studies on hospital-based MDR for hip fracture patients, so an original decision analysis was developed to determine the cost-effectiveness of HFP vs. GORU/MARU vs. usual inpatient rehabilitation (usual care).

The cost-effectiveness model was based on an indirect comparison of randomised trials, but clearly showed that usual care was not the optimal approach.

The increased costs of hospital MDR were more than offset by:

- reduction in the acute hospital stay costs, including those associated with complications such as delirium and pressure sores.
- a reduction in the level of domiciliary social care costs as a result of increased probability of regaining pre-fracture independence in activities of daily living.
- reduction in costs for patients who avoid the need for long-term care in a residential or a nursing home.

HFP was the strategy with the highest incremental net benefit averaged across all the probabilistic simulations, and appeared to be the optimal strategy in the cost-effectiveness analysis both in comparison to usual care, and in comparison to GORU/MARU.

However, there remains some uncertainty about the relative cost-effectiveness of HFP and GORU/MARU. In particular, the results were sensitive to the proportion of patients returning home after completing the rehabilitation programme. Sensitivity analysis suggested that if the probability of returning home in the GORU/MARU programme was increased to 83% (instead of 79% as in the base case) then GORU/MARU would become the optimal strategy.

Quality of evidence

The GDG noted that the precision of the cost-effectiveness analysis was partially limited by the lack of clinical trials directly comparing HFP vs. GORU/MARU, and by the heterogeneous patient population in the meta-analysis of clinical trials on which the cost-effectiveness analysis is based.

However, the GDG agreed that the outcomes used in the economic analysis were overall of moderate quality and that the decision model is likely to provide a relatively unbiased estimate of cost effectiveness.

There are consistent trends towards benefit across all outcomes, but the small size of individual trials with a highly heterogeneous patient population means that statistical significance is difficult to achieve.

Inconsistency in definition of outcome (variable length of follow-up, differing functional outcome measures, and poor definition of

'super-spell') result in several similar outcomes reported separately which could not be combined in a meta-analysis.

There are no studies in which orthogeriatrician input is confined to initial assessment and peri-operative medical care, (without then leading into orthogeriatric MDR). Therefore, the value of such early orthogeriatrician involvement can only be inferred from the outcome of HFP studies.

The quality of the studies ranges from low to high, with the majority of outcomes obtaining a moderate score.

Other considerations

The orthogeriatric assessment that would be provided to individual patients by a multidisciplinary HFP team will vary according to individual circumstances, and it was not felt appropriate to specify these in detail in this Guideline.

Assumptions – all papers included an orthogeriatrician, but the outcomes are most plausibly those of coordinated hospital-based multidisciplinary team working, with orthogeriatricians playing a medical and supervisory role within the team.

An important function of the HFP is to ensure the required liaison with, or cross-coverage of, the programmes in place for the secondary prevention of fracture by means of the assessment and treatment of osteoporosis and risk of falling (see NICE Clinical Guideline 21 & Technology Appraisal 161 and 204 [227,234-236]). In some centres HFP staff (including the orthogeriatrician) have common or parallel commitments within these programmes, with the resulting potential to achieve additional economies over and above those identified in the model.

The GDG highlighted this recommendation as a key priority for implementation.

Recommendation	**If a hip fracture complicates or precipitates a terminal illness, the multidisciplinary team should still consider the role of surgery as part of a palliative care approach that:** • **minimises pain and other symptoms and** • **establishes patients' own priorities for rehabilitation and** • **considers patients' wishes about their end-of-life care.**

Relative values of different outcomes

Patients with advanced, life-threatening cardiorespiratory, neurological, and malignant disease make up a substantial proportion of those presenting with hip fracture.

In addition the trauma of suffering a hip fracture, and orthopaedic and medical complications of the injury, immobility and surgery can themselves precipitate a deterioration in the health of individuals.

In these circumstances such individuals and their families may view relief of pain, restoration of function and return home as a higher

priority than survival. Taking this into consideration the GDG prioritised pain, functional status and discharge destination as the most important outcomes.

Sometimes this may make it necessary to move from an active surgical and rehabilitative approach to a palliative focus that ensures that the patient can die with dignity, with appropriate attention pain and other symptoms, and all the support necessary to minimise their and their family's distress.

Trade off between clinical benefits and harms

Pain, immobility, continence, pressure ulcer risk and dignity are all improved if the hip fracture can be addressed surgically, and perioperative risk should not preclude consideration of surgical management as an integral component of palliative care.

The prognosis for an individual patient's recovery, mobility and return home can change markedly and multidisciplinary assessment is necessary if patients, their families and carers are given information with which to make informed decisions about their priorities for care (see chapter 13 Patient and carer views and information).

High quality palliative and terminal care requires a multi-disciplinary approach, which should be provided as a key part of the support that the Hip Fracture Programme offers. Early orthogeriatric assessment and ongoing multidisciplinary working will help in:

- avoidance of complications such as pressure sores [344] and delirium [203]
- expediting discharge.

Economic considerations

No cost-effectiveness evidence was identified on this sub-group of patients. Additional time spent in counseling and supporting patients and their families will clearly carry a cost. While improvements in a patient's symptoms and quality of life may be of only short duration, sensitively handled palliative care can substantially improve their relatives' distress both before and for many years after bereavement.

Quality of evidence

There is no evidence directly relating to this very frail sub-group. Terminally ill patients were often excluded from these papers and if included were not reported in specific sub group analysis. This recommendation was based on GDG consensus opinion.

Other considerations

For patients whose hip fracture occurs in the context of advanced or terminal cancer-related illness, please see NICE Clinical Guideline “Improving supportive and palliative care for adults with cancer”[227].

Recommendation	**Healthcare professionals should deliver care that minimises the patient's risk of delirium and maximises their independence, by:** • **actively looking for cognitive impairment when patients first present with hip fracture** • **reassessing patients to identify delirium that may arise during their admission** • **offering individualised care in line with 'Delirium' (NICE clinical guideline 103)**
Relative values of different outcomes	Patients with memory problems make up a substantial proportion of admissions, and face increased risk of delirium, medical complications, mortality, prolonged length of stay, and failure to return to pre-fracture independence. The GDG considered medical complications, mortality, length of stay and discharge destination as the most important outcomes.
Trade off between clinical benefits and harms	Patients with memory problems are known to benefit from acute comprehensive geriatric assessment and targeted intervention as a means of reducing their risk of delirium and severe delirium, which are significant contributors to increased length of stay and increased risk of morality at 6 months [150,150], as well as being a source of profound distress for patients, their families and carers [203,203]. In addition, intensive rehabilitation has been shown to be effective in improving outcome in terms of independent living among patients with mild to moderate cognitive impairment [157,157]. No evidence of harm was found and the GDG would not expect harm. Although no evidence met our inclusion criteria for this area, GDG consensus is that the potential benefits include avoidance of the distress that delirium causes to patients, their family, carers, and other inpatients, along with avoidance of the persistent reduction in cognitive function that can follow an episode of delirium, and of the increased length of stay and mortality associated with delirium. The avoidance and management of delirium in patients with hip fracture is specifically addressed in the NICE Guideline on Delirium[224].
Economic considerations	The decision model from the NICE guideline on Delirium (CG103) found that the tailored multi-component intervention package was cost-effective for hip fracture patients (£8,000 per QALY gained), as this care would lead to a reduced risk of long-term institutional care placement, lower incidence of other medical complications and lower length of hospital stay for these patients.

Quality of evidence

Patients with cognitive impairment are usually a group excluded from studies. Over 60% of the papers reviewed either excluded patients with cognitive impairment and/ or dementia, or made no specific comments relating to this subgroup. The studies that specifically analysed this subgroup[157,203] are of moderate quality.

Other considerations

For patients whose hip fracture occurs in the context of dementia, please see the NICE guidance on dementia[224].

Identification of cognitive impairment is a key part of assessment, and a number of tools have been used in patients with hip fracture. The Abbreviated Mental Test (AMT) score is often used, and forms part of the National Hip Fracture Database's dataset, but the GDG did not examine the choice of tool or approach to assessment.

Assessment of mental state can be complex in patients who are in pain, or who have received strong analgesia at the time of presentation. Approaches to the prevention and management of delirium require much more than screening for cognitive impairment at admission, and must include a sensitivity to changes in mental state and an awareness that delirium may arise at any stage of a patient's stay.

Delirium is not confined to patients with pre-existing cognitive problems, and its incidence will be reduced most effectively by the provision of continuous orthogeriatric support to all patients[203]. Evidence on the effectiveness of models to prevent and manage delirium following hip fracture were key to the recommendations made in the NICE Guideline on Delirium[224], and that Guideline should be read alongside our own when developing services for patients with hip fracture.

12.3 Research recommendations on hospital multidisciplinary rehabilitation

12.3.1 Hip fracture unit

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of a designated hip fracture unit within the trauma ward compared to units integrated into acute trusts on mortality, quality of life and functional status in patients with hip fracture?

Why this is important

The increasingly structured approach to hip fracture care has led to a number of UK units considering or establishing a specific 'hip fracture ward' as a specialist part of their acute orthopaedic service.

Designated hip fracture wards may prove an effective means of delivering the whole programme of coordinated perioperative care and multidisciplinary rehabilitation which this NICE Guidance

has proposed, but at present there is no high quality evidence of their clinical effectiveness when compared to such care within general orthopaedic or trauma beds.
It may not be practical to run an RCT within a trauma unit, but there is certainly potential for cohort studies to explore the effect of such units on individual patients' mobility, discharge residence, mortality and length of stay. Units considering the establishment of hip fracture wards should be encouraged to consider performing such trials.

12.4 Community-based multidisciplinary rehabilitation versus usual care

In addition or as an alternative to hospital based multidisciplinary rehabilitation (MDR), a number of studies have evaluated the role of community based MDR.

Community-based MDR includes approaches that are:

- based in the patient's own home - Early Supported Discharge (ESD)
- based within a residential care unit or community hospital
- based within a Social Care Unit (SC) - or their near equivalents.

The many versions of these services across the country are named differently (for example 'intermediate care at home', 'intermediate care residential rehabilitation'), but each consists of a rehabilitation component delivered in one of the above settings.

12.4.1 Review question

In patients with hip fracture what is the clinical and cost effectiveness of community-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?

Two studies met the inclusion criteria for this review question, with a total of 168 patients. See evidence table 11, Appendix E and forest plots G140 to G149 Appendix G.

12.4.1.1 Clinical evidence

Table 12-68: Home-based multidisciplinary early supported discharge vs. usual care – Clinical study characteristics

Outcome	*Number of studies*	*Design*	*Limitations*	*Inconsistency*	*Indirectness*	*Other considerations/ imprecision*
Mortality at 12 months [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
Moved to a higher level of care [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
Unable to walk [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
SF-36 scores at 12 months (0: worst to 100: best) - Physical component summary scores [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision

Outcome	Number of studies	Design	Limitations	Inconsistency	Indirectness	Other considerations/ imprecision
SF-36 scores at 12 months (0: worst to 100: best) - Mental component summary scores [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(c)]
Length of hospital stay [59,360]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Lengths of hospital or rehabilitation stays (days) - Length of rehabilitation (hospital + home) [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	no serious imprecision
Readmission to hospital during 4 months follow-up [59]	1	RCT	serious[(a)]	no serious inconsistency	no serious indirectness	serious[(b)]
Degree of independence (Functional Independent Measure) - FIM Self-care – 1 month [360]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Degree of independence (Functional Independent Measure) - FIM Mobility [360]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Degree of independence (Functional Independent Measure) - FIM Locomotion [360]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision
Mobility and strength tests - Up and go test [360]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	serious[(b)]
Mobility and strength tests - Sit-to-stand test [360]	1	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision

(a) Baseline data for Crotty et al., 2003[59] each study arm not given.

(b) *The relatively few events and few patients give wide confidence intervals around the estimate of effect. This makes it difficult to know the true effect size for this outcome*
(c) *The wide confidence intervals around the measurement make the result imprecise. This makes it difficult to know the true effect size for this outcome.*

Table 12-69: Home-based multidisciplinary early supported discharge vs. usual care - Clinical summary of findings

Outcome	Intervention	Control	Relative risk	Absolute effect	Quality
Mortality at 12 months	3/34 (8.8%)	4/32 (12.5%)	RR 0.71 (0.17, 2.91)	36 fewer per 1000 (from 104 fewer to 239 more)	Low
Moved to a higher level of care	1/34 (2.9%)	2/32 (6.3%)	RR 0.47 (0.04 to 4.94)	33 fewer per 1000 (from 60 fewer to 246 more)	Low
Unable to walk	0/34 (0%)	2/32 (6.3%)	RR 0.19 (0.01 to 3.78)	51 fewer per 1000 (from 62 fewer to 174 more)	Low
SF-36 scores at 12 months (0: worst to 100: best) - Physical component summary scores	34	32	N/A	MD 4.7 (0.04 to 9.44)	Moderate
SF-36 scores at 12 months (0: worst to 100: best) - Mental component summary scores	34	32	N/A	MD 1.5 (2.54 to 5.54)	Low
Length of hospital stay (days)	82	86	N/A	MD -2.96 (-5.50 to -0.42)	Moderate
Lengths of hospital or rehabilitation stays (days) - Length of rehabilitation (hospital + home)	34	32	N/A	MD 2.96 (5.5 to 0.42)	Moderate
Readmission to hospital during 4 months follow-up	8/34 (23.5%)	7/32 (21.9%)	RR 1.08 (0.44, 2.62)	18 more per 1000 (from 123 fewer to 354 more)	Low
Degree of independence (Functional Independent Measure) - FIM Self-care	48	54	N/A	MD 4.90 (2.81, 6.99)	High
Degree of independence (Functional Independent Measure) - FIM Mobility – 1 month	48	54	N/A	MD 2.00 (1.02, 2.98)	High

Degree of independence (Functional Independent Measure) - FIM Locomotion	48	54	N/A	MD 2.80 (1.61, 3.99)	High
Mobility and strength tests - Up and go test	48	54	N/A	MD 5.9 lower (12 lower to 0.2 higher)	Moderate
Mobility and strength tests - Sit-to-stand test	48	54	N/A	MD 1.5 lower (2.49 to 0.51 lower)	High

12.4.2 Economic evidence

Our search identified five studies on community MDR versus usual care. Of these, one [55,55] was excluded as it included a mixed population with only 31% hip fracture patients. Van Balen et al., 2002[340,340] was excluded as patients in the early supported discharge scheme were only discharged to a nursing home with rehabilitation facilities and not to their own home.

The following studies were included as economic evidence on the cost-effectiveness of home-based multidisciplinary early supported discharge vs. usual care: Hollingworth (1993)[148,148] O'Cathain (1994)[245] and Parker (1991)[270,270]. Hollingworth (1993)[148,148] is a cost analysis based on a case series. O'Cathain (1994)[245] is a cost-consequences analysis based on a non-randomised trail with concurrent controls. Parker (1991)[270,270] is a cost-consequences analysis based on a prospective observational study. For further details on these studies please refer to the Evidence Table 16 in Appendix F.

An original decision analysis has been conducted comparing the cost-effectiveness of the community MDR vs. usual care. A decision tree model with Markov states was developed, adopting a life-time horizon.

Treatment effects and EQ-5Ds scores were based on the findings of Crotty (2002) [60] and applied only up to 4 months from follow-up. Resource use was determined from the NHS and PSS perspective. Effectiveness was measured in QALYs. Costs and QALYs were discounted at a rate of 3.5%. Please see section 20.7 in Appendix H for further detail.

Table 12-70: Home-based multidisciplinary early supported discharge vs. usual care - Economic study characteristics

Study	*Limitations*	*Applicability*	*Other Comments*
Hollingworth 1993[148]	Potentially serious limitations (a)	Partial applicability	A community-based MDR at home scheme was compared to usual care. The MDR at home programme consisted of: care from trained nurses, nursing auxiliaries, physiotherapists, and occupational therapists in the patient's home for up to 24 hrs a day under the medical supervision of the general practitioner
O'Cathain 1994[245]	Potentially serious limitations (b)	Partial applicability	MDR at home compared to usual care. MDR team consisted of district nurses, physiotherapists, occupational therapists and generic workers, all working under the clinical responsibility of a GP for a maximum of 12 days.
Parker 1991[270]	Potentially serious limitations (c)	Partial applicability	MDR at home scheme compared to usual care. MDR team consisted of trained nurses, nursing auxiliaries, physiotherapists, and occupational therapists.
NCGC economic model	Minor limitations (d)	Direct applicability	Cost-effectiveness analysis of community MDR – ESD versus usual care based on the RCT by Crotty et al (2002) [60] included in the clinical review.

(a) *Unclear follow up time. HRQoL not calculated. Information on costs obtained from hospital records, not national statistics. Not an RCT.*

(b) *The length of time during which costs are calculated is unclear. No sensitivity analysis was conducted. Not based on a RCT. Not a CUA.*

(c) *Not based on a RCT. No sensitivity analysis. Cost data from hospital source, not national statistics. Only patients admitted from their own home were then discharged under the HAH scheme.*

(d) *The analysis consists of a decision tree with Markov states which spans a life-time horizon. Treatment effects based on the findings of the paper by Crotty in the clinical review and applied only up to 4 months from follow-up. Resource use determined from the NHS and PSS perspective, Effectiveness measured in QALYs. QALYs discounted at a rate of 3.5%.*

Table 12-71: Home-based multidisciplinary early supported discharge vs. usual care - Economic summary of findings

Study	*Incremental cost (£)*	*Incremental effects*	*ICER*	*Uncertainty*
Hollingworth 1993	-£722	LOS; readmissions [(l)]	N/A	One way sensitivity analysis: costs of MDR scheme at home would still be lower than usual care if inpatients costs 50% lower and MDR at home costs 50% higher than predicted.
O'Cathain 1994	-£370	Several outcomes reported [(m)]	N/A	N/R
Parker 1991	-£799.80[(n)]	Several outcomes reported [(o)]	N/A	N/R
NCGC economic model	£434.6[(p)]	0.0456 QALYs[(q)]	£9533/QALYs	95% CI: Community MDR dominant –usual care dominant [(r)]

(l) LOS for MDR at home vs. usual care: 32.5 vs. 41.7 days (p<0.001); readmission rates at 1 year: 6.8% (53 patients) vs. 2.7% (8 patients), p=0.008

(m) Several outcomes were reported: HRQoL measured with the Nottingham Health Profile questionnaire (14 vs. 24, p<0.05); Mortality (5.3% vs. 5.9%; p = NR); readmission rates at 3 months: (15.8% vs. 8.8%, p=0.187); LOS (median no of days): 10 vs. 17, p<0.001

(n) Costs based on the following resource use: hospital length of stay; sessions with hospital occupational therapist; readmission days; MDR ESD staff time; other NHS or social services (GP visits, day care, meals on wheels, community services)

(o) LOS (mean, days): 29 vs. 38 (p value: 0.035). Mortality (at 90 days): 40 (14%) vs. 14 (11%)

(p) The mean costs associated with community MDR were estimated to be £6901.20 and for usual care £6466.60

(q) The mean effectiveness corresponded to 3.1283 QALYs and 3.0827 QALYs for usual care.

(r) Deterministic sensitivity analysis showed that findings were sensitive to the length of stay spent in hospital and during rehabilitation at home. Community MDR was found to be the most cost-effective option in 50% of the 10,000 simulations run in the PSA at a willingness to pay of £20k, and in 60% of the simulations at a willingness to pay of 30k per QALY.

12.4.3 Evidence statement (s)

Clinical There is a statistically significant and clinically significant reduction in hospital length of stay, but an increase in total length of rehabilitation (hospital + home) with home-based multidisciplinary early supported discharge (ESD) compared with usual care. (MODERATE QUALITY)

There is a statistically significant and clinically significant increase in functional independence measures with home-based multidisciplinary ESD compared with usual care. (HIGH QUALITY)

There is no statistically significant difference in mortality at 12 months and readmission to hospital at 4 months with home-based multidisciplinary ESD compared with usual care. (LOW QUALITY)

Economic Home-based MDR – ESD is cost-effective in the rehabilitation of patients with hip fracture. This evidence has minor limitations and direct applicability.

12.4.4 Recommendations and link to evidence

Recommendation	**Consider early supported discharge as part of the Hip Fracture Programme, provided the Hip Fracture Programme multidisciplinary team remains involved, and the patient:** • **is medically stable and** • **has the mental ability to participate in continued rehabilitation and** • **is able to transfer and mobilise short distances and** • **has not yet achieved their full rehabilitation potential, as discussed with the patient, carer and family.**
Relative values of different outcomes	Length of hospital stay, functional outcomes and re-admission rates were considered the primary outcomes of interest. All these outcomes were used in the decision analytical model.
Trade off between clinical benefits and harms	Multidisciplinary ESD at home in selected patients reduces hospital length of stay but may result in overall prolonged rehabilitation (hospital + home) compared to hospital MDR. Selected patients were defined from the studies as medically stable, cognitively intact, able to transfer independently, and mobilise short distances. Despite only a few low quality studies being identified the GDG consensus was that multidisciplinary ESD at home is beneficial to a specific patient group, as defined above. The evidence reviewed showed an increase in functional independence measures with ESD compared to usual care. Our decision analysis found QALYs were 0.0456 higher in the community MDR arm of the study compared to usual care.
Economic considerations	No cost-effectiveness studies were identified for this clinical question. An original decision analytical model was developed, which was based on the findings of an RCT included in our clinical review [58,60]. The analysis showed that there is uncertainty as to whether MDR ESD at home is cost-effective compared to usual care. In particular, findings were sensitive to the length of hospital stay and length of the home-based rehabilitation programme. However, the GDG noted that the ICER of £9533/QALYs is well below the £20,000 threshold. It is also important to note that our model did not find community MDR to be cost saving compared to usual care. This was because patients in the community MDR branch of the model underwent rehabilitation in their own home for a relatively longer period of time than those of the other studies included in the economic evidence profile in section 8.7 in Appendix H.
Quality of evidence	There were few studies identified, which ranged from low to high quality with often only one study per outcome. Therefore our

	confidence in the results is low. Studies were undertaken in medically stable and cognitively intact patients and there were no studies that evaluated multidisciplinary ESD at home in cognitively impaired patients or patients living in care/nursing homes. This recommendation was therefore partly based on evidence and partly GDG consensus opinion.
Other considerations	Patient selection, as defined above is very important for multidisciplinary ESD at home and may represent a very small number of eligible patients. The benefits of MDR ESD in patient with mild to moderate cognitive impairment living at home alone or with a relative /carer are unknown. MDR ESD in this context may be beneficial and should be considered. The benefits of MDR ESD in patients living in care /nursing homes are unknown. MDR ESD in these patients, undertaken alongside the care/nursing homes may be beneficial. Interaction with any key carer and evaluation of his/her ability and willingness to provide support and care is in all cases an essential and normative element of the decision making process in considering the appropriateness or otherwise of early supported discharge The GDG highlighted this recommendation as a key priority for implementation.

Recommendation	**Only consider intermediate care (continued rehabilitation in a community hospital or residential care unit) if all of the following criteria are met:** • **intermediate care is included in the Hip Fracture Programme and** • **the Hip Fracture Programme team retains the clinical lead, including patient selection, agreement of length of stay and ongoing objectives for intermediate care and** • **the Hip Fracture Programme team retains the managerial lead, ensuring that intermediate care is not resourced as a substitute for an effective acute hospital Programme.**
Relative values of different outcomes	The GDG considered the most important outcomes to be length of stay in hospital (in particular superspell) and return to pre fracture residence.
Trade off between clinical benefits and harms	There are risks that transfer to intermediate care may prematurely move a co-morbid patient group from a diagnostically supported environment, impair continuity, and prolong the superspell.

	In certain settings and specific circumstances, proximity to home with access for relatives/carers visiting and a more relaxed and "homely" atmosphere for continued rehabilitation than the acute hospital might be considered advantageous.
Economic considerations	The average weekly cost of the social care received in an intermediate care setting based in residential homes varies from a minimum of £412 to a maximum of £840 for schemes run by local authorities. The average weekly cost of social and health care services in the same setting but for schemes run by the local authority in conjunction with primary care trusts amounts to £574 (source: PSSRU 2009[61]). Subject to the criteria in the recommendation above, intermediate care may be feasible for our population, but there is currently no evidence on its cost-effectiveness.
Quality of evidence	There is no evidence on the effectiveness or cost-effectiveness of rehabilitation within a community hospital or residential care unit in hip fracture rehabilitation. This recommendation was based on GDG consensus opinion.
Other considerations	Intermediate care rehabilitation for hip fracture remains ill-defined and highly variable in the UK in terms of its admission criteria, multidisciplinary composition, intervention components and mechanisms for shared outcome and resource accountability within a comprehensive hip fracture programme.

Recommendation	**Patients admitted from care or nursing homes should not be excluded from rehabilitation programmes in the community or hospital, or as part of an early supported discharge programme.**
Relative values of different outcomes	The GDG considered the most important outcomes to be functional status, readmission to hospital and return to pre-fracture residence. Early assessment and MDR offered as part of a hip fracture programme with continued rehabilitation for patients admitted from care/nursing homes is likely to improve/maintain the patient's functional ability with regard to mobility, transfers from bed to chair and activities of daily living. This is in the interests of both patients and care/nursing home staff. In addition patient status as a care home resident as opposed to a nursing home resident may be maintained and equality for patients in care/nursing homes is maintained with regard to access to rehabilitation.
Trade off between clinical benefits and harms	There is no evidence of harm accruing to care/nursing home residents from the provision of appropriately individualised rehabilitation programmes. For some patients admitted from care/nursing homes there may be advantages (and no particular risks) in completing their rehabilitation after hospital MDR within that home (subject to the

recommended criteria above), recognising that their rehabilitation goals may be more complex and must be shared by the HFP team on a continuing basis with the care/nursing home staff.

The potential benefits of ESD for patients admitted from care/nursing homes include the possibility of functional recovery within the patient's familiar environment, shared communication, goal setting and collaboration between care/nursing home staff and HFP team resulting in improved functional outcome, and the possibility of reduced hospital stay and inappropriate hospital readmission.

This subgroup is considered at particular risk of premature discharge because of ease of access to the care/nursing home environment and the corresponding perception that functional recovery matters less. Failure to undertake adequate rehabilitation carries the subsequent risk of inappropriate functional decline and/or levels of dependency, reduced quality of life, unnecessary hospital readmission, and premature mortality.

Provision of part of a patient's continuing rehabilitation programme in the care or nursing home of origin is correctly categorised as either early supported discharge or intermediate care, and the continued involvement of the Hip Fracture Programme team in liaison with the community-based component is therefore correspondingly a requirement.

Economic considerations

There was no cost-effectiveness evidence. The GDG believe that any increase in the cost of hospital bed days from the avoidance of premature discharge should be at least partially offset by the avoidance of inappropriate readmissions and reduction in subsequent care costs resulting from optimised functional status.

Quality of evidence

No RCTs were identified regarding patients admitted from care or nursing homes undergoing community ESD, as this patient subgroup has typically been excluded from clinical trials. The recommendation is based on GDG opinion and consensus that this group of patients would benefit from ESD.

Other considerations

There is a high prevalence of cognitive impairment in this population, therefore realistic rehabilitation goals need to be defined, but not at the expense of excluding rehabilitation.

12.5 Research recommendations on community multidisciplinary rehabilitation

12.5.1 Early supported discharge

The GDG recommended the following research question:

- What is the clinical and cost effectiveness of early supported discharge on mortality, quality of life and functional status in patients with hip fracture who are admitted from a care home?

Why this is important

Residents of care and nursing homes account for about 30% of all patients with hip fracture admitted to hospital. Two-thirds of these come from care homes and the remainder from nursing homes. These patients are frailer, more functionally dependent and have a higher prevalence of cognitive impairment than patients admitted from their own homes. One-third of those admitted from a care home are discharged to a nursing home and one-fifth are readmitted to hospital within 3 months. There are no clinical trials to define the optimal rehabilitation pathway following hip fracture for these patients and therefore represent a discrete cohort where the existing meta-analyses do not apply. As a consequence, many patients are denied structured rehabilitation and are discharged back to their care home or nursing home with very little or no rehabilitation input.

Given the patient frailty and comorbidities, rehabilitation may have a limited effect on clinical outcomes for this group. However, the fact that they already live in a home where they are supported by trained care staff, clearly provides an opportunity for a systematic approach to rehabilitation. Early care/nursing home based multidisciplinary rehabilitation would take advantage of the day-to-day care arrangements already in place in homes and provide additional NHS support to deliver naturalistic rehabilitation, where problems are tackled in the setting in which the patient lives.

Early supported multidisciplinary rehabilitation could reduce hospital stay, improve early return to function, and affect both readmission rates and the level of NHS-funded nursing care required.

The research would follow a two-stage design: (1) An initial feasibility study to refine the selection criteria and process for reliable identification and characterisation of those considered most likely to benefit, together with the intervention package and measures for collaboration between the HFP team, care-home staff and other community-based professionals, and (2) A cluster randomized controlled comparison (with two or more intervention units and matched control units) set against agreed outcome criteria. The latter should include those specified above, together with measures of the impact on care-home staff activity and cost, as well as qualitative data from patients on relevant quality-of-life variables.

12.5.2 Care/nursing home residents

The GDG recommended the following research question:

- Do patients admitted to hospital with a fractured hip who live permanently in a care/nursing home have equal access to multidisciplinary rehabilitation as patients admitted from their own homes?

Why this is important

The existing literature on the effectiveness of multidisciplinary rehabilitation typically excludes patients who live in care/nursing homes. From an equality perspective it hypothesised that this group of people do not have access to the same multidisciplinary rehabilitation as patients who are returning home as it is assumed patients returning to care/nursing homes will have their care needs met by the home. The research design would be a prospective observational cohort study to determine the extent and quality of rehabilitation services available to this group in comparison to patients returning to their own homes.

13 Patient and carer views and information

13.1 Introduction

Patient views about their hip fracture and its management, and the way patients are provided with information are important elements of the natural recovery and treatment of hip fracture. Care givers also have need for information, and can influence the recovery process. Timely and clear information could reduce stress and uncertainty for patients and potentially improve their outcome. This section examines the literature on patient views and the provision of information to patients.

13.2 Patient and carer views

A systematic literature review was conducted into the views of patients and carers about their experience of hip fracture management from hospital admission until discharge from rehabilitation. Studies examining areas not covered by the guideline scope were not included. For example, hip protectors for falls management, nutrition support or patient views relating to the time after discharge from rehabilitation programmes.

The aim of this review was to provide:

- Supplementary evidence to clinical questions addressed in the guideline

- A general overview of patients views' on hip fracture and hip fracture management
- Evidence relating to the provision of information to patients and carers

Eleven qualitative studies are included here, only two of which are UK based studies. More details about the studies are presented in the evidence table (Evidence table 12 in Appendix E). Studies were assessed using the NICE methodology checklist for qualitative studies[233].

13.2.1 Summary of studies

Table 13-72 Patient views study quality

Study	Population	Methods	Analysis	Relevance to guideline population
Archibald 2003[8]	Adequately reported	Adequately reported	Adequately reported, credible	Community hospital in UK 4 patients interviewed during rehabilitation
Borkan 1991 & 1992[28,29]	Adequately reported	Well reported	Well reported, credible	4 hospitals in USA 80 patients interviewed during hospital stay
Bowman 1997[33]	Adequately reported	Poorly reported	Poorly reported, credible	Teaching hospital in Canada 17 patients interviewed on day of admission
Furstenberg 1986[105]	Adequately reported	Poorly reported	Poorly reported, credible	Urban hospital in USA 11 patients interviewed at one or more points during hospital stay
Olsson 2007[249]	Well reported	Well reported	Well reported, credible	Geriatric/ orthopaedic ward in Sweden 13 patients interviewed soon after the operation
Pownall 2004[274]	Well reported	Poorly reported	Adequately reported, credible	Trauma/ orthopaedic ward in UK 1 patient interviewed prior to discharge from acute trauma and orthopaedic ward
Slauenwhite 1998[314]	Poorly reported	Adequately reported	Poorly reported, credible	Hospital in Canada 23 'caregivers' for 23 patients interviewed 4 to 6 weeks after discharge
William 1994[354]	Poorly reported	Poorly reported	Poorly reported, credible	Hospital in USA 120 patients interviewed before hospital discharge and followed up at 2, 8 & 14 weeks
Wykes 2009[355]	Well reported	Well reported	Well reported, credible	Rehabilitat-ion hospital in Australia 5 patients interviewed during rehabilitation
Young 2009[358]	Adequately reported	Well reported	Well reported, credible	Rehabiliitat-ion centre in USA 62 patients interviewed after 12 month follow up meeting

Study	Population	Methods	Analysis	Relevance to guideline population
Ziden 2010[362]	Well reported	Well reported	Well reported, credible	Hospital in Sweden 18 patients interviewed at 1 month follow up meeting and 15 at 1 year follow up

Archibald et al (2003)[8] conducted a qualitative study of 5 hip fracture patients in a community hospital in the UK. Their aim was to explore experiences of individuals who had suffered a hip fracture. Interviews with open ended questions were conducted during their stay in hospital.

Four main themes were identified: injury experience, pain experience, recovery experience, disability experience. Only the pain and recovery experience relate to their time in hospital and rehabilitation. Most patients described the pain they experienced, one mentioned being in a lot of pain in the orthopaedic unit despite pain killers. Another mentioned they thought the pain went with rest after a while, but not completely. Only 1 person was still having pain at time of interview. The recovery experience was split into 3 sequential categories: the operation, beginning the struggle and regaining independence. Only 1 person described the operation, they had a "horrendous" recollection of a noisy operating theatre, like being in an engineering shop or something". Three patients remembered 'beginning the struggle': they reported not being able to do anything; struggling to get to the toilet and into a chair; and hating using a bed pan. The comments relating to regaining independence were all positive. Motivation, be it getting to the toilet, the dining room or smoke room was found to be a key factor in the recovery of the patients.

Borkan et al (1991 & 1992)[28,29] conducted a qualitative study of 80 hip fracture patients in 4 hospitals in the USA. Their aim was to investigate the meanings of hip fracture to older patients, and to identify potentially important prognostic indicators or risk factors for rehabilitation outcomes. Patients were interviewed during the first week after hip fracture with a combination of open-ended and multiple choice questions.

The study reports how patients perceive their fracture, their perception of their disability and whether they were hopeful for the future (see evidence table). Also reported were patient expectations of recovery (43 expected full recovery, 14 partial recovery and the rest did not know or did not give an answer) and patient expectations about their living situation (61% predicted going home, 15% into a nursing home though none came from one, 9% predicted being discharged to their children's houses and 15% did not know or did not respond). The actual figures showed that 43% were discharged to long term care institutions, of these 38% remained in the institution at 1 year, 53% returned home and 9% died.

Bowman (1997)[33] conducted a quantitative study of 43 patients undergoing surgery on the hip in a hospital in Canada, 17 of these had a hip fracture. The main aim was to describe sleep satisfaction, pain perceptions and psychological concerns of patients undergoing hip operations. Also two open ended questions were asked at the time of admission to elucidate the patient's biggest concerns about their injury and forthcoming surgery, and whether they had concerns about their ability to recover fully and quickly. The mean age of hip fracture patients was 80 years old and, unlike most the other studies, it also included patients with delirium (8 out of 17). Six out of 17 patients feared being unable to walk again, an additional 3 out of 17 were concerned about their recovery and managing on their own.

Fustenberg (1986)[105] conducted a qualitative study of 11 patients of hospitalised patients with hip fracture in a hospital in the USA. The aim of the study was to "construct a natural history of the hip fracture", from the events surrounding the hip fracture through the hospitalisation period. Ethnographic interviews were carried out at one or more points during their hospital stay.

The findings were split into two main sets: immediate patient expectations about their recovery and "contextual factors" to the evolving expectations about their recovery. The immediate expectations mostly included expressions of despair and discouragement: hip fracture was going to result in extended period of slow recovery of function, with attendant dependency, postponement or relinquishment of plans and changed living situation with the threat of permanent loss of independent living. Participants also suffered uncertainty about timing and completeness of return to full recovery

As time progressed participants commented that although progress was slow they could see improvements. They also took encouragement from other people's recovery. The study notes that while patients could focus on positive and negative points, the participants only focused on encouraging examples.

The study also reports that healthcare professionals' cues, encouragement and feedback guided the participants' perceptions about their own progress. However, some participants "referred to the elusiveness of the doctors and their own unanswered questions."

Olsson et al (2007)[249] conducted a qualitative study of 13 hospitalised patients in Sweden. The aim of the study was to describe patient's own perceptions of their situation and views of their responsibility in the rehabilitation process. Interviews were conducted with semi-structured questions as soon after the operation as the patients felt strong enough.

The study categorised the findings into different conceptions: 'autonomous' – responses from people who appeared confident and accustomed to managing on their own; 'modest' – responses from people who gave the impression of being vulnerable and dependent on others, this group worried about their future more than the others; 'heedless' – responses from people who appeared to have a sense of detachment. The heedless did not doubt they would recover and that people around them would care for them. This group was characterised predominantly by a reluctance to reflect on their own situation, by a refusal to accept responsibility and by their need for information.

The study also identified some common traits: a lack of awareness - most patients lacked awareness about their condition, what to do and how to act, and needed more information; a shocking event - although several suspected they had a fracture all were distressed by the diagnosis. The period before surgery was mostly blurred and filled with fear and pain. The participants worried about how they would function postoperatively; zest for life - all expressed a strong desire to recuperate although, while confined to bed they worried about the pain, their inability to move their leg, their forthcoming operation and the fear of being unable to walk again.

Pownall 2004[274] conducted a critical appraisal of a 60 year old women's experience with hip fracture in a UK hospital. The study was undertaken in an effort to understand further the nature of personal experience. Narrative was acquired as part of a routine nursing evaluation and helped to illuminate nursing care issues through the eyes of the patient. The participant was interviewed prior to discharge with four open-ended questions.

The study identified three areas for improvement within the hospital: better communication skills; time management for staff so time spent with the patient is used effectively; and better pain management. The participant's comments included not understanding why they had to wait so long in the Emergency department after the x-ray as

they had already been told their hip was fractured; staff were so busy, no one had time to sit and explain things to her; concern that the operation was explained to her son but not her; shock at being mobilised the day after surgery.

Slauenwhite and Simpson (1998)[314] conducted a qualitative study of 23 "caregivers" for 23 patients who had experienced hip fracture in Canada. The purpose of the study was to investigate the impact of enhanced early discharge on families experiencing a repaired hip fracture in an older adult. "Caregivers" were interviewed 4 to 6 weeks after discharge.

The length of stay was considered too long by the patient with the fracture and too short by the carer for families. 15 out of the 23 families found length of stay not an issue. 20 of the families stated pain management was not a problem in hospital or at home. Several families thought the transition from hospital to home was a problem as it took several hours to days for all the information to be relayed to home care system. This went hand in hand for those with comorbidities. Many caregivers had stories of dissatisfaction which was suggested to be related to health care system and mismatched care. Mismatched care was not well defined.

Williams et al (1994)[354] conducted a study into patient recovery and views for 120 patients after hospital discharge in the USA. Participants were asked what advice they would offer to other patients who had just fractured their hip. Patients were interviewed at 14 weeks after discharge.

The advice offered was grouped into categories: 94 patients emphasised the importance of mental attitude with comments such as patients should "maintain hope" and "look to the future"; 76 patients suggested that following experts' advice; 34 advised mobility was key with comments such as keep mobile, rest before getting up to walk, use walker to help get up; 15 advised maintain healthy lifestyle; 7 said use caution and be careful not to fall; 3 suggested limiting stay in institution and get help to be at home if possible; and 6 gave no specific advice as they commented that everyone is different.

Wykes et al (2009)[355] conducted a qualitative pilot study to explore the impact of hip fracture on the lives of previously independent women and to identify their concerns when participating in inpatient rehabilitation. Five patients were interviewed during their stay in a rehabilitation hospital in Australia.

The impact of the fracture was an issue for all five women as others had to assume responsibility for things they had done previously. The study categorised the women's concerns into four categories: the behaviour of others; what was happening to them; the impact of their injury on others; and other health issues. A few comments were raised about the behaviour of others including things others said and did, friends and family doing things without asking first, the family not being told when one woman had moved hospital, concern that staff expect one woman's daughter to look after her until rehabilitation started. Concerns about what was happening to them included a possible loss of independence, possible accommodation changes after discharge and money issues. The women were also concerned about inconveniencing or upsetting others by telling them what they were feeling or asking too many questions. Two women had pre-existing health issues which, combined with their hip fracture, had adverse effects on their outcome. These overshadowed specific concerns about their hip fracture.

Young and Resnick (2009)[358] conducted a qualitative study to explore the perceptions of 62 older adults regarding their functional recovery 1 year after hip fracture and after participating in rehabilitation programme in the USA. Participants were asked whether they were satisfied with their functional recovery, what helped or hindered recovery, what

would improve recovery and what one piece of advice they would offer other hip fracture patients. The themes identified are listed below.

53 participants were satisfied with their functional recovery. The main factors they listed as facilitators of recovery were seeing health care professionals and their positive attitude (40 respondents); social support, particularly from family and friends (13 respondents); and their own determination (12 respondents). Other factors mentioned included lifestyle factors or an environment that encourage healthy living, individualised care & verbal encouragement; spirituality and identifying goals. The nine people who were dissatisfied with their recovery listed medical complications or comorbidities, unpleasant sensations and age as factors that hindered their recovery.

The respondents also identified areas that would facilitate recovery: more direct physical & occupational therapy and more education about the recovery process and ways to optimise physical function (26 respondents); better follow up and care in the home setting after discharge from rehabilitation (9 respondents); spirituality (3 respondents), social support (2 respondents); additional information (8 respondents); elimination of unpleasant sensations (4 respondents) and policy (1 respondent).

The patients also offered the following advice on how to facilitate recovery to anyone with a hip fracture: listen to healthcare instructions (19 respondents) and participate as much as possible in rehabilitation activities (48 respondents); participants strongly recommended that older adults who sustain hip fractures maintain a positive attitude (20 respondents) and remain determined throughout the recovery experience (13 respondents); be careful to avoid subsequent trauma and prevent anything that would impede recovery (8 respondents); push through the pain and use all medication offered (6 respondents); and don't worry (4 respondents).

Ziden et al (2008 & 2010)[362,363] conducted a qualitative study to explore and describe the consequences of an acute hip fracture among home dwelling elderly people shortly after discharge from hospital in Sweden. Patients, who had participated in a randomised controlled trial investigating rehabilitation[360] included in the rehabilitation chapter (Section 12.2), attended semi-structured interviews at 1 month and 1 year after hip fracture.

The study identified different responses or perceptions over time. At 1 month patients: found they were limited in movement and have lost confidence in their body (18 people); had become humble and grateful (7 people); respected themselves and their own needs (2 people); had become more dependent on others (12 people); gain more human contact and are treated in a friendly way by others (2 people); were secluded and trapped at home (4 people); were old, closer to death and have lost your zest for life (4 people); were taking one day at a time and were uncertain about the future (7 people). At 1 year after discharge patients felt: more insecure and afraid (11 patients); they had more limited ability to move (12 patients); disappointed and sad that identity and life have changed (8 patients); satisfied with the situation or felt even better than before their fracture (5 patients).

The study also identified some patient views about determinants of hip fracture recovery: 10 patients stated their own mind and actions influenced recovery; 4 patients stated that treatment and the actions from others influenced recovery; whereas 6 patients stated you cannot influence recovery.

13.2.2 Common themes

The following themes have been identified from the studies:

Initial outlook in hospital

Five studies with 126 participants reported views from this period [8,28,29,33,105,249]. One of the studies reported the responses varied "from stubborn optimism to despair"[28,29]. Another study also reported all 13 participants expressed a strong desire to recuperate [249]. However, most of the expressions were negative with no positive comments reported in the papers. The concerns covered:

- pain and the inability to move their leg while confined to bed
- the fear of being unable to walk
- not being able to do anything
- hating using a bed pan
- struggling to get out of the chair or bed
- concern about recovery and managing on their own
- return to independent living
- limitations on their functioning and consequent implications
- being burden on their "caretakers" [families and carers]
- further falls
- uncertainty about timing and completeness of return to full recovery

Attitude as patients began to regain independence

Two studies reported comments relating to this period.

- Archibald (2003)[8] with 5 participants reported motivation to be key factor in recovery. All comments in the study were positive about regaining independence during their rehabilitation.
- In Furstenberg (1986)[105] (11 participants) participants commented that although progress was slow they could see improvement. Participants also took encouragement from others' progress.

Management by health care professionals

Positive and negative comments were reported about healtcare professionals:

- Encouragement and positive attitude - Furstenberg (1986)[105] (11 participants) reported that healthcare professionals' cues, encouragement and feedback guided the informants' perceptions about their own progress. 40 out of the 62 participants in Young (2009)[358] identified that communication and a positive attitude by professionals were seen as a facilitator of recovery.
- Provision of information to patients - Two studies also noted some negative points, some patients "referred to the elusiveness of the doctors and their own unanswered questions." in Furstenberg (1986)[105]. The woman with a hip fracture in the individual patient narrative [274] was unhappy that things were not explained to her. One of her comments highlighted this where she reported that the "staff were so busy no one has time to sit and explain things to you".
- Explaining directly to patients - The patient from the individual narrative [274] was also unhappy that she could hear the nurse explaining the operation to her son, but nothing was explained to her.

13.2.3 Recommendations and link to evidence

Overall, little evidence was identified that provided direct comments relating to our review questions. Where applicable data were identified, reference to the evidence has been made in the link to evidence of the relevant recommendations. These related to:

- Several comments were identified that fed into our recommendation relating to the provision of information to patients (see next section 13.3).
- Some supplementary evidence was identified relating to pain that fed into our analgesia recommendations (see section 7.2.2).

13.3 Information for patients

This section covers structured health education approaches, advice, information and reassurance. In addition to qualitative literature the search conducted for patient views included terms relating to patient education interventions. This also aimed to identify randomised controlled trials investigating the effectiveness of different ways of providing information to patients with hip fracture in improving outcomes.

13.3.1 Evidence

No randomised evidence was identified. However, good quality advice, reassurance, information and education were highlighted by patients as important to the recovery process in the qualitative review presented above.

The evidence above suggests that

- The positive attitude of and encouragement by health professionals is important
- Patients value time spent with them, and the advice and explanation given. This seems important in the recovery process
- Patients should be treated with dignity, and provided with an explanation about their condition and information about recovery.

Two studies asked participants to suggest what advice they would offer other hip fracture patients based on their experiences. The main advice by participants in the studies to other patients with hip fracture was:

- Maintain a positive attittude
- Follow experts advice and participate as much as possible in the rehabilitation process
- Keep mobile

13.3.2 Recommendations and link to evidence

Recommendation	**Offer patients (or, as appropriate, their carer and/or family) verbal and printed information about treatment and care including:** • **diagnosis** • **choice of anaesthesia** • **choice of analgesia and other medications** • **surgical procedures** • **possible complications** • **postoperative care** • **rehabilitation programme** • **long-term outcomes** • **healthcare professionals involved.**
Relative values of different outcomes	Patient views on their satisfaction with the management of their condition were the main outcomes.
Trade off between clinical benefits and harms	The data highlighted examples where information was not provided to individual patients. Patients were unhappy when things were not explained to them. Patients were also unhappy when issues about their fracture were discussed with their family members instead of directly to them. The themes that came out of the evidence suggest that: a positive attitude of healthcare professionals is important; patients value time spent with them, and the advice and explanation given; and patients should be treated with dignity, and provided with an explanation about their condition and information about recovery. The GDG were unanimous in their view that discussion with patients (and where necessary their carers) about all aspects of the management of their hip fracture in is an important contributory factor in the recovery process.
Economic considerations	Although staff time is a scarce resource, information can be passed on to patients in the course of usual care and therefore needn't increased costs. Furthermore there may be benefits from greater adherence to treatment plans.
Quality of evidence	The qualitative evidence identified was of mixed quality. Data were not identified covering all the points mentioned above.
Other considerations	No comments were identified in the studies mentioning that adequate or good information was provided. However, the studies did not specifically ask about the quality of the information provided.

13.4 Carer involvment

In patients who have been discharged after hip fracture repair, what is the effectiveness of having a non paid carer (e.g. spouse, relative or friends) on mortality, length of stay, place of residence/discharge, functional status, hospital readmission and quality of life?

No published evidence was identified. The GDG recognised the often crucial and sometimes major contribution made by involved relatives and other non-professional carers to successful rehabilitation. Early discussion with carers of prognosis and discharge planning avoids misunderstanding of rehabilitation objectives, enables those involved to prepare in an informed and timely manner for a patient's return home, consequently averts inappropriate delay in discharge, and may reduce both length of stay and the likelihood of inappropriate readmission to hospital.

There is the potential for the delay of some decisions with this approach and it remains incumbent on clinicians with the agreement of patients (and/or any nominated proxy) to ensure that their best interests are correctly identified and not compromised, particularly (but not exclusively) in any urgent decision-making situation.

13.4.1 Clinical evidence

No relevant studies were identified.

13.4.2 Economic evidence

No relevant studies were identified.

13.5 Research recommendations

13.5.1 Quality of life

The GDG recommended the following research question:

- What quality of life value do individual patients and their carers place on different mobility, independence and residence states following rehabilitation?

Why this is important

It is important in evaluating future priorities for intervention to determine whether the perceived clinical and health economic benefits of rehabilitation outcomes in the research literature are matched over the same time-frame by the quality of life judgements, aspirations and expectations of patients themselves and their carers. There is currently no evidence.

13.5.2 Patient experience

The GDG recommended the following research question:

- What is the patient's experience of being admitted to hospital with a hip fracture in relation to surgery, pain management, timeliness of information given, and rehabilitation?

Why this is important

No studies from NHS populations were identified where patients commented specifically on their surgery, their pain management and rehabilitation programme. There were comments in the patient views studies about not being kept informed about the management of their condition, however, there was no information identified about the appropriate time to be told. It may be that different patients want the information at different times. The studies suggest that patients suffer from fear, pain and delirium until after surgery and it is important to learn what (if anything) can be done to alleviate this which for many will be considered the worst stage in their treatment.

Glossary

Abstract	Summary of a study, which may be published alone or as an introduction to a full scientific paper.
Algorithm (in guidelines)	A flow chart of the clinical decision pathway described in the guideline, where decision points are represented with boxes, linked with arrows.
Allocation concealment	The process used to prevent advance knowledge of group assignment in a RCT. The allocation process should be impervious to any influence by the individual making the allocation, by being administered by someone who is not responsible for recruiting participants.
AO classification	Classification system used to describe stable trochanteric fractures (type A1), unstable trochanteric (type A2), and transtrochanteric which includes those fracture lines at the level of the lesser trochanter and reversed fracture lines (type A3) [219].
Applicability	The degree to which the results of an observation, study or review are likely to hold true in a particular clinical practice setting.
Arm (of a clinical study)	Sub-section of individuals within a study who receive one particular intervention, for example placebo arm.
Association	Statistical relationship between two or more events, characteristics or other variables. The relationship may or may not be causal.

Baseline	The initial set of measurements at the beginning of a study (after run-in period where applicable), with which subsequent results are compared.
Before-and-after study	A study that investigates the effects of an intervention by measuring particular characteristics of a population both before and after taking the intervention, and assessing any change that occurs.
Bias	Systematic (as opposed to random) deviation of the results of a study from the 'true' results that is caused by the way the study is designed or conducted.
Blinding	Keeping the study participants, caregivers, researchers and outcome assessors unaware about the interventions to which the participants have been allocated in a study.
Carer (caregiver)	Someone other than a health professional who is involved in caring for a person with a medical condition.
Case-control study	Comparative observational study in which the investigator selects individuals who have experienced an event (For example, developed a disease) and others who have not (controls), and then collects data to determine previous exposure to a possible cause.
Case-series	Report of a number of cases of a given disease, usually covering the course of the disease and the response to treatment. There is no comparison (control) group of patients.
Clinical efficacy	The extent to which an intervention is active when studied under controlled research conditions.
Clinical effectiveness	The extent to which an intervention produces an overall health benefit in routine clinical practice.
Clinician	A healthcare professional providing direct patient care, for example doctor, nurse or physiotherapist.
Cochrane Review	The Cochrane Library consists of a regularly updated collection of evidence-based medicine databases including the Cochrane Database of Systematic Reviews (reviews of randomised controlled trials prepared by the Cochrane Collaboration).
Cohort study	A retrospective or prospective follow-up study. Groups of individuals to be followed up are defined on the basis of presence or absence of exposure to a suspected risk factor or intervention. A cohort study can be comparative, in which case two or more groups are selected on the basis of differences in their exposure to the agent of interest.
Comorbidity	Co-existence of more than one disease or an additional disease (other than that being studied or treated) in an individual.
Community hospital	A local hospital, unit or centre providing an appropriate range and format of accessible health care facilities and resources. These are typically small, and provide non-emergency services.

Comparability	Similarity of the groups in characteristics likely to affect the study results (such as health status or age).
Concordance	This is a recent term whose meaning has changed. It was initially applied to the consultation process in which doctor and patient agree therapeutic decisions that incorporate their respective views, but now includes patient support in medicine taking as well as prescribing communication. Concordance reflects social values but does not address medicine-taking and may not lead to improved adherence.
Confidence interval (CI)	A range of values for an unknown population parameter with a stated 'confidence' (conventionally 95%) that it contains the true value. The interval is calculated from sample data, and generally straddles the sample estimate. The 'confidence' value means that if the method used to calculate the interval is repeated many times, then that proportion of intervals will actually contain the true value.
Confounding	In a study, confounding occurs when the effect of an intervention on an outcome is distorted as a result of an association between the population or intervention or outcome and another factor (the 'confounding variable') that can influence the outcome independently of the intervention under study.
Consensus methods	Techniques that aim to reach an agreement on a particular issue. Consensus methods may used when there is a lack of strong evidence on a particular topic.
Control group	A group of patients recruited into a study that receives no treatment, a treatment of known effect, or a placebo (dummy treatment) - in order to provide a comparison for a group receiving an experimental treatment, such as a new drug.
Cost benefit analysis	A type of economic evaluation where both costs and benefits of healthcare treatment are measured in the same monetary units. If benefits exceed costs, the evaluation would recommend providing the treatment.
Cost-consequences analysis (CCA)	A type of economic evaluation where various health outcomes are reported in addition to cost for each intervention, but there is no overall measure of health gain.
Cost-effectiveness analysis (CEA)	An economic study design in which consequences of different interventions are measured using a single outcome, usually in 'natural' units (For example, life-years gained, deaths avoided, heart attacks avoided, cases detected). Alternative interventions are then compared in terms of cost per unit of effectiveness.
Cost-effectiveness model	An explicit mathematical framework, which is used to represent clinical decision problems and incorporate evidence from a variety of sources in order to estimate the costs and health outcomes.

Cost-utility analysis (CUA)	A form of cost-effectiveness analysis in which the units of effectiveness are quality-adjusted life-years (QALYs).
Credible Interval	The Bayesian equivalent of a confidence interval.
Lag screw cut-out	A complication in which the implant may protrude into the surrounding tissue or penetrate into the acetabulum. Symptoms include increasing pain and impaired mobility; and treatment depends on the severity of the symptoms as well as the fitness of the patient to undergo what may be major revision surgery. It may take the form of re-fixation of the fracture, replacement arthroplasty, or simple removal of the implant.
Decision analysis	An explicit quantitative approach to decision making under uncertainty, based on evidence from research. This evidence is translated into probabilities, and then into diagrams or decision trees which direct the clinician through a succession of possible scenarios, actions and outcomes.
Discounting	Costs and perhaps benefits incurred today have a higher value than costs and benefits occurring in the future. Discounting health benefits reflects individual preference for benefits to be experienced in the present rather than the future. Discounting costs reflects individual preference for costs to be experienced in the future rather than the present.
Dominance	An intervention is said to be dominated if there is an alternative intervention that is both less costly and more effective.
Drop-out	A participant who withdraws from a trial before the end.
Early Supported Discharge (ESD)	Patients are discharged home from the acute trauma ward, or in some cases a subsequent rehabilitation ward within the hospital, with a supported 4-6 week rehabilitation package.
Economic evaluation	Comparative analysis of alternative health strategies (interventions or programmes) in terms of both their costs and consequences.
Effect (as in effect measure, treatment effect, estimate of effect, effect size)	The observed association between interventions and outcomes or a statistic to summarise the strength of the observed association.
Effectiveness	See ‘Clinical effectiveness’.
Efficacy	See ‘Clinical efficacy’.
Epidemiological study	The study of a disease within a population, defining its incidence and prevalence and examining the roles of external influences (For example, infection, diet) and interventions.

EQ-5D (EuroQol-5D)	A standardise instrument used to measure a health outcome. It provides a single index value for health status.
Evidence	Information on which a decision or guidance is based. Evidence is obtained from a range of sources including randomised controlled trials, observational studies, expert opinion (of clinical professionals and/or patients).
Exclusion criteria (literature review)	Explicit standards used to decide which studies should be excluded from consideration as potential sources of evidence.
Exclusion criteria (clinical study)	Criteria that define who is not eligible to participate in a clinical study.
Extended dominance	If Option A is both more clinically effective than Option B and has a lower cost per unit of effect, when both are compared with a do-nothing alternative then Option A is said to have extended dominance over Option B. Option A is therefore more efficient and should be preferred, other things remaining equal.
Extramedullary implant	Implants used to fix extracapsular fractures. Examples of extramedullary implants include the sliding hip screw and the Medoff plate.
Extrapolation	In data analysis, predicting the value of a parameter outside the range of observed values.
Follow-up	Observation over a period of time of an individual, group or initially defined population whose appropriate characteristics have been assessed in order to observe changes in health status or health-related variables.
Generalisability	The extent to which the results of a study based on measurement in a particular patient population and/or a specific context hold true for another population and/or in a different context. In this instance, this is the degree to which the guideline recommendation is applicable across both geographical and contextual settings. For instance, guidelines that suggest substituting one form of labour for another should acknowledge that these costs might vary across the country.
Gold standard	See 'Reference standard'.
Geriatric Orthopaedic Rehabilitation Unit (GORU)	A separate geriatrician-led trauma ward. The extent of surgical input to the GORU varies, depending on how early patients are moved from the acute trauma wards.
GRADE / GRADE profile	A system developed by the GRADE Working Group to address the shortcomings of present grading systems in healthcare. The GRADE system uses a common, sensible and transparent approach to grading the quality of evidence. The results of applying the GRADE system to

clinical trial data are displayed in a table known as a GRADE profile.

Harms Adverse effects of an intervention.

Health economics The study of the allocation of scarce resources among alternative healthcare treatments. Health economists are concerned with both increasing the average level of health in the population and improving the distribution of health.

Health-related quality of life (HRQoL) A combination of an individual's physical, mental and social well-being; not merely the absence of disease.

Heterogeneity Or lack of homogeneity. The term is used in meta-analyses and systematic reviews when the results or estimates of effects of treatment from separate studies seem to be very different – in terms of the size of treatment effects or even to the extent that some indicate beneficial and others suggest adverse treatment effects. Such results may occur as a result of differences between studies in terms of the patient populations, outcome measures, definition of variables or duration of follow-up.

Hip fracture programme (HFP) Formal 'orthogeriatric' care - with the geriatric medical team contributing to joint preoperative patient assessment, and increasingly taking the lead in postoperative medical care, MDR and discharge planning.

Imprecision Results are imprecise when studies include relatively few patients and few events and thus have wide confidence intervals around the estimate of effect.

Inclusion criteria (literature review) Explicit criteria used to decide which studies should be considered as potential sources of evidence.

Incremental analysis The analysis of additional costs and additional clinical outcomes with different interventions.

Incremental cost The mean cost per patient associated with an intervention minus the mean cost per patient associated with a comparator intervention.

Incremental cost effectiveness ratio (ICER) The difference in the mean costs in the population of interest divided by the differences in the mean outcomes in the population of interest for one treatment compared with another.

$$ICER = \frac{(Cost_A - Cost_B)}{(Effectiveness_A - Effectiveness_B)}$$

Incremental net benefit (INB) The value (usually in monetary terms) of an intervention net of its cost compared with a comparator intervention. The INB can be calculated for a given cost-effectiveness (willingness to pay) threshold. If the threshold is £20,000 per QALY gained then the INB is calculated as: (£20,000 x QALYs gained) – Incremental cost.

Indirectness	The available evidence is different to the review question being addressed, in terms of PICO (population, intervention, comparison and outcome).
Intention to treat analysis (ITT)	A strategy for analysing data from a randomised controlled trial. All participants are included in the arm to which they were allocated, whether or not they received (or completed) the intervention given to that arm. Intention-to-treat analysis prevents bias caused by the loss of participants, which may disrupt the baseline equivalence established by randomisation and which may reflect non-adherence to the protocol.
Intermediate care	Care provided in community hospitals or residential care units as an intermediate step between hospital care and care in a person's own home
Intervention	Healthcare action intended to benefit the patient, for example, drug treatment, surgical procedure, psychological therapy.
Intraoperative	The period of time during a surgical procedure.
Intramedullary implant	Implants used to fix extracapsular fractures. Examples of intramedullary implants are the Gamma nail, the intramedullary hip screw and the proximal femoral nail.
Kappa statistic	A statistical measure of inter-rater agreement that takes into account the agreement occurring by chance.
Length of stay	The total number of days a participant stays in hospital.
Licence	See 'Product licence'.
Life-years gained	Mean average years of life gained per person as a result of the intervention compared with an alternative intervention.
Likelihood ratio	The likelihood ratio combines information about the sensitivity and specificity**.** It tells you how much a positive or negative result changes the likelihood that a patient would have the disease. The likelihood ratio of a positive test result (LR+) is sensitivity divided by 1- specificity.
Long-term care	Care in a home that may include skilled nursing care and help with everyday activities. This includes nursing homes and care homes.
Loss to follow-up	Also known as attrition. The loss of participants during the course of a study. Participants that are lost during the study are often call dropouts.
Markov model	A method for estimating long-term costs and effects for recurrent or chronic conditions, based on health states and the probability of transition between them within a given time period (cycle).

Meta-analysis

A statistical technique for combining (pooling) the results of a number of studies that address the same question and report on the same outcomes to produce a summary result. The aim is to derive more precise and clear information from a large data pool. It is generally more reliably likely to confirm or refute a hypothesis than the individual trials.

Mixed Assessment and Rehabilitation Unit (MARU)

A rehabilitation unit able to accept patients with a variety of medical, surgical and orthopaedic conditions.

Mobilisation

Mobilisation is the process of re-establishing the ability to move between postures (for example sit to stand), maintain an upright posture, and to ambulate with increasing levels of complexity (speed, changes of direction, dual and multi-tasking).

Multidisciplinary rehabilitation (MDR)

Rehabilitation after hip fracture incorporating the following core components of assessment and management: medicine; nursing; physiotherapy; occupational therapy; social care. Additional components may include: dietetics, pharmacy, clinical psychology.

Multivariate model

A statistical model for analysis of the relationship between two or more predictor (independent) variables and the outcome (dependent) variable.

Negative predictive value (NPV)

[In screening/diagnostic tests:] A measure of the usefulness of a screening/diagnostic test. It is the proportion of those with a negative test result who do not have the disease, and can be interpreted as the probability that a negative test result is correct. It is calculated as follows:

$$NPV = \frac{(\text{specificity})(1 - \text{prevalence})}{(\text{specificity})(1 - \text{prevalence}) + (1 - \text{sensitivity})(\text{prevalence})}$$

Non-union

The terms non-union, pseudarthrosis or delayed union are used for those fractures that fail to heal after a few months.

Number needed to treat (NNT)

The number of patients that who on average must be treated to prevent a single occurrence of the outcome of interest.

Observational study

Retrospective or prospective study in which the investigator observes the natural course of events with or without control groups; for example, cohort studies and case–control studies.

Odds ratio

A measure of treatment effectiveness. The odds of an event happening in the treatment group, expressed as a proportion of the odds of it happening in the control group. The 'odds' is the ratio of events to non-events.

Opportunity cost The loss of other health care programmes displaced by investment in or introduction of another intervention. This may be best measured by the health benefits that could have been achieved had the money been spent on the next best alternative healthcare intervention.

Orthogeriatrician A care of the elderly physician with an interest in fracture care.

Outcome Measure of the possible results that may stem from exposure to a preventive or therapeutic intervention. Outcome measures may be intermediate endpoints or they can be final endpoints. See 'Intermediate outcome'.

P-value The probability that an observed difference could have occurred by chance, assuming that there is in fact no underlying difference between the means of the observations. If the probability is less than 1 in 20, the P value is less than 0.05; a result with a P value of less than 0.05 is conventionally considered to be 'statistically significant'.

Perioperative The period from admission through surgery until discharge, encompassing the preoperative and postoperative periods.

Placebo An inactive and physically identical medication or procedure used as a comparator in controlled clinical trials.

Polypharmacy The use or prescription of multiple medications.

Positive predictive value (PPV) In screening/diagnostic tests: A measure of the usefulness of a screening/diagnostic test. It is the proportion of those with a positive test result who have the disease, and can be interpreted as the probability that a positive test result is correct. It is calculated as follows:

$$PPV = \frac{(\text{sensitivity})(\text{prevalence})}{(\text{sensitivity})(\text{prevalence}) + (1 - \text{specificity})(1 - \text{prevalence})}$$

Postoperative Pertaining to the period after patients leave the operating theatre, following surgery.

Post-test probability For diagnostic tests. The proportion of patients with that particular test result who have the target disorder (post test odds/[1 + post-test odds]).

Power (statistical) The ability to demonstrate an association when one exists. Power is related to sample size; the larger the sample size, the greater the power and the lower the risk that a possible association could be missed.

Preoperative The period before surgery commences.

Pre-test probability	For diagnostic tests. The proportion of people with the target disorder in the population at risk at a specific time point or time interval. Prevalence may depend on how a disorder is diagnosed.
Primary care	Healthcare delivered to patients outside hospitals. Primary care covers a range of services provided by general practitioners, nurses, dentists, pharmacists, opticians and other healthcare professionals.
Primary outcome	The outcome of greatest importance, usually the one in a study that the power calculation is based on.
Product licence	An authorisation from the MHRA to market a medicinal product.
Prognosis	A probable course or outcome of a disease. Prognostic factors are patient or disease characteristics that influence the course. Good prognosis is associated with low rate of undesirable outcomes; poor prognosis is associated with a high rate of undesirable outcomes.
Prospective study	A study in which people are entered into the research and then followed up over a period of time with future events recorded as they happen. This contrasts with studies that are *retrospective.*
Publication bias	Also known as reporting bias. A bias caused by only a subset of all the relevant data being available. The publication of research can depend on the nature and direction of the study results. Studies in which an intervention is not found to be effective are sometimes not published. Because of this, systematic reviews that fail to include unpublished studies may overestimate the true effect of an intervention. In addition, a published report might present a biased set of results (e.g. only outcomes or sub-groups where a statistically significant difference was found.
Quality of life	See 'Health-related quality of life'.
Quality-adjusted life year (QALY)	An index of survival that is adjusted to account for the patient's quality of life during this time. QALYs have the advantage of incorporating changes in both quantity (longevity/mortality) and quality (morbidity, psychological, functional, social and other factors) of life. Used to measure benefits in cost-utility analysis. The QALYs gained are the mean QALYs associated with one treatment minus the mean QALYs associated with an alternative treatment.
Quick Reference Guide	An abridged version of NICE guidance, which presents the key priorities for implementation and summarises the recommendations for the core clinical audience.
Randomisation	Allocation of participants in a research study to two or more alternative groups using a chance procedure, such as computer-generated random numbers. This approach is used in an attempt to ensure there is an even distribution of participants with different characteristics between groups and thus reduce sources of bias.

Randomised controlled trial (RCT)	A comparative study in which participants are randomly allocated to intervention and control groups and followed up to examine differences in outcomes between the groups.
Residential care unit	A unit or centre where care is given outside of the patient's home. Care can be 24 hour care or partial care depending on the person's needs.
RCT	See 'Randomised controlled trial'.
Receiver operated characteristic (ROC) curve	A graphical method of assessing the accuracy of a diagnostic test. Sensitivity Is plotted against 1-specificity. A perfect test will have a positive, vertical linear slope starting at the origin. A good test will be somewhere close to this ideal.
Reference standard	The test that is considered to be the best available method to establish the presence or absence of the outcome – this may not be the one that is routinely used in practice.
Relative risk (RR)	The number of times more likely or less likely an event is to happen in one group compared with another (calculated as the risk of the event in group A/the risk of the event in group B).
Reporting bias	See publication bias.
Resource implication	The likely impact in terms of finance, workforce or other NHS resources.
Retrospective study	A retrospective study deals with the present/ past and does not involve studying future events. This contrasts with studies that are *prospective.*
Review question	In guideline development, this term refers to the questions about treatment and care that are formulated to guide the development of evidence-based recommendations.
Secondary outcome	An outcome used to evaluate additional effects of the intervention deemed a priori as being less important than the primary outcomes.
Selection bias	A systematic bias in selecting participants for study groups, so that the groups have differences in prognosis and/or therapeutic sensitivities at baseline. Randomisation (with concealed allocation) of patients protects against this bias.
Sensitivity	Sensitivity or recall rate is the proportion of true positives which are correctly identified as such. For example in diagnostic testing it is the proportion of true cases that the test detects. See the related term 'Specificity'

Sensitivity analysis	A means of representing uncertainty in the results of economic evaluations. Uncertainty may arise from missing data, imprecise estimates or methodological controversy. Sensitivity analysis also allows for exploring the generalisability of results to other settings. The analysis is repeated using different assumptions to examine the effect on the results. One-way simple sensitivity analysis (univariate analysis): each parameter is varied individually in order to isolate the consequences of each parameter on the results of the study. Multi-way simple sensitivity analysis (scenario analysis): two or more parameters are varied at the same time and the overall effect on the results is evaluated. Threshold sensitivity analysis: the critical value of parameters above or below which the conclusions of the study will change are identified. Probabilistic sensitivity analysis: probability distributions are assigned to the uncertain parameters and are incorporated into evaluation models based on decision analytical techniques (For example, Monte Carlo simulation).
Significance (statistical)	A result is deemed statistically significant if the probability of the result occurring by chance is less than 1 in 20 ($p < 0.05$).
Specificity	The proportion of true negatives that a correctly identified as such. For example in diagnostic testing the specificity is the proportion of non-cases incorrectly diagnosed as cases. See related term 'Sensitivity'. In terms of literature searching a highly specific search is generally narrow and aimed at picking up the key papers in a field and avoiding a wide range of papers.
Stakeholder	Those with an interest in the use of the guideline. Stakeholders include manufacturers, sponsors, healthcare professionals, and patient and carer groups.
Subtrochanteric extracapsular fracture	Subtrochanteric fractures are those in which the fracture is predominantly in the 5cms of bone immediately distal to the lesser trochanter.
Superspell	Total time in NHS care.

Systematic review	Research that summarises the evidence on a clearly formulated question according to a pre-defined protocol using systematic and explicit methods to identify, select and appraise relevant studies, and to extract, collate and report their findings. It may or may not use statistical meta-analysis.
Time horizon	The time span over which costs and health outcomes are considered in a decision analysis or economic evaluation.
Treatment allocation	Assigning a participant to a particular arm of the trial.
Trochanteric extracapsular fracture	Extracapsular fractures occur outside or distal to the hip joint capsule and include basal, trochanteric and subtrochanteric fractures. Trochanteric fractures may be further subdivided into two part fractures, which are also termed stable fractures, and those that are comminuted or multi-fragmentary, which may be termed unstable fractures.
Univariate	Analysis which separately explores each variable in a data set.

The management of hip fracture in adults

Appendices A – J

Produced by the National Clinical Guideline Centre

Appendices

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Appendix A: Scope

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Hip fracture: the management of hip fracture in adults

13.6.1 Short title

Hip fracture

13.7 The remit

The Department of Health has asked NICE: ”to prepare a clinical guideline on the management of fractured neck of femur”.

13.8 Clinical need for the guideline

13.8.1 Epidemiology

a) About 70–75,000 hip fractures (proximal femoral fractures) occur annually in the UK. Hip fracture is the commonest reason for admission to an orthopaedic ward, and is usually a ‘fragility’ fracture [2] caused by a fall affecting an older person with osteoporosis or osteopaenia (a lesser degree of bone reduction and weakness due to the same process as in osteoporosis). The average age of a person with hip fracture is 77 years. The annual cost of medical and social

[2] The strict definition of a fragility fracture is one caused by a fall from standing height or less. For the purposes of this guidance, the definition will be slightly more flexible to encompass all hip fractures judged to have an osteoporotic or osteopaenic basis

care for all the hip fracture cases in the UK amounts to about £2 billion. Demographic projections indicate that the UK annual incidence will rise to 91,500 by 2015 and 101,000 in 2020, with an associated increase in annual expenditure that could reach £2.2 billion by 2020. The majority of this expenditure will be accounted for by hospital bed days and a further substantial contribution will come from health and social aftercare. About a quarter of patients with hip fracture are admitted from institutional care. About 10–20% of those admitted from home ultimately move to institutional care.

b) Mortality is high – about 10% of people with a hip fracture die within 1 month, and about one third within 12 months. However, fewer than half of deaths are attributable to the fracture. This reflects the high prevalence of comorbidity in people with hip fractures; often the combination of fall and fracture brings to light underlying ill health. This presents major challenges for anaesthetic, surgical, postoperative and rehabilitative care.

13.8.2 Current practice

a) The primary and secondary prevention of fragility fractures by treating osteoporosis and reducing the risk of falls are of key importance to the current and future epidemiology of hip fracture. These are, or will be, covered by related NICE guidance (see section 5).

b) The diagnosis and management of hip fracture itself and of any comorbidity before, during and after surgery, have a profound effect on outcome, both for individuals and for services.

c) Patients with hip fracture need immediate referral to hospital (other than in exceptional circumstances). Their assessment and management on admission commonly involve a range of specialties and disciplines, but it is not always clear how and when this involvement should take place. Prompt surgery is important but is sometimes delayed for administrative or clinical reasons. It is

essential that mobilisation and rehabilitation after surgery are undertaken according to individual need, but this does not always happen.

d) In spite of a significant body of evidence, hip fracture management and the resulting length of hospital stay vary markedly among centres across England and Wales.

e) Existing UK guidance from other sources includes:

- Scottish Intercollegiate Guidelines Network (2002) Prevention and management of hip fracture in older people. Available from www.sign.ac.uk/guidelines/fulltext/56/index.html
- British Orthopaedic Association (2007) The care of patients with fragility fracture. Available from www.nhfd.co.uk
- Department of Health (2001) National service framework for older people[3]. Available from www.dh.gov.uk

f) This clinical guideline will provide guidance on the emergency, preoperative, operative and postoperative management of hip fracture, including rehabilitation, in adults. It will not cover those aspects of hip fracture addressed by related NICE guidance, but will refer to them as appropriate.

g) At all stages of hip fracture management, and especially during rehabilitation, the importance of optimal communication with, and support for, patients themselves and those who provide or will provide care – including unpaid care family members or others – will be a fundamental tenet of guidance development.

[3] Elaborates on relevant (but not specific) standards of contextual importance (intermediate care, general hospital care and falls).

13.9 The guideline

The guideline development process is described in detail on the NICE website (see section 6, 'Further information').

This scope defines what the guideline will (and will not) examine, and what the guideline developers will consider. The scope is based on the referral from the Department of Health.

The areas that will be addressed by the guideline are described in the following sections.

13.9.1 Population

13.9.1.1 Groups that will be covered

a) Adults aged 18 years and older presenting to the health service with a clinical diagnosis (firm or provisional) of fragility fracture of the hip.

b) People with the following types of hip fracture:[4]

- intracapsular (undisplaced and displaced)
- extracapsular (trochanteric and subtrochanteric).

c) Those with comorbidity strongly predictive of outcome, and those without such comorbidity. The influence (if any) of advanced age or gender on clinical decision-making, management and outcome will be specifically evaluated.

13.9.1.2 Groups that will not be covered

People younger than 18 years.

People with fractures caused by specific pathologies other than osteoporosis or osteopaenia (because these would require more condition-specific guidance).

[4] These terms explain where the bone has fractured, which can be either near or within the hip joint.

13.9.2 Healthcare setting

a) Secondary care settings where preoperative, operative, and postoperative acute and subacute care are undertaken.

b) Primary, secondary and social care settings, as well as an individual's own home, where rehabilitation is undertaken.

13.9.3 Clinical management

13.9.3.1 Key clinical issues that will be covered

a) Using alternative radiological imaging to confirm or exclude a suspected hip fracture in patients with a normal X-ray.

b) Involving a physician or orthogeriatrician in the care of patients presenting with hip fracture.

c) Early surgery (within 48 hours).

d) Optimal preoperative and postoperative analgesia (pain relief), including the use of nerve blockade.

e) Regional (spinal – also known as 'epidural') versus general anaesthesia in patients undergoing surgery for hip fracture.

f) Does surgeon experience reduce the incidence of mortality, the need for repeat surgery, and poor outcome in terms of mobility?

g) For displaced intracapsular fracture:

- internal fixation versus arthroplasty (hip replacement surgery)
- total hip replacement versus hemiarthroplasty (replacing the head of the femur only) .

h) Choice of surgical implants - Sliding hip screw versus intramedullary nail for trochanteric extracapsular fracture.

i) Choice of surgical implants - Sliding hip screw versus intramedullary nail for subtrochanteric extracapsular fracture.

j) Cemented versus non-cemented arthroplasty implants.

k) Hospital-based multidisciplinary rehabilitation for patients who have undergone hip fracture surgery.

l) Early transfer to community-based multidisciplinary rehabilitation for patients who have undergone hip fracture surgery.

13.9.3.2 Clinical issues that will not be covered

The following will not be directly covered in this guideline, but related NICE guidance will be referred to if appropriate:

a) Primary and secondary prevention of fragility fracture.

b) Prevention and management of pressure sores.

c) Prophylaxis for venous thromboembolism.

d) Prevention and management of infection at the surgical site.

e) Nutritional support.

f) Selection of prostheses for hip replacement.

g) Complementary and alternative therapies.

13.9.4 Main outcomes

a) Requirement for surgical revision.

b) Short-term and long-term mortality.

c) Length of stay in secondary care.

d) Length of time before community resettlement/discharge.

e) Place of residence (compared with baseline) 12 months after fracture.

f) Short-, medium- and long-term functional status.

g) Short-, medium- and long-term quality of life.

13.9.5 Economic aspects

Developers will take into account both clinical and cost effectiveness when making recommendations involving a choice between alternative interventions. A review of the economic evidence will be conducted and analyses will be carried out as appropriate. The preferred unit of effectiveness is the quality-adjusted life year (QALY), and the costs considered will usually be only from an NHS and personal social services (PSS) perspective. Further detail on the methods can be found in 'The guidelines manual' (see 'Further information').

13.9.6 Status

13.9.6.1 Scope

This is the final scope.

13.9.6.2 Timing

The development of the guideline recommendations will begin in June 2010.

13.10 Related NICE guidance

13.10.1 Published

- Surgical site infection. NICE clinical guideline 74 (2008). Available from www.nice.org.uk/CG74
- Alendronate, etidronate, risedronate, raloxifene, strontium ranelate and teriparatide for the secondary prevention of osteoporotic fragility fractures in postmenopausal women. NICE technology appraisal guidance 161 (2008). Available from www.nice.org.uk/TA161
- Alendronate, etidronate, risedronate, raloxifene and strontium ranelate for the primary prevention of osteoporotic fragility fractures in postmenopausal women. NICE technology appraisal guidance 160 (2008). Available from www.nice.org.uk/TA160

- Venous thromboembolism. NICE clinical guideline 46 (2007). Available from www.nice.org.uk/CG46
- Delirium: diagnosis, prevention and management of delirium. NICE clinical guideline 103 (2010). Available from www.nice.org.uk/guidance/CG103
- Venous thromboembolism –prevention. NICE clinical guideline 92 (2010). Available from www.nice.org.uk/guidance/CG92Minimally invasive hip replacement. NICE interventional procedure guidance (2010). Available from www.nice.org.uk/guidance/IPG363
- Nutrition support in adults. NICE clinical guideline 32 (2006). www.nice.org.uk/CG32
- The management of pressure ulcers in primary and secondary care. NICE clinical guideline 29 (2005). Available from www.nice.org.uk/CG29
- Falls. NICE clinical guideline 21 (2004). Available from www.nice.org.uk/CG21
- Preoperative tests. NICE clinical guideline 3 (2003). Available from www.nice.org.uk/CG3
- The selection of prostheses for primary total hip replacement. NICE technology appraisal guidance 2 (2000). Available from www.nice.org.uk/TA2

13.10.2 Guidance under development

NICE is currently developing the following related guidance (details available from the NICE website).

- Osteoporosis. NICE clinical guideline. Publication date to be confirmed.

13.11 Further information

Information on the guideline development process is provided in:

- 'How NICE clinical guidelines are developed: an overview for stakeholders, the public and the NHS'
- 'The guidelines manual'.

These are available from the NICE website (www.nice.org.uk/guidelinesmanual). Information on the progress of the guideline will also be available from the NICE website (www.nice.org.uk).

14 Appendix B: Declarations of Interest

14.1 Introduction

All members of the GDG and all members of the NCGC staff were required to make formal declarations of interest at the outset of each meeting, and these were updated at every subsequent meeting throughout the development process. No interests were declared that required actions.

14.2 Declarations of interests of the GDG members

14.2.1 Professor Cameron Swift

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup meeting) (18th January 2010)	No interests to declare
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	Declared a non personal non pecuniary interest: has been invited to join the Department of Health Board on Fragility Fractures Programme
Twelfth GDG Meeting (29th July 2010)	No change
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.2.2 Professor Opinder Sahota

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	Did not attend
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	No interests to declare
Seventh GDG Meeting (9th March 2010)	Declared a non personal, non pecuniary interest regarding involvement in the Map of Medicine project with the Department of Health.
Eighth GDG Meeting (26th April 2010)	No change
Tenth GDG Meeting 11th June 2010)	Did not attend
Eleventh GDG Meeting (30th June 2010)	Declared a non personal non pecuniary interest: has been invited to join the Department of Health Board on Fragility Fractures Programme
Twelfth GDG Meeting (29th July 2010)	No change
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	Did not attend
Actions	None required

14.2.3 Dr Antony Johansen

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup Workshop) (18th January 2010)	No interests to declare
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	Did not attend
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	No interests to declare
Thirteenth GDG Meeting (8th September 2010)	No interests to declare
Fourteenth GDG Meeting (18th January 2011)	No interests to declare
Fifteenth GDC Meeting (24th March 2011)	No interests to declare
Actions	None required

14.2.4 Mr Tim Chesser

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	Performed consultancy work with orthopaedic manufacturer for unrelated orthopaedic implants (locking plates for particular fractures)- compliance and worded guidelines. His Department receives research support from orthopaedic manufacturers including DePuy, Smith and Nephew, Biomet and Stryker. Department have research fellows funded by orthopaedic manufacturer. Publishing RCT on surgical treatment for peri-articular fractures which was not funded by industry.
Second GDG Meeting (17th July 2009)	Did not attend
Third GDG Meeting (15th September 2009)	Performed consultancy work with orthopaedic manufacturer for unrelated orthopaedic implants (locking plates for particular fractures)- compliance and worded guidelines. His Department receives research support from orthopaedic manufacturers including DePuy, Smith and Nephew, Biomet and Stryker. Department have research fellows funded by orthopaedic manufacturer. Publishing RCT on surgical treatment for peri-articular fractures which was not funded by industry.
Fourth GDG Meeting (8th December 2009)	Travel and accommodation funded by the Orthopaedic Trauma Association in the US to present a poster on outcomes in Pelvic Fractures at an Experts in Pelvic Trauma meeting (sponsored by Stryker Trauma).
Fifth GDG Meeting (14th December 2009)	No change
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	Did not attend
Eighth GDG Meeting (26th April 2010)	No change
Tenth GDG Meeting (11th June 2010)	No change
Eleventh GDG Meeting (30th June 2010)	Did not attend meeting
Twelfth GDG Meeting (29th July 2010)	Declared a personal non pecuniary interest- invited to teach on a hip fracture surgical techniques course organised by Stryker who paid his travel expenses. No other payment was received.
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	Declared that he has a contract with an orthopaedic company (Stryker) to design reduction clamps, instrumentation and update for pelvic ring and acetabular fractures. He was also invited to be on the NHS Map of Medicine Commissioners' toolkit.
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.2.5 Mr Bob Handley

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	Non personal pecuniary interest: responsibility for – Synthes Fellows in the Trauma Department at the John Radcliffe hospital- 2 week fellowships usually 3-4 per year.
Second GDG Meeting (17th July 2009)	No change
Third GDG Meeting (15th September 2009)	No change
Fourth GDG Meeting (8th December 2009)	No change
Fifth GDG Meeting (14th December 2009)	No change
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	No change
Eighth GDG Meeting (26th April 2010)	No change
Tenth GDG Meeting (11th June 2010)	No change
Eleventh GDG Meeting (30th June 2010)	Did not attend meeting
Twelfth GDG Meeting (29th July 2010)	No change
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.2.6 Ms Karen Hertz

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	Miss Karen Hertz- funding for flights and accommodation by a Chinese university to attend a conference in Hong Kong.
Fifth GDG Meeting (14th December 2009)	No change
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	No change
Seventh GDG Meeting (9th March 2010)	KH declared a non personal, non pecuniary interest regarding involvement in the Map of Medicine project with the Department of Health.
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	Did not attend
Eleventh GDG Meeting (30th June 2010)	No change
Twelfth GDG Meeting (29th July 2010)	Declared a non personal non pecuniary interest: has been invited to join the Department of Health Board on Fragility Fractures Programme
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.2.7 Dr Richard Griffiths

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	Did not attend
Third GDG Meeting (15th September 2009)	Did not attend
Fourth GDG Meeting (8th December 2009)	Did not attend
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	Did not attend
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	Did not attend
Thirteenth GDG Meeting (8th September 2010)	Did not attend
Fourteenth GDG Meeting (18th January 2011)	Did not attend
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.2.8 Professor Sallie Lamb

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	Did not attend
Second GDG Meeting (17th July 2009)	Declared a non personal pecuniary interest: NIHR funded research grant. One trial is in the final stages of finding approval in primary care- using peripheral fracture (including hip fracture). The second- potential trial-ideas unclear as to whether they will be submitted. Vitamin D in Hip fracture; anaemia in hip fracture.
Third GDG Meeting (15th September 2009)	No change
Fourth GDG Meeting (8th December 2009)	No change
Fifth GDG Meeting (14th December 2009)	No change
Sixth GDG Meeting (Subgroup workshop) (28th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	Did not attend
Eighth GDG Meeting (26th April 2010)	No change
Tenth GDG Meeting (11th June 2010)	No change
Eleventh GDG Meeting (30th June 2010)	No change
Twelfth GDG Meeting (29th July 2010)	Did not attend
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	Did not attend
Fifteenth GDC Meeting (24th March 2011)	Did not attend
Actions	None required

14.2.9 Mrs Heather Towndrow

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	No interests to declare
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	No interests to declare
Thirteenth GDG Meeting (8th September 2010)	No interests to declare
Fourteenth GDG Meeting (18th January 2011)	Did not attend
Fifteenth GDC Meeting (24th March 2011)	Did not attend
Actions	None required

14.2.10 Dr Sally Hope

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	Did not attend
Second GDG Meeting (17th July 2009)	Declared a personal pecuniary interest- MSD paid for hotel in Manchester for NOS Conference (approx £200) in July 2009: in accordance with NOS policy to reduce costs for speakers.
Third GDG Meeting (15th September 2009)	Did not attend
Fourth GDG Meeting (8th December 2009)	No change
Fifth GDG Meeting (14th December 2009)	No change
Sixth GDG Meeting (Subgroup workshop) (28th January 2010)	Did not attend meeting
Seventh GDG Meeting (9th March 2010)	Declared a non personal, non pecuniary interest regarding involvement in the Map of Medicine project with the Department of Health.
Eighth GDG Meeting (26th April 2010)	Did not attend
Tenth GDG Meeting (11th June 2010)	No change
Eleventh GDG Meeting (30th June 2010)	Did not attend meeting
Twelfth GDG Meeting (29th July 2010)	No change
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	Did not attend
Actions	None required

14.2.11 Ms Tessa Somerville

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend meeting
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	No interests to declare
Thirteenth GDG Meeting (8th September 2010)	No interests to declare
Fourteenth GDG Meeting (18th January 2011)	No interests to declare
Fifteenth GDC Meeting (24th March 2011)	No interests to declare
Actions	None required

14.2.12 Mr Anthony Field

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	Did not attend
Fifth GDG Meeting (14th December 2009)	Did not attend
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	No interests to declare
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	No interests to declare
Thirteenth GDG Meeting (8th September 2010)	No interests to declare
Fourteenth GDG Meeting (18th January 2011)	No interests to declare
Fifteenth GDC Meeting (24th March 2011)	No interests to declare
Actions	None required

14.2.13 Mr Martin Wise

GDG meeting	*Declaration of Interests*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	No interests to declare
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	Did not attend
Seventh GDG Meeting (9th March 2010)	No interests to declare
Eighth GDG Meeting (26th April 2010)	Did not attend
Tenth GDG Meeting (11th June 2010)	No interests to declare
Eleventh GDG Meeting (30th June 2010)	No interests to declare
Twelfth GDG Meeting (29th July 2010)	No interests to declare
Thirteenth GDG Meeting (8th September 2010)	No interests to declare
Fourteenth GDG Meeting (18th January 2011)	No interests to declare
Fifteenth GDC Meeting (24th March 2011)	No interests to declare
Actions	None required

14.3 Declarations of interests of the NCGC members

GDG meeting	*Declaration of Interests of the NCGC members*
First GDG meeting (1st July 2009)	No interests to declare
Second GDG Meeting (17th July 2009)	No interests to declare
Third GDG Meeting (15th September 2009)	No interests to declare
Fourth GDG Meeting (8th December 2009)	No interests to declare
Fifth GDG Meeting (14th December 2009)	Antonia Morga declared her husband works for Novartis
Sixth GDG Meeting (Subgroup workshop) (18th January 2010)	No change
Seventh GDG Meeting (9th March 2010)	No change
Eighth GDG Meeting (26th April 2010)	No change
Tenth GDG Meeting (11th June 2010)	No change
Eleventh GDG Meeting (30th June 2010)	No change
Twelfth GDG Meeting (29th July 2010)	No change
Thirteenth GDG Meeting (8th September 2010)	No change
Fourteenth GDG Meeting (18th January 2011)	No change
Fifteenth GDC Meeting (24th March 2011)	No change
Actions	None required

14.4 Declarations of interests of the Expert Advisors

14.4.1 Mr Martin Parker

Mr Martin Parker only attended the first and second GDG meetings. He declared that he had received and may in the future receive money for advising implant manufacturing companies about their products and advising on implant design. He has produced research papers with different conclusions and publically presented the results. No actions were required as the first two meetings were introductory and did not involve any discussions about the evidence or formulating recommendations.

14.4.2 Mrs Pamela Holmes

Mrs Pamela Holmes had no interests to declare and did not attend any GDG meetings

14.4.3 Professor Judith Adams

Professor Judith Adams only attended the twelfth GDG meeting on July 29th 2010 and did not have any interests to declare.

15 Appendix C: Review protocols

15.1 Review protocol – Imaging in occult hip fracture

Component	Description
Review question	In patients with a continuing clinical suspicion of hip fracture, despite negative radiographic findings, what is the clinical and cost-effectiveness of additional imaging (radiography after at least 48 hours), Radionuclide scanning (RNS), ultrasound (US) and cpmputed tomography (CT), compared to magnetic resonance imaging (MRI), in confirming, or excluding, a hip fracture?

Objectives	To identify an alternative method of diagnosis of occult hip fractures when MRI is not available.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	▪ Computed tomography ▪ Radionuclide scanning (also known as isotope scanning or scintigraphy).
Comparison	▪ Magnetic resonance imaging
Outcomes	▪ Sensitivity ▪ Specificity ▪ Positive and negative predictive values ▪ Positive and negative likelihood ratios
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin
The review strategy	Meta-analysis will not be conducted for diagnostic studies. Ranges of results will be reported. If there is heterogeneity the following subgroups will be analysed separately: ▪ Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them) ▪ Concurrent medication ▪ Age ▪ Gender ▪ Cognitive impairment ▪ *Palliative care patients*

15.2 Review protocol – Timing of surgery

Component	Description
Review question	In patients with hip fractures what is the clinical and cost effectiveness of early surgery (within 24, 36 or 48 hours) on the incidence of complications such as mortality, pneumonia, pressure sores, cognitive dysfunction and increased length of hospital stay?
Objectives	To investigate whether early surgery improves patient outcomes.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Early surgery (within the cut off of 24, 36 and 48 hours of admission to hospital)
Comparison	Late surgery (after the cut off of 24, 36 and 48 hours of admission)
Outcomes	Mortality (30 days, 3 months, 1 year) Length of stay in secondary care Length of time before community resettlement/discharge. Place of residence (compared with baseline) 12 months after fracture. Functional status (30 days, 3 months, 1 year) Quality of life (30 days, 3 months, 1 year) Complications (including pressure ulcers)
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found well conducted cohort studies and observational studies may also be considered. In particular, cohort studies using logistic regression to adjust for confounders such as comorbidity and age, which is a particular bias in this area. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin
The review strategy	Meta-analyses will be conducted where possible. If there is heterogeneity the following subgroups will be analysed separately: ▪ Reason for delay to surgery (administrative or medical reasons) ▪ Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them) ▪ Concurrent medication ▪ Age

- Gender
- Cognitive impairment

15.3 Review protocol – Analgesia- systemic medications

Component	Description
Review question	In patients who have or are suspected of having a hip fracture, what is the comparative effectiveness and cost effectiveness of systemic analgesics in providing adequate pain relief and reducing side effects and mortality?
Objectives	To identify the most effective systemic analgesia medication for pain relief in hip fracture patients
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Systemic: ▪ Opioids e.g o Buprenorphine o Codeine o Dihydrocodeine o Hydromorphone o Morphine o Oxycodone o Papaveretum (no, has been withdrawn) o Pentazocine o Pethidine (?) causes delirium in elderly o Tramadol (potent cause of delirium in elderly) ▪ Non Opioid e.g. o Paracetamol, iv, PR, oral o Non steroidal anti inflammatory (NSAIDs)
Comparison	Systemic: ▪ Opioids e.g o Buprenorphine o Codeine o Dihydrocodeine o Hydromorphone o Morphine o Oxycodone o Papaveretum (no, has been withdrawn) o Pentazocine o Pethidine (?) causes delirium in elderly o Tramadol (potent cause of delirium in elderly) ▪ Non Opioid e.g.

- Paracetamol, iv, PR, oral
- Non steroidal anti inflammatory (NSAIDs)

Outcomes

- Pain (generally measured by visual analogue scale or verbal rating)
- Need for 'breakthrough' analgesia
- Mortality
- Adverse effects
  - Paracetamol
    - Virtually none but may decrease blood pressure with iv
  - Opioids
    - Itching/histamine release,
    - PONV,
    - respiratory depression,
    - decrease in blood pressure,
    - delerium

Search strategy

The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED.

Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered.

Studies will be restricted to English language only

No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Comorbidities strongly predictive of outcome
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Type of fracture
- Type of surgery
  - THR vs. hemiarthroplasty
  - THR vs. internal fixation

15.4 Review protocol – Analgesia- Nerve blocks comapared to systemic analgesics

Component	Description
Review question	In patients who have or are suspected of having a hip fracture, what is the clinical and cost effectiveness of nerve blocks compared to systemic analgesia in providing adequate pain relief and reducing side effects and mortality?
Objectives	To identify an optimal analgesia protocol including the use of nerve blocks which may help reduce usage of systemic analgesics with strong side effects in this patient group.
Population	Patients over 18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Nerve blocks (any type: lateral cutaneous, femoral, triple, psoas, 3-in-1 [includes femoral, obturator, lateral femoral cutaneous nerves], fascia iliaca, with ultrasound guidance for localisation)

Comparison	Pharmacological (systemic):
	▪ Opioids e.g
	  ○ Buprenorphine
	  ○ Codeine
	  ○ Dihydrocodeine
	  ○ Hydromorphone
	  ○ Morphine
	  ○ Oxycodone
	  ○ Papaveretum (no, has been withdrawn)
	  ○ Pentazocine
	  ○ Pethidine (?) causes delirium in elderly
	  ○ Tramadol (potent cause of delirium in elderly)
	▪ Non Opioid e.g.
	  ○ Paracetamol, iv, PR, oral
	▪ NSAIDs
	  ○ upper gastrointestinal bleeding
	  ○ renal, hepatic and cardiovascular side effects

Outcomes	▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Need for 'breakthrough' analgesia ▪ Mortality

- Adverse effects
  - Nerve Block:
    - Nerve damage
    - Pressure necrosis following motor block
    - Postoperative nausea and vomiting (PONV)
  - Paracetamol
    - Virtually none but may decrease blood pressure with iv
  - Opioids
    - Itching/histamine release,
    - PONV,
    - respiratory depression,
    - decrease in blood pressure,
    - delirium
  - NSAIDs
    - upper gastrointestinal bleeding
    - renal, hepatic and cardiovascular side effects

Search strategy

The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED.

Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered.

Studies will be restricted to English language only

No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Comorbidities strongly predictive of outcome
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Type of fracture
- Type of surgery
  - THR vs. hemiarthroplasty
  - THR vs. internal fixation

15.5 Review protocol - Anaesthesia

Component	Description
Review question	In patients undergoing surgical repair for hip fractures, what is the clinical and cost effectiveness of regional (spinal/epidural) anaesthesia compared to general anaesthesia in reducing complications such as mortality, cognitive dysfunction thromboembolic events, postoperative respiratory morbidity, renal failure and length of stay in hospital?
Objectives	To identify whether regional anaesthesia confers any benefit compared to general anaesthesia with regards to reducing complications and improving patient outcomes after surgery.
Population	Patients over 18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	General anaesthesia for different types of surgery
Comparison	• Regional anaesthesia for the same type of surgery ▪ Spinal/epidural without nerve block ▪ Spinal/epidural with nerve block
Outcomes	▪ Patient preference ▪ Mortality at 30 days ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Adverse effects o General: ▪ postoperative lung complications ▪ Pulmonary emboli ▪ Pneumonia ▪ Myocardial infarction ▪ Renal failure ▪ Postoperative nausea and vomiting (PONV) o Regional ▪ Neural damage ▪ Spinal haematoma

Search strategy

The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED.

Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered.

Studies will be restricted to English language only

No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately (where possible):

- Comorbidities strongly predictive of outcome
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Type of surgery
    - THR vs. hemiarthroplasty
    - THR vs. internal fixation
- Duration of anaesthesia

15.6 Review protocol – surgeon seniority

Component	Description
Review question	Does surgeon seniority (consultant or equivalent) reduce the incidence of mortality, operative revision and poor functional outcome?
Objectives	To investigate whether senior surgeons lead to better outcomes for hip fracture patients
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	▪ Consultant grade or equivalent
Comparison	▪ Below consultant grade or equivalent ▪ Trainee
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Reoperation rate ▪ Dislocations ▪ Wound infection
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library and CINAHL. Randomised controlled trials (RCTs) will be considered. If no RCTs are found well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin
The review strategy	Meta-analyses will be conducted where possible. If there is heterogeneity the following subgroups will be analysed separately: ▪ Age

15.7 Review protocol – Cement

Component	Description
Review question	In hip fracture patients undergoing total hip replacement what is the clinical and cost effectiveness of cemented total hip replacement versus uncemented total hip replacement on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?
Objectives	To examine the effectiveness of cement when inserting arthroplasty for surgical repair
Population	Patients >18 years old with a hip fracture undergoing surgical repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Cemented arthroplasty
Comparison	Uncemented arthroplasty
Outcomes	▪ Perioperative mortality ▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture ▪ Wound healing complications
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin All questions relating to surgical repair for hip fractures will be searched together.
The review strategy	Meta-analyses will be conducted where possible. Studies will be restricted to English language articles If there is heterogeneity the following subgroups will be analysed

separately:

- Comorbidities
- Age
- Ideally “younger and fitter” patients compared to the “older and frailer” patients. Could be a combination of age and comorbidities
- Type of arthroplasty

15.8 Review protocol – Intracapsular fractures

Component	Description
Review question	In patients undergoing repair for intracapsular hip fractures what is the clinical and cost effectiveness of internal fixation compared to hemiarthroplasty compared to total hip replacement on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?
Objectives	To examine the effectiveness of the 3 different techniques for fixing displaced intracapsular fractures
Population	Patients >18 years old with a hip fracture undergoing surgical repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	• Internal fixation • Hemiarthroplasty • Total hip replacement
Comparison	All of the above are compared to each other.
Outcomes	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin All questions relating to surgical repair for hip fractures will be searched together.

The review strategy

Meta-analyses will be conducted where possible.

Studies will be restricted to English language articles

If there is heterogeneity the following subgroups will be analysed separately:

- Ideally “younger and fitter” patients compared to the “older and frailer” patients. Could be a combination of age and comorbidities
- Type of internal fixation or arthroplasty
- Use of cement in arthroplasty

15.9 Review protocol – surgical approach

Component	Description
Review question	In patients having surgical treatment for intracapsular hip fracture with hemiarthroplasty what is the clinical and cost effectiveness of anterolateral compared to posterior surgical approach on mortality, number of reoperations, dislocation, functional status, length of hospital stay, quality of life and pain?
Objectives	To investigate whether one surgical approach is better than the other when inserting a hemiarthroplasty.
Population	Patients >18 years old with a hip fracture undergoing replacement arthroplasty with a hemiarthroplasty People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	▪ Anterolateral approach
Comparison	▪ Posterior approach
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of hospital stay ▪ Reoperation rate ▪ Dislocations ▪ Functional status ▪ Quality of life ▪ Pain
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library and CINAHL. Randomised controlled trials (RCTs) and well conducted cohort studies and observational studies that adjust for confounders will be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Type of procedure

15.10 Review protocol – Hemiarthroplasty stem design

Component	Description
Review question	In patients undergoing surgery for hip fracture what is the clinical and cost effectiveness of 'OEDP 10A rating' designs of stems in preference to Austin Moore or Thompson stems when inserting a hemiarthroplasty on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?
Objectives	To examine the effectiveness of modern design stems ('OEDP 10A rating') compared to Austin Moore or Thompson stems.
Population	Patients >18 years old with a hip fracture undergoing hemiarthroplasty People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Hemiarthroplasty with a modern design stem ('OEDP 10A rating')
Comparison	Hemiarthroplasty with an Austin Moore or Thompson
Outcomes	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Place of residence 12 months after fracture
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin All questions relating to surgical repair for hip fractures will be searched together.

The review strategy

Meta-analyses will be conducted where possible.

Studies will be restricted to English language articles

If there is heterogeneity the following subgroups will be analysed separately:

- Ideally “younger and fitter” patients compared to the “older and frailer” patients. Could be a combination of age and comorbidities

15.11 Review protocol – extracapsular fractures

Component	Description
Review question	In patients undergoing repair for trochanteric extracapsular hip fractures what is the clinical and cost effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture? In patients undergoing repair for subtrochanteric extracapsular hip fractures, what is the effectiveness of extramedullary sliding hip screws compared to intramedullary nails on mortality, surgical revision, functional status, length of stay, quality of life, pain and place of residence after hip fracture?
Objectives	To examine the effectiveness of extramedullary implants, including sliding hip screws, compared to intramedullary implants, including nails, in fixing trochanteric and subtrochanteric fractures.
Population	Patients >18 years old with a extracapsular hip fracture undergoing surgical repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Extramedullary sliding hip screws
Comparison	Intramedullary nails
Outcomes	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Requirement for reoperation (operative or postoperative fracture of the femur, cut-out and non-union) ▪ Length of stay in hospital/acute care ▪ Length of stay in to community or resettlement (i.e. superspell) ▪ Wound healing complications
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin

All questions relating to surgical repair for hip fractures will be searched together.

The review strategy

Meta-analyses will be conducted where possible.

Studies will be restricted to English language articles

If there is heterogeneity the following subgroups will be analysed separately:

- Stability of fracture
- Comorbidities
- Age
- Previous fracture or surgery to femur

15.12 Review protocol – Mobilisation strategies

Component	Description
Review question	In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of early mobilisation (<48 hours after surgery) compared to late mobilisation on functional status, mortality, place of residence/discharge, pain and quality of life?
Objectives	To examine the effectiveness of early mobilisation on functional outcomes compared to delayed mobilisation
Population	Patients >18 years old that have had surgery for a hip fracture. People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Mobilisation (physiotherapy) within 48 hours of surgery.
Comparison	Mobilisation (physiotherapy) after 48 hours of surgery.
Outcomes	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Discharge destination
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin All questions relating to surgical repair for hip fractures will be searched together.
The review strategy	Meta-analyses will be conducted where possible. Studies will be restricted to English language articles If there is heterogeneity the following subgroups will be analysed separately: ▪ Comorbidities ▪ Age ▪ Previous fracture or surgery to femur

Component	Description
Review question	In patients who have undergone surgery for hip fracture, what is the clinical and cost effectiveness of intensive physiotherapy compared to non intensive physiotherapy on functional status, mortality, place of residence/discharge, pain and quality of life?
Objectives	To examine the effectiveness of intensity of mobilisation on functional outcomes.
Population	Patients >18 years old that have had surgery for a hip fracture. People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Intensive physiotherapy, defined by an increased number of sessions or an increase in intensity (strength) of exercise.
Comparison	Fewer sessions of physiotherapy or usual care ad defined by the paper.
Outcomes	▪ Mortality at 30 days, 3 months & 1 year or longer ▪ Functional status up to 1 year ▪ Pain (generally measured by visual analogue scale or verbal rating) ▪ Quality of life ▪ Discharge destination ▪ Mobility
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. No date restriction will be applied. Databases will be searched from their date of origin All questions relating to surgical repair for hip fractures will be searched together.
The review strategy	Meta-analyses will be conducted where possible. Studies will be restricted to English language articles If there is heterogeneity the following subgroups will be analysed separately: ▪ Type or component of exercise programme ▪ Comorbidities ▪ Age ▪ Previous fracture or surgery to femur

15.13 Review protocol – Multidisciplinary rehabilitation

Component	Description
Review question	In patients with hip fracture what is the clinical and cost effectiveness of 'orthogeriatrician' involvement in the whole pathway of assessment, peri-operative care and rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?
Objectives	To identify the benefit of an orthogeriatrician involved early in the care pathway to patient outcomes.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Involvement of an orthogeriatrician/physician throughout patient care, starting from admission
Comparison	No involvement of an orthogeriatrician/physician throughout the care pathway (e.g. only present in rehabilitation).
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge. ▪ Place of residence (compared with baseline) 12 months after fracture. ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them)
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Palliative care patients
- Patients from nursing homes

Component	Description
Review question	In patients with hip fracture what is the clinical and cost effectiveness of hospital-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?
Objectives	To identify the effectiveness of hospital-based multidisciplinary rehabilitation compared to usual care.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Multidisciplinary hospital-based rehabilitation. Multidisciplinary rehabilitation after hip fracture will be assumed if the following core components are present: medicine; nursing; physiotherapy; occupational therapy; social care. Additional components may include: nutrition, pharmacy, clinical psychology. Additional criteria include formal arrangements for co-ordination/teamwork and regular on-going multidisciplinary assessment. Types of multidisciplinary hospital-based rehabilitation include Geriatric orthopaedic rehabilitation unit (GORU); mixed assessment and rehabilitation unit (MARU); geriatric hip fracture programme (GHFP).
Comparison	Usual hospital-based care (not multidisciplinary)
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge. ▪ Place of residence (compared with baseline) 12 months after fracture. ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Type of hospital-based MDR
- Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them)
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Palliative care patients
- Patients from nursing homes

Component	Description
Review question	In patients with hip fracture what is the clinical and cost effectiveness of community-based multidisciplinary rehabilitation on functional status, length of stay in secondary care, mortality, place of residence/discharge, hospital readmission and quality of life?
Objectives	To compare community-based programmes with each other and usual care.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Community-based multidisciplinary rehabilitation, including intermediate care unit-based, home-based (early supported discharge) and social care unit-based. Any programme starting more than 1 week postoperatively will be excluded.
Comparison	Usual hospital-based care (not multidisciplinary)
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge. ▪ Place of residence (compared with baseline) 12 months after fracture. ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin

The review strategy

Meta-analyses will be conducted where possible.

If there is heterogeneity the following subgroups will be analysed separately:

- Type of community rehabilitation programme
- Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them)
- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Palliative care patients
- Patients from nursing homes

15.14 Review protocol – Carer involvement

Component	Description
Review question	In patients who have been discharged after hip fracture repair, what is the clinical and cost effectiveness of having a non paid carer (e.g. spouse, relative, friends) on mortality, length of stay, place of residence/discharge, functional status, hospital readmission and quality of life?
Objectives	To compare the effectiveness of hospital-based multidisciplinary rehabilitation with involvement of a carer versus without a carer.
Population	Patients >18 years old with a hip fracture undergoing different types of surgery for hip fracture repair People with fractures caused by specific pathologies other than osteoporosis or osteopaenia, and patients under 18 years old are excluded from the scope.
Intervention	Hospital-based multidisciplinary rehabilitation with involvement of a non paid carer (e.g. spouse, relative, friends).
Comparison	Hospital-based multidisciplinary rehabilitation without involvement of a non paid carer (e.g. spouse, relative, friends).
Outcomes	▪ Mortality (30 days, 3 months, 1 year) ▪ Length of stay in secondary care ▪ Length of time before community resettlement/discharge. ▪ Place of residence (compared with baseline) 12 months after fracture. ▪ Functional status (30 days, 3 months, 1 year) ▪ Hospital readmission ▪ Quality of life (30 days, 3 months, 1 year)
Search strategy	The databases to be searched are Medline, Embase, The Cochrane Library, CINAHL and AMED. Randomised controlled trials (RCTs) will be considered. If no RCTs are found for certain outcomes such as adverse events, well conducted cohort studies and observational studies may also be considered. Studies will be restricted to English language only No date restriction will be applied. Databases will be searched from their date of origin
The review strategy	Meta-analyses will be conducted where possible. If there is heterogeneity the following subgroups will be analysed separately: ▪ Comorbidities strongly predictive of outcome (as mentioned in the scope but will need the GDG to list them)

- Concurrent medication
- Age
- Gender
- Cognitive impairment
- Palliative care patients
- Patients from nursing homes

15.15 Review protocol – Health Economics

Objectives

The aim is to identify economic studies relevant to the review questions set out above.

Criteria

Populations, interventions and comparators as specified in the review protocols above. Must be a relevant economic study design (cost-utility analysis, cost-benefit analysis, cost-effectiveness analysis, cost-consequence analysis, comparative cost analysis).

Search strategy

See Appendix D, section 4.2

The review strategy

Each study is assessed using the NICE economic evaluation checklist – NICE (2009) Guidelines Manual, Appendix H.

Inclusion/exclusion criteria

- If a study is rated as both 'Directly applicable' and 'Minor limitations' (using the NICE economic evaluation checklist) then it should be *included* in the guideline. An evidence table should be completed and it should be included in the economic profile.
- If a study is rated as either 'Not applicable' or 'Very serious limitations' then it should be *excluded* from the guideline. It should not be included in the economic profile and there is no need to include an evidence table.
- If a study is rated as 'Partially applicable' and/or 'Potentially serious limitations' then there is *discretion* over whether it should be included. The health economist should make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the GDG if required. The ultimate aim being to include studies that are helpful for decision making in the context of the guideline. Where exclusions occur on this basis, this should be noted in the relevant section of the guideline with references.

Also exclude:

- unpublished reports unless submitted as part of the call for evidence
- abstract-only studies
- letters

- editorials
- reviews of economic evaluations[5]
- foreign language articles

Where there is discretion

The health economist should be guided by the following hierarchies.

Setting:

1. UK NHS
2. OECD countries with predominantly public health insurance systems (e.g. France, Germany, Sweden)
3. OECD countries with predominantly private health insurance systems (e.g. USA, Switzerland)
4. Non-OECD settings (always 'Not applicable')

Economic study type:

1. Cost-utility analysis
2. Other type of full economic evaluation (cost-benefit analysis, cost-effectiveness analysis, Cost-consequence analysis)
3. Comparative cost analysis
4. Non-comparative cost analyses including cost of illness studies (always 'Not applicable')

Year of analysis:

- The more recent the study, the more applicable it is

Quality of effectiveness data used in the economic analysis:

- The more closely the effectiveness data used in the economic analysis matches with the studies included for the clinical review the more useful the analysis will be to decision making for the guideline.

[5] Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.

16 Appendix D: Literature search strategies

16.1 Search Strategies

Searches were constructed by using the following groups of terms. These groups are expanded in full in Section 1.2 below.

All searches were run in Medline, Embase and the Cochrane Library. Additionally CINAHL and PsychINFO were searched where this was deemed appropriate. Economic searches were conducted in Medline, Embase, NHS EED and the HTA (Health Technology Reports) database from the Cochrane Library.

Anaesthesia search

Hip fracture terms
AND
Anaesthesia terms
AND
RCT filter or systematic review filter
NOT
Animal/publication filter

Analgesia search

Hip fracture terms
AND
Analgesia terms
AND
RCT filter or systematic review filter
NOT
Animal/publication filter

Carer involvement search

Hip fracture terms
AND
Carer involvement terms
NOT
Animal/publication filter

Early surgery search

Hip fracture terms
AND
Early surgery terms
NOT
Animal/publication filter

Economic searches (Medline and Embase)

Hip fracture terms
AND
Economic filter
NOT
Animal/publication filter

Economic searches (NHS EED and HTA)

Hip fracture terms

Orthogeriatrician search

Hip fracture terms
AND
Orthogeriatrician terms
NOT
Animal/publication filter

Patient education search

Hip fracture terms
AND
Patient education terms
NOT
Animal/publication filter

Patient views search

Hip fracture terms
AND
Patient view terms
NOT
Animal/publication filter

Radiological imaging search

Hip fracture terms
AND
Radiological imaging terms
AND
RCT filter or systematic review filter or diagnostic filter
NOT
Animal/publication filter

Rehabilitation search

Hip fracture terms
AND
Rehabilitation terms
NOT
Animal/publication filter

Surgeon seniority search

Hip fracture terms
AND
Surgeon seniority terms
NOT
Animal/publication filter

Surgical interventions search

Hip fracture terms
AND
Surgical intervention terms
AND
RCT filter or systematic review filter
NOT
Animal/publication filter

16.2 Search terms

Anaesthesia

Anaesthesia terms – Cochrane Library

1	MeSH descriptor Anesthesia explode all trees
2	((an?esthet* or an?esthesia) NEAR/4 (regional* or local* or general or spinal or epidural)):ti,ab,kw
3	#1 OR #2

Anaesthesia terms - OVID Embase

1 exp Anesthesia/
2 ((an?esthet$ or an?esthesia) adj4 (regional$ or local$ or general or spinal or epidural)).ti,ab.
3 1 or 2

Anaesthesia terms - OVID Medline

1 exp Anesthesia/
2 ((an?esthet$ or an?esthesia) adj4 (regional$ or local$ or general or spinal or epidural)).ti,ab.
3 1 or 2

Analgesia

Analgesia terms – Cochrane Library

1 MeSH descriptor Analgesia explode all trees
2 MeSH descriptor Analgesics explode all trees
3 MeSH descriptor Nerve Block explode all trees
4 (analg$ or (pain* NEAR/3 relie*) or ((nerve* or neural*) NEAR/3 block*)):ti,ab,kw
5 (opioid* or opiate*):ti,ab,kw
6 (paracetamol or propacetamol or acetaminophen or co-codamol):ti,ab,kw
7 (morphine or buprenorphine or codeine or diphenoxylate or dipipanone or diamorphine or dihydrocodeine or alfentanil or fentanyl or remifentanil or meptazinol or methadone or oxycodone or papaveretum or pentazocine or pethidine or tramadol):ti,ab,kw
8 MeSH descriptor Opiate Alkaloids explode all trees
9 MeSH descriptor Acetaminophen explode all trees
10 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9

Analgesia terms - OVID Embase

1 exp analgesia/
2 exp Nerve Block/
3 (analg$ or (pain$ adj3 relie$) or ((nerve$ or neural$) adj3 block$)).ti,ab.
4 exp analgesic agent/
5 (morphine or buprenorphine or codeine or diphenoxylate or dipipanone or diamorphine or dihydrocodeine or alfentanil or fentanyl or remifentanil or meptazinol or methadone or oxycodone or papaveretum or pentazocine or pethidine or tramadol).ti,ab.
6 (paracetamol or propacetamol or acetaminophen or co-codamol).ti,ab.
7 (opioid$ or opiate$).ti,ab.
8 or/1-7

Analgesia terms - OVID Medline

1 exp Analgesia/
2 exp Nerve Block/
3 exp Analgesics/
4 (analg$ or (pain$ adj3 relie$) or ((nerve$ or neural$) adj3 block$)).ti,ab.
5 (opioid$ or opiate$).ti,ab.

6	(paracetamol or propacetamol or acetaminophen or co-codamol).ti,ab.
7	(morphine or buprenorphine or codeine or diphenoxylate or dipipanone or diamorphine or dihydrocodeine or alfentanil or fentanyl or remifentanil or meptazinol or methadone or oxycodone or papaveretum or pentazocine or pethidine or tramadol).ti,ab.
8	exp Opiate Alkaloids/
9	acetaminophen/
10	or/1-9

Animal/publication filter

Animal/publication filter - OVID Embase

1	Case-Study/ or Abstract-Report/ or Letter/ or (case adj report).tw.
2	(exp Animal/ or Nonhuman/ or exp Animal-Experiment/) not exp Human/
3	or/1-2

Animal/publication filter - OVID Medline

1	((Case-Reports not Randomized-Controlled-Trial) or Letter or Historical-Article or Review-Of-Reported-Cases).pt.
2	exp Animal/ not Human/
3	or/1-2

Carer involvement

Carer involvement terms – Cochrane Library

1	MeSH descriptor Family explode all trees
2	MeSH descriptor Caregivers, this term only
3	MeSH descriptor Friends, this term only
4	MeSH descriptor Voluntary Workers, this term only
5	(carer* or caregiver* or care giver* or ((care* or caring) NEAR/5 (child* or parent* or husband* or wife* or wives or relative* or relation* or spous* or partner* or offspring or son* or daughter* or famil* or brother* or sister* or sib* or friend* or volunteer*))):ti,ab,kw
6	#1 or #2 or #3 or #4 or #5

Carer involvement terms – EBSCO CINAHL

1	mh Family+ or mh caregivers or mh friends or mh voluntary workers
2	carer* or caregiver* or care giver* or care* n5 child* or care* n5 parent* or care* n5 husband* or care* n5 wife* or care* n5 wives or care* n5 relative* or care* n5 relation* or care* n5 spous* or care* n5 partner*
3	care* n5 offspring or care* n5 son* or care* n5 daughter* or caring n5 child* or caring n5 parent* or caring n5 husband* or caring n5 wife* or caring n5 wives or caring n5 relative* or caring n5 relation* or caring n5 spous* or caring n5 partner*
4	care* n5 famil* or care* n5 brother* or care* n5 sister* or caring n5 offspring or caring n5 son* or caring n5 daughter* or caring n5 famil* or caring n5 brother* or caring n5 sister* or caring n5 sib* or caring n5 friend* or caring n5 volunteer*
5	care* n5 sib* or care* n5 friend* or care* n5 volunteer*
6	S1 or S2 or S3 or S4 or S5

1	Case-Study/ or Abstract-Report/ or Letter/ or (case adj report).tw. or ((exp Animal/ or Nonhuman/ or exp Animal-Experiment/) not exp Human/)

Carer involvement terms – Ovid Embase

1	(carer$ or caregiver$ or care giver$ or ((care$ or caring) adj5 (child$ or parent$ or husband$ or wife$ or wives or relative$ or relation$ or spous$ or partner$ or offspring or son$ or daughter$ or famil$ or brother$ or sister$ or sib$ or friend$ or volunteer$ or voluntary))).ti,ab.
2	exp family/ or friend/ or caregiver/ or volunteer/
3	or/1-2

Carer involvement terms – Ovid Medline

1	exp Family/ or caregivers/ or friends/ or voluntary workers/
2	(carer$ or caregiver$ or care giver$ or ((care$ or caring) adj5 (child$ or parent$ or husband$ or wife$ or wives or relative$ or relation$ or spous$ or partner$ or offspring or son$ or daughter$ or famil$ or brother$ or sister$ or sib$ or friend$ or volunteer$ or voluntary))).ti,ab.
3	or/1-2

Diagnostic filter

Diagnostic filter - OVID Embase

1	exp "SENSITIVITY AND SPECIFICITY"/
2	(sensitivity or specificity).tw.
3	(predictive adj3 value$).tw.
4	((false adj positiv$) or (false adj negativ$)).tw.
5	(observer adj variation$).tw.
6	(roc adj curve$).tw.
7	(likelihood adj3 ratio$).tw.
8	*Diagnostic Accuracy/
9	exp *hip fracture/di
10	or/1-9

Diagnostic filter - OVID Medline

1	exp "Sensitivity and Specificity"/
2	(sensitivity or specificity).tw.
3	(predictive adj3 value$).tw.
4	exp diagnostic errors/
5	((false adj positiv$) or (false adj negativ$)).tw.
6	(observer adj variation$).tw.
7	(roc adj curve$).tw.
8	(likelihood adj3 ratio$).tw.
9	likelihood functions/
10	exp *hip fractures/di, ra, ri, us
11	or/1-10

Early Surgery

Early surgery terms – Cochrane Library

1	MeSH descriptor Time Factors explode all trees
2	(((early or time* or delay*) NEAR/3 (surger* or operat*)) or (fast NEAR/2 track*) or (rapid NEAR/2 transit*) or (time* NEAR/2 factor*)):ti,ab,kw
3	#1 OR #2

Early surgery terms – EBSCO CINAHL

1	early n3 surger* or early n3 operat* or time* n3 surger* or time* n3 operat* or delay* n3 surger* or delay* n3 operat* or fast n2 track* or rapid n2 transit* or time* n2 factor*
2	mh time factors+ or mh treatment delay+
3	S1 or S2

Early surgery terms - OVID Embase

1	(((early or time$ or delay$) adj3 (surger$ or operat$)) or (fast adj2 track$) or (rapid adj2 transit$) or (time$ adj2 factor$)).ti,ab.
2	Therapy Delay/
3	1 or 2

Early surgery terms - OVID Medline

1	time factors/
2	(((early or time$ or delay$) adj3 (surger$ or operat$)) or (fast adj2 track$) or (rapid adj2 transit$) or (time$ adj2 factor$)).ti,ab.
3	1 or 2

Economic

Economic filter - OVID Embase

1	exp economic aspect/
2	cost$.tw.
3	(price$ or pricing$).tw.
4	(fee or fees).tw.
5	(financial or finance or finances or financed).tw.
6	(value adj2 (money or monetary)).tw.
7	resourc$ allocat$.tw.
8	expenditure$.tw.
9	(fund or funds or funding or fundings or funded).tw.
10	(ration or rations or rationing or rationings or rationed).tw.
11	(saving or savings).tw.
12	or/1-11
13	Quality of Life/
14	quality of life.tw.
15	life quality.tw.
16	quality adjusted life.tw.
17	(qaly$ or qald$ or qale$ or qtime$).tw.
18	disability adjusted life.tw.
19	daly$.tw.

20 (sf36 or sf 36 or short form 36 or shortform 36 or sf thirtysix or sf thirty six or shortform thirtysix or shortform thirty six or short form thirtysix or short form thirty six).tw.
21 (sf6 or sf 6 or short form 6 or shortform 6 or sf six or sfsix or shortform six or short form six).tw.
22 (sf12 or sf 12 or short form 12 or shortform 12 or sf twelve or sftwelve or shortform twelve or short form twelve).tw.
23 (sf16 or sf 16 or short form 16 or shortform 16 or sf sixteen or sfsixteen or shortform sixteen or short form sixteen).tw.
24 (sf20 or sf 20 or short form 20 or shortform 20 or sf twenty or sftwenty or shortform twenty or short form twenty).tw.
25 (euroqol or euro qol or eq5d or eq 5d).tw.
26 (hql or hqol or h qol or hrqol or hr qol).tw.
27 (hye or hyes).tw.
28 health$ equivalent$ year$.tw.
29 (hui or hui1 or hui2 or hui3).tw.
30 health utilit$.tw.
31 disutilit$.tw.
32 rosser.tw.
33 (quality of wellbeing or quality of well being).tw.
34 qwb.tw.
35 willingness to pay.tw.
36 standard gamble$.tw.
37 time trade off.tw.
38 time tradeoff.tw.
39 tto.tw.
40 factor analy$.tw.
41 preference based.tw.
42 (state adj2 valu$).tw.
43 Life Expectancy/
44 life expectancy$.tw.
45 ((duration or length or period of time or lasting or last or lasted) adj4 symptom$).tw.
46 or/13-46
47 exp model/
48 exp Mathematical Model/
49 markov$.tw.
50 Monte Carlo Method/
51 monte carlo.tw.
52 exp Decision Theory/
53 (decision$ adj2 (tree$ or anlay$ or model$)).tw.
54 model$.tw.
55 or/47-55
56 12 or 46 or 55

Economic filter - OVID Medline

1 exp "Costs and Cost Analysis"/
2 Economics/
3 Economics, Nursing/ or Economics, Medical/ or Economics, Hospital/ or Economics, Pharmaceutical/
4 exp "Fees and Charges"/
5 exp Budgets/
6 budget$.tw.

7	cost$.ti.
8	(cost$ adj2 (effective$ or utilit$ or benefit$ or minimi$)).ab.
9	(economic$ or pharmacoeconomic$ or pharmaco-economic$).ti.
10	(price$ or pricing$).tw.
11	(financial or finance or finances or financed).tw.
12	(fee or fees).tw.
13	(value adj2 (money or monetary)).tw.
14	Value of Life/
15	quality adjusted life.tw.
16	(qaly$ or qald$ or qale$ or qtime$).tw.
17	disability adjusted life.tw.
18	daly$.tw.
19	Health Status Indicators/
20	(sf36 or sf 36 or short form 36 or shortform 36 or sf thirtysix or sf thirty six or shortform thirtysix or shortform thirty six or short form thirtysix or short form thirty six).tw.
21	(sf6 or sf 6 or short form 6 or shortform 6 or sf six or sfsix or shortform six or short form six).tw.
22	(sf12 or sf 12 or short form 12 or shortform 12 or sf twelve or sftwelve or shortform twelve or short form twelve).tw.
23	(sf16 or sf 16 or short form 16 or shortform 16 or sf sixteen or sfsixteen or shortform sixteen or short form sixteen).tw.
24	(sf20 or sf 20 or short form 20 or shortform 20 or sf twenty or sftwenty or shortform twenty or short form twenty).tw.
25	(euroqol or euro qol or eq5d or eq 5d).tw.
26	(hql or hqol or h qol or hrqol or hr qol).tw.
27	(hye or hyes).tw.
28	(hui or hui1 or hui2 or hui3).tw.
29	utilit$.tw.
30	disutilit$.tw.
31	rosser.tw.
32	quality of wellbeing.tw.
33	qwb.tw.
34	willingness to pay.tw.
35	standard gamble$.tw.
36	time trade off.tw.
37	time tradeoff.tw.
38	tto.tw.
39	exp models, economic/
40	models, theoretical/ or models, organizational/
41	economic model$.tw.
42	markov chains/
43	markov$.tw.
44	Monte Carlo Method/
45	monte carlo.tw.
46	exp Decision Theory/
47	(decision$ adj2 (tree$ or anlay$ or model$)).tw.
48	or/1-47

Hip Fracture Terms

	Hip fracture terms – Cochrane Library
1	MeSH descriptor Hip Fractures explode all trees

2 ((hip* or pertrochant* or intertrochant* or trochant* or subtrochant* or intracapsular* or extracapsular* or ((femur* or femoral*) NEAR/3 (neck or proximal))) NEAR/4 fracture*):ti,ab,kw
3 #1 OR #2

Hip fracture terms – EBSCO CINAHL

1 mh hip fractures+
2 femur* n3 proximal n4 fracture* or femur* n3 neck n4 fracture* or femoral* n3 proximal n4 fracture* or femoral* n3 neck n4 fracture* or pertrochant* n4 fracture* or intertrochant* n4 fracture* or trochanteric n4 fracture* or subtrochanteric n4 fracture* or extracapsular* n4 fracture* or hip* n4 fracture*
3 intracapsular* n4 fracture* or femur* n4 fracture* or femoral* n4 fracture*
4 S1 or S2 or S3

Hip fracture terms - OVID Embase

1 exp Hip Fracture/
2 ((femur$ or femoral$) adj3 (head or neck or proximal) adj4 fracture$).ti,ab.
3 ((hip$ or femur$ or femoral$ or trochant$ or pertrochant$ or intertrochant$ or subtrochant$ or intracapsular$ or extracapsular$) adj4 fracture$).ti,ab.
4 1 or 2 or 3

Hip fracture terms - OVID Medline

1 exp Hip Fractures/
2 ((femur$ or femoral$) adj3 (head or neck or proximal) adj4 fracture$).ti,ab.
3 ((hip$ or femur$ or femoral$ or trochant$ or pertrochant$ or intertrochant$ or subtrochant$ or intracapsular$ or extracapsular$) adj4 fracture$).ti,ab.
4 1 or 2 or 3

Hip fracture terms - OVID PsychInfo

1 hips/
2 ((femur$ or femoral$) adj3 (head or neck or proximal) adj4 fracture$).ti,ab.
3 ((hip$ or femur$ or femoral$ or trochant$ or pertrochant$ or intertrochant$ or subtrochant$ or intracapsular$ or extracapsular$) adj4 fracture$).ti,ab.
4 1 or 2 or 3

Orthogeriatrician

Orthogeriatrician terms – Cochrane Library

1 (geriatr*-orthop* or orthop?edic-geriatr* or ortho*-geriatr* or orthogeriatr*):ti,ab,kw
2 (orthop* NEAR/2 geriatr*):ti,ab,kw
3 MeSH descriptor Physicians, this term only
4 MeSH descriptor Geriatrics explode all trees
5 #1 or #2 or #3 or #4

Orthogeriatrician terms – EBSCO CINAHL

1 orthop* n2 geriatr*
2 geriatr*-orthop* or orthogeriatr* or ortho*-geriatr* or orthop?edic-geriatr*
3 (MH "Physicians")
4 (MH "Geriatrics")
5 (MH "Multidisciplinary Care Team")
6 S1 or S2 or S3 or S4 or S5

Orthogeriatrician terms - OVID Embase

1 (geriatr$-orthop$ or orthop?edic-geriatr$ or ortho$-geriatr$ or orthogeriatr$).ti,ab.
2 (orthop$ adj2 geriatr$).ti,ab.
3 geriatric care/
4 geriatrics/
5 physician/
6 or/1-5

Orthogeriatrician terms - OVID Medline

1 (geriatr$-orthop$ or orthop?edic-geriatr$ or ortho$-geriatr$ or orthogeriatr$).ti,ab.
2 (orthop$ adj2 geriatr$).ti,ab.
3 Physicians/
4 Geriatrics/
5 or/1-4

Patient education

Patient education – EBSCO CINAHL

1 mh Patients or mh Inpatients or mh Outpatients
2 mh Caregivers or mh Family+ or mh Parents+ or mh Guardianship, Legal
3 patients or carer* or famil*
4 S1 or S2 or S3
5 mh Information Services+ or mh Books+ or mh Pamphlets or mh Counseling
6 S4 and S5
7 patient n3 education or patient n3 educate or patient n3 educating or patient n3 information or patient n3 literature or patient n3 leaflet* or patient n3 booklet* or patient n3 pamphlet*
8 patients n3 education or patients n3 educate or patients n3 educating or patients n3 information or patients n3 literature or patients n3 leaflet* or patients n3 booklet* or patients n3 pamphlet*
9 mh Patient Education+
10 S6 or S7 or S8 or S9

Patient education - OVID Embase

1 Patient/ or Hospital patient/ or Outpatient/
2 Caregiver/ or exp Family/ or exp Parent/
3 (patients or carer$ or famil$).tw.
4 or/1-3

5	Information Service/ or Information center/ or Publication/ or Book/ or Counseling/ or Directive counseling/
6	4 and 5
7	((patient or patients) adj3 (education or educate or educating or information or literature or leaflet$ or booklet$ or pamphlet$)).ti,ab.
8	Patient information/ or Patient education/
9	or/6-8

Patient education – OVID Medline

1	Patients/ or Inpatients/ or Outpatients/
2	Caregivers/ or exp Family/ or exp Parents/ or exp Legal-Guardians/
3	(patients or carer$ or famil$).tw.
4	or/1-3
5	Popular-Works-Publication-Type/ or exp Information-Services/ or Publications/ or Books/ or Pamphlets/ or Counseling/ or Directive-Counseling/
6	4 and 5
7	((patient or patients) adj3 (education or educate or educating or information or literature or leaflet$ or booklet$ or pamphlet$)).ti,ab.
8	Patient-Education/ or Patient-Education-Handout-Publication-Type/
9	or/6-8

Patient education – Ovid PsychInfo

1	exp patients/
2	caregivers/ or exp family/ or exp parents/ or exp guardianship/
3	(patients or carer$ or famil$).tw.
4	or/1-3
5	exp information services/ or exp printed communications media/ or reading materials/ or exp counseling/
6	4 and 5
7	((patient or patients) adj3 (education or educate or educating or information or literature or leaflet$ or booklet$ or pamphlet$)).ti,ab.
8	client education/
10	or/6-9

Patient views

Patient views – EBSCO CINAHL

1	mh Consumer Satisfaction+ or mh Consumer Attitudes or mh Personal Satisfaction or mh Consumer Participation or mh Patient Rights+ or mh Questionnaires+ or mh Interviews+ or mh Focus groups or mh surveys
2	patient* n3 view* or patient* n3 opinion* or patient* n3 awareness or patient* n3 tolerance or patient* n3 perception or patient* n3 persistenc* or patient* n3 attitude* or patient* n3 compliance or patient* n3 satisfaction or patient* n3 concern* or patient* n3 belief* or patient* n3 feeling*
3	patient* n3 position or patient* n3 idea* or patient* n3 preference* or patient* n3 choice*
4	discomfort or comfort or inconvenience or bother* or trouble or fear* or anxiety or anxious or embarrass*
5	S1 or S2 or S3 or S4

Patient views - OVID Embase

1	Consumer attitude/ or patient satisfaction/ or patient compliance/ or patient right/ or health survey/ or questionnaire/ or interview/
2	(patient$ adj3 (view$ or opinion$ or awareness or tolerance or perception or persistenc$ or attitude$ or compliance or satisfaction or concern$ or belief$ or feeling$ or position or idea$ or preference$ or choice$)).tw.
3	(Discomfort or comfort or inconvenience or bother$4 or trouble or fear$ or anxiety or anxious or embarrass$4).tw.
4	or/1-3

Patient views - OVID Medline

1	exp Consumer-Satisfaction/ or Personal-Satisfaction/ or exp Patient-Acceptance-Of-Health-Care/ or exp Consumer-Participation/ or exp Patient-Rights/ or Health Care Surveys/ or Questionnaires/ or Interview/ or Focus groups/
2	(patient$ adj3 (view$ or opinion$ or awareness or tolerance or perception or persistenc$ or attitude$ or compliance or satisfaction or concern$ or belief$ or feeling$ or position or idea$ or preference$ or choice$)).tw.
3	(Discomfort or comfort or inconvenience or bother$4 or trouble or fear$ or anxiety or anxious or embarrass$4).tw.
4	or/1-3

Patient views - OVID PsychInfo

1	exp consumer satisfaction/ or exp client attitudes/ or client participation/ or exp client rights/ or treatment compliance/ or consumer surveys/ or exp questionnaires/ or interviews/ or expectations/
2	(patient$ adj3 (view$ or opinion$ or awareness or tolerance or perception or persistenc$ or attitude$ or compliance or satisfaction or concern$ or belief$ or feeling$ or position or idea$ or preference$ or choice$ or expect$)).tw.
3	((Discomfort or comfort or inconvenience or bother$4 or trouble or fear$ or anxiety or anxious or embarrass$4).tw..
4	or/1-3

Radiological Imaging

Radiological imaging terms – Cochrane Library

1	MeSH descriptor Magnetic Resonance Imaging, this term only
2	((MR or NMR) NEAR/2 tomograph*):ti,ab,kw
3	(MRI):ti,ab,kw
4	((magnetic resonance or MR or NMR) NEAR/2 imag*):ti,ab,kw
5	MeSH descriptor Tomography, X-Ray Computed, this term only
6	MeSH descriptor Tomography, Spiral Computed, this term only
7	mdct:ti,ab,kw
8	(ct or compute* tomograph* or compute*-tomograph* or cat):ti,ab,kw
9	MeSH descriptor Radionuclide Imaging, this term only
10	(((radionuclide or radioisotope or isotope) NEAR (imag* or scan*)) or rns or scintigraph* or scintiphotograph*):ti,ab,kw
11	MeSH descriptor Ultrasonography, this term only
12	(ultrason* or ultrasound* or sonograph* or echograph*):ti,ab,kw
13	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12

Radiological imaging terms – EBSCO CINAHL

1	mh Magnetic Resonance Imaging or magnetic resonance n2 imag* or MR n2 imag* or NMR n2 imag* or MR n2 tomograph$ or NMR n2 tomograph$ or MRI
2	mdct or compute* tomograph* or cat or MH "Tomography, X-Ray Computed" or mh Tomography, Spiral Computed or compute*-tomograph* or "ct"
3	mh Radionuclide Imaging or radionuclide n1 imag* or radioisotope n1 imag* or isotope n1 imag* or radionuclide n1 scan* or radioisotope n1 scan* or isotope n1 scan* or rns or scintigraph* or scintiphotograph*
4	mh Ultrasonography or ultrason* or sonograph* or echograph* or ultrasound*
5	S1 or S2 or S3 or S4

Radiological imaging terms – OVID Embase

1	nuclear magnetic resonance imaging/
2	((magnetic resonance or MR or NMR) adj2 imag$).ti,ab.
3	(((MR or NMR) adj2 tomograph$) or MRI).ti,ab.
4	computer assisted tomography/
5	spiral computer assisted tomography/
6	mdct.ti,ab.
7	(ct or compute$ tomograph$ or compute$-tomograph$ or cat).ti,ab.
8	scintiscanning/ or scintigraphy/
9	(((radionuclide or radioisotope or isotope) adj1 (imag$ or scan$)) or rns or scintigraph$ or scintiphotograph$).ti,ab.
10	(ultrason$ or ultrasound$ or sonograph$ or echograph$).ti,ab.
11	echography/
12	or/1-11

Radiological imaging terms – OVID Medline

1	Magnetic Resonance Imaging/
2	((magnetic resonance or MR or NMR) adj2 imag$).ti,ab.
3	(((MR or NMR) adj2 tomograph$) or MRI).ti,ab.
4	Tomography, X-Ray Computed/
5	Tomography, Spiral Computed/
6	mdct.ti,ab.
7	(ct or compute$ tomograph$ or compute$-tomograph$ or cat).ti,ab.
8	Radionuclide Imaging/
9	(((radionuclide or radioisotope or isotope) adj1 (imag$ or scan$)) or rns or scintigraph$ or scintiphotograph$).ti,ab.
10	Ultrasonography/
11	(ultrason$ or ultrasound$ or sonograph$ or echograph$).ti,ab.
12	or/1-11

RCT filter

RCT filter Embase

1	Clinical-Trial/ or Randomized-Controlled-Trial/ or Randomization/ or Single-Blind-Procedure/ or Double-Blind-Procedure/ or Crossover-Procedure/ or Prospective-Study/ or Placebo/

2 (((clinical or control or controlled) adj (study or trial)) or ((single or double or triple) adj (blind$3 or mask$3)) or (random$ adj (assign$ or allocat$ or group or grouped or patients or study or trial or distribut$)) or (crossover adj (design or study or trial)) or placebo or placebos).ti,ab.
3 1 or 2

RCT filter Medline

1 Randomized-Controlled-Trials/ or Random-Allocation/ or Double-Blind-Method/ or Single-Blind-Method/ or exp Clinical-Trials as topic/ or Cross-Over-Studies/ or Prospective-Studies/ or Placebos/
2 (Randomized-Controlled-Trial or Clinical-Trial or Controlled-Clinical-Trial).pt.
3 (((clinical or control or controlled) adj (study or trial)) or ((single or double or triple) adj (blind$3 or mask$3)) or (random$ adj (assign$ or allocat$ or group or grouped or patients or study or trial or distribut$)) or (crossover adj (design or study or trial)) or placebo or placebos).ti,ab.
4 or/1-3

Rehabilitation

Rehabilitation terms - Cochrane Library

1 MeSH descriptor Rehabilitation explode all trees
2 MeSH descriptor Rehabilitation Centers explode all trees
3 MeSH descriptor Rehabilitation Nursing explode all trees
4 MeSH descriptor Patient Care Team explode all trees
5 MeSH descriptor Patient Care Management explode all trees
6 MeSH descriptor Occupational Therapy explode all trees
7 MeSH descriptor Physical Therapy Modalities explode all trees
8 MeSH descriptor Physical Therapy Department, Hospital explode all trees
9 MeSH descriptor Physical Therapy (Specialty) explode all trees
10 MeSH descriptor Critical Pathways explode all trees
11 MeSH descriptor Therapy, Computer-Assisted explode all trees
12 MeSH descriptor Exercise Therapy explode all trees
13 MeSH descriptor Social Work explode all trees
14 MeSH descriptor Social Support explode all trees
15 MeSH descriptor Pain Clinics explode all trees
16 MeSH descriptor Patient Education as Topic explode all trees
17 MeSH descriptor Health Education explode all trees
18 MeSH descriptor Recovery of Function, this term only
19 MeSH descriptor Subacute Care, this term only
20 MeSH descriptor Residential Facilities explode all trees
21 MeSH descriptor Day Care, this term only
22 MeSH descriptor Home Care Services, this term only
23 MeSH descriptor Home Care Services, Hospital-Based, this term only
24 MeSH descriptor Home Nursing, this term only
25 MeSH descriptor Hospital Units, this term only
26 MeSH descriptor Nursing Homes explode all trees
27 MeSH descriptor Walking explode all trees
28 MeSH descriptor Caregivers, this term only
29 (rehab* or habilitat* or recover*):ti,ab,kw
30 (multidisciplinar* or interdisciplinar* or multiprofessional* or multimodal* or mdt or mdr):ti,ab,kw
31 (social NEAR (work* or support or care)):ti,ab,kw

32 (pain clinic* or pain service* or pain relief unit* or (pain center* or pain centre*)):ti,ab,kw
33 ((treatment* or therap* or training or education* or healthcare) NEAR/10 (program* or intervention* or approach*)):ti,ab,kw
34 (early NEAR (mobil* or discharg* or ambulat*)):ti,ab,kw
35 (occupational therap* or physical therap* or physiotherap* or physio):ti,ab,kw
36 (exercis* NEAR/3 therap*):ti,ab,kw
37 ((early or earli* or immediat* or initial* or begin* or first* or first-line or first line or first choice or primar* or preceed* or original*) NEAR/3 (interven* or treat* or therap* or care or medicine* or technique* or strateg* or activit* or mobili*)):ti,ab,kw
38 (walk or walks or walking):ti,ab,kw
39 mobili?ation strateg*:ti,ab,kw
40 (ambulate* or ambulation* or ambulating*):ti,ab,kw
41 (exerci* NEAR/3 (rehab* or habilitat* or recover* or therap* or treat* or medicine* or intervention* or technique* or strateg*)):ti,ab,kw
42 ((walk* or mobil* or mov* or motor* or physi*) NEAR/3 (rehab* or habilitat* or recover* or therap* or treat* or medicine* or intervention* or technique* or strateg*)):ti,ab,kw
43 (extend* NEAR/2 care* NEAR/3 (facilit* or service* or unit* or center* or clinic* or program* or residen* or home* or hous*)):ti,ab,kw
44 ((residen* or intermediate* or assist* liv*) NEAR/3 (facilit* or care* or service* or unit* or center* or clinic* or program* or residen* or home* or hous*)):ti,ab,kw
45 ((halfway or transition*) NEAR/3 (home* or hous* or facilit* or care* or residen* or service* or unit* or center* or clinic* or program*)):ti,ab,kw
46 (nurs* NEAR/2 home*):ti,ab,kw
47 (geriatr*-orthop* or orthop?edic-geriatr* or ortho*-geriatr* or orthogeriatr* or goru):ti,ab,kw
48 (orthop* NEAR/2 geriatr*):ti,ab,kw
49 rehabilitation unit*:ti,ab,kw
50 (mixed assessment or maru):ti,ab,kw
51 (geriatric hip fracture program* or ghfp):ti,ab,kw
52 (day NEAR (hospital* or care or unit*)):ti,ab,kw
53 ((home-based or home based) NEAR care):ti,ab,kw
54 carer* involve*:ti,ab,kw
55 (esd or early supported discharge):ti,ab,kw
56 sequential care:ti,ab,kw
57 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 or #49 or #50 or #51 or #52 or #53 or #54 or #55 or #56

Rehabilitation terms – EBSCO CINAHL

1 (MH "Rehabilitation+")
2 (MH "Rehabilitation Nursing")
3 (MH "Recovery")
4 (MH "Subacute Care")
5 (MH "Rehabilitation Centers+")
6 mh residential facilities or mh Assisted Living Facilities or mh Halfway Houses
7 mh Day Care or mh home care services or mh home care services, hospital-based or mh home nursing or mh Hospital Units
8 mh Nursing Homes+ or mh Patient Care Team+ or mh Patient Care Management+ or mh Physical Therapy Techniques+ or mh Physical Therapy Department,

	Hospital+
9	mh Critical Pathways+ or mh Therapy, Computer-Assisted+ or mh Exercise Therapy+ or mh Walking+
10	mh Social Work+ or mh Social Support+ or mh Pain Clinics+ or mh Patient Education+ or mh Health Education+ or mh Caregivers
11	(MH "Multidisciplinary Care Team+")
12	rehab* or habilitat* or recover*
13	multidisciplinar* or mdr or mdt or multimodal* or multiprofessional* or interdisciplinar*
14	social n1 work* or social n1 support or social n1 care
15	pain clinic* or pain service* or pain relief unit* or pain center* or pain centre*
16	treatment* n10 program* or treatment* n10 intervention* or treatment* n10 approach* or therap* n10 program* or therap* n10 intervention* or therap* n10 approach* or training n10 program* or training n10 intervention* or training n10 approach* or education* n10 program* or education* n10 intervention* or education* n10 approach*
17	healthcare n10 program* or healthcare n10 intervention* or healthcare n10 approach*
18	early n1 mobil* or early n1 discharg* or early n1 ambulat*
19	occupational therap* or physical therap* or physiotherap* or physio
20	exercis* n3 therap*
21	early n3 interven* or early n3 treat* or early n3 therap* or early n3 care or early n3 medicine* or early n3 technique* or early n3 strateg* or early n3 activit* or early n3 mobili*
22	earli* n3 interven* or earli* n3 treat* or earli* n3 therap* or earli* n3 care or earli* n3 medicine* or earli* n3 technique* or earli* n3 strateg* or earli* n3 activit* or earli* n3 mobili*
23	immediat* n3 interven* or immediat* n3 treat* or immediat* n3 therap* or immediat* n3 care or immediat* n3 medicine* or immediat* n3 technique* or immediat* n3 strateg* or immediat* n3 activit* or immediat* n3 mobili*
24	initial* n3 interven* or initial* n3 treat* or initial* n3 therap* or initial* n3 care or initial* n3 medicine* or initial* n3 activit* or initial* n3 technique* or initial* n3 strateg* or initial* n3 mobili*
25	begin* n3 interven* or begin* n3 treat* or begin* n3 therap* or begin* n3 care or begin* n3 medicine* or begin* n3 technique* or begin* n3 strateg* or begin* n3 activit* or begin* n3 mobili*
26	first* n3 interven* or first* n3 treat* or first* n3 therap* or first* n3 care or first* n3 medicine* or first* n3 technique* or first* n3 strateg* or first* n3 activit* or first* n3 mobili*
27	first-line n3 interven* or first-line n3 treat* or first-line n3 therap* or first-line n3 care or first-line n3 medicine* or first-line n3 technique* or first-line n3 strateg* or first-line n3 activit* or first-line n3 mobili*
28	primar* n3 interven* or primar* n3 treat* or primar* n3 therap* or primar* n3 care or primar* n3 medicine* or primar* n3 technique* or primar* n3 strateg* or primar* n3 activit* or primar* n3 mobili*
29	original* n3 interven* or original* n3 treat* or original* n3 therap* or original* n3 care or original* n3 medicine* or original* n3 technique* or original* n3 strateg* or original* n3 activit* or original* n3 mobili*
30	preceed* n3 interven* or preceed* n3 treat* or preceed* n3 therap* or preceed* n3 care or preceed* n3 medicine* or preceed* n3 technique* or preceed* n3 strateg* or preceed* n3 activit* or preceed* n3 mobili*
31	walk or walks or walking
323	mobili?ation strateg*
33	ambulate* or ambulation* or ambulating*
34	exerci* n3 rehab* or exerci* n3 habilitat* or exerci* n3 recover* or exerci* n3

therap* or exerci* n3 treat* or exerci* n3 medicine* or exerci* n3 intervention* or exerci* n3 technique* or exerci* n3 strateg*

35 walk* n3 rehab* or walk* n3 habilitat* or walk* n3 recover* or walk* n3 therap* or walk* n3 treat* or walk* n3 medicine* or walk* n3 intervention* or walk* n3 technique* or walk* n3 strateg*

36 mov* n3 rehab* or mov* n3 habilitat* or mov* n3 recover* or mov* n3 therap* or mov* n3 treat* or mov* n3 medicine* or mov* n3 intervention* or mov* n3 technique* or mov* n3 strateg*

37 motor* n3 rehab* or motor* n3 habilitat* or motor* n3 recover* or motor* n3 therap* or motor* n3 treat* or motor* n3 medicine* or motor* n3 intervention* or motor* n3 technique* or motor* n3 strateg*

38 physi* n3 rehab* or physi* n3 habilitat* or physi* n3 recover* or physi* n3 therap* or physi* n3 treat* or physi* n3 medicine* or physi* n3 intervention* or physi* n3 technique* or physi* n3 strateg*

39 extend* n2 care* n3 facilit* or extend* n2 care* n3 service* or extend* n2 care* n3 unit* or extend* n2 care* n3 center* or extend* n2 care* n3 clinic* or extend* n2 care* n3 program* or extend* n2 care* n3 residen* or extend* n2 care* n3 home* or extend* n2 care* n3 hous*

40 residen* n3 facilit* or residen* n3 care* or residen* n3 service* or residen* n3 unit* or residen* n3 center* or residen* n3 clinic* or residen* n3 program* or residen* n3 residen* or residen* n3 home* or residen* n3 hous*

41 intermediate* n3 facilit* or intermediate* n3 care* or intermediate* n3 service* or intermediate* n3 unit* or intermediate* n3 center* or intermediate* n3 clinic* or intermediate* n3 program* or intermediate* n3 residen* or intermediate* n3 home* or intermediate* n3 hous*

42 assist* liv* n3 facilit* or assist* liv* n3 care* or assist* liv* n3 service* or assist* liv* n3 unit* or assist* liv* n3 center* or assist* liv* n3 clinic* or assist* liv* n3 program* or assist* liv* n3 residen* or assist* liv* n3 home* or assist* liv* n3 hous*

43 halfway n3 home* or halfway n3 hous* or halfway n3 facilit* or halfway n3 care* or halfway n3 residen* or halfway n3 service* or halfway n3 unit* or halfway n3 center* or halfway n3 clinic* or halfway n3 program*

44 transition* n3 home* or transition* n3 hous* or transition* n3 facilit* or transition* n3 care* or transition* n3 residen* or transition* n3 service* or transition* n3 unit* or transition* n3 center* or transition* n3 clinic* or transition* n3 program*

45 nurs* n2 home* or geriatr*-orthop* or orthop?edic-geriatr* or ortho*-geriatr* or orthogeriatr* or goru or orthop* n2 geriatr* or rehabilitation unit* or mixed assessment or maru

46 geriatric hip fracture program* or ghfp or day n1 hospital* or day n1 care or day n1 unit* or home-based n1 care or home based n1 care or carer* involve* or esd or early supported discharge or sequential care

47 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32 or S33 or S34 or S35 or S36 or S37 or S38 or S39 or S40 or S41 or S42 or S43 or S44 or S45 or S46

Rehabilitation terms - OVID Embase

1 exp Rehabilitation/ or exp Rehabilitation Nursing/ or exp daily life activity/

2 assisted living facility/ or nursing home/ or pain clinic/ or rehabilitation center/ or residential home/ or halfway house/

3 day hospital/ or home care/ or home health agency/ or home physiotherapy/ or home rehabilitation/ or patient care/ or patient care planning/ or rehabilitation care/

4 exp mobilization/ or exp Occupational Therapy/ or exp Physiotherapy/ or exp

	kinesiotherapy/ or walking/
5	exp clinical pathway/ or social care/ or caregiver support/ or social support/ or caregiver/
6	(rehab$ or habilitat$ or recover$).ti,ab.
7	(multidisciplinar$ or interdisciplinar$ or multiprofessional$ or multimodal$ or mdt or mdr).ti,ab.
8	(social adj1 (work$ or support or care)).ti,ab.
9	(pain clinic$ or pain service$ or pain relief unit$ or (pain center$ or pain centre$)).ti,ab.
10	((treatment$ or therap$ or training or education$ or healthcare) adj10 (program$ or intervention$ or approach$)).ti,ab.
11	(early adj1 (mobil$ or discharg$ or ambulat$)).ti,ab.
12	(occupational therap$ or physical therap$ or physiotherap$ or physio).ti,ab.
13	(exercis$ adj3 therap$).ti,ab.
14	((early or earli$ or immediat$ or initial$ or begin$ or first$ or first-line or first line or first choice or primar$ or preceed$ or original$) adj3 (interven$ or treat$ or therap$ or care or medicine$ or technique$ or strateg$ or activit$ or mobili$)).ti,ab.
15	(walk or walks or walking).ti,ab.
16	mobili?ation strateg$.ti,ab.
17	(ambulate$ or ambulation$ or ambulating$).ti,ab.
18	(exerci$ adj3 (rehab$ or habilitat$ or recover$ or therap$ or treat$ or medicine$ or intervention$ or technique$ or strateg$)).ti,ab.
19	((walk$ or mobil$ or mov$ or motor$ or physi$) adj3 (rehab$ or habilitat$ or recover$ or therap$ or treat$ or medicine$ or intervention$ or technique$ or strateg$)).ti,ab.
20	(extend$ adj2 care$ adj3 (facilit$ or service$ or unit$ or center$ or clinic$ or program$ or residen$ or home$ or hous$)).ti,ab.
21	((residen$ or intermediate$ or assist$ liv$) adj3 (facilit$ or care$ or service$ or unit$ or center$ or clinic$ or program$ or residen$ or home$ or hous$)).ti,ab.
22	((halfway or transition$) adj3 (home$ or hous$ or facilit$ or care$ or residen$ or service$ or unit$ or center$ or clinic$ or program$)).ti,ab.
23	(nurs$ adj2 home$).ti,ab.
24	(geriatr$-orthop$ or orthop?edic-geriatr$ or ortho$-geriatr$ or orthogeriatr$ or goru).ti,ab.
25	(orthop$ adj2 geriatr$).ti,ab.
26	rehabilitation unit$.ti,ab.
27	(mixed assessment or maru).ti,ab.
28	(geriatric hip fracture program$ or ghfp).ti,ab.
29	(day adj (hospital$ or care or unit$)).ti,ab.
30	((home-based or home based) adj care).ti,ab.
31	carer$ involve$.ti,ab.
32	(esd or early supported discharge).ti,ab.
33	sequential care.ti,ab.
34	or/1-33

Rehabilitation terms - OVID Medline

1	exp rehabilitation/ or exp rehabilitation nursing/ or "Recovery of Function"/ or Subacute Care/
2	exp rehabilitation centers/ or Residential Facilities/ or Assisted Living Facilities/ or Halfway Houses/
3	Day Care/ or home care services/ or home care services, hospital-based/ or home

	nursing/ or Hospital Units/
4	exp Nursing Homes/ or exp Patient Care Team/ or exp Patient Care Management/ or exp Occupational Therapy/ or exp Physical Therapy Techniques/ or exp Physical Therapy Department, Hospital/
5	exp "Physical Therapy (Specialty)"/ or exp Critical Pathways/ or exp Therapy, Computer-Assisted/ or exp Exercise Therapy/ or exp Walking/
6	exp Social Work/ or exp Social Support/ or exp Pain Clinics/ or exp Patient Education/ or exp Health Education/ or Caregivers/
7	(rehab$ or habilitat$ or recover$).ti,ab.
8	(multidisciplinar$ or interdisciplinar$ or multiprofessional$ or multimodal$ or mdt or mdr).ti,ab.
9	(social adj1 (work$ or support or care)).ti,ab.
10	(pain clinic$ or pain service$ or pain relief unit$ or (pain center$ or pain centre$)).ti,ab.
11	((treatment$ or therap$ or training or education$ or healthcare) adj10 (program$ or intervention$ or approach$)).ti,ab.
12	(early adj1 (mobil$ or discharg$ or ambulat$)).ti,ab.
13	(occupational therap$ or physical therap$ or physiotherap$ or physio).ti,ab.
14	(exercis$ adj3 therap$).ti,ab.
15	((early or earli$ or immediat$ or initial$ or begin$ or first$ or first-line or first line or first choice or primar$ or preceed$ or original$) adj3 (interven$ or treat$ or therap$ or care or medicine$ or technique$ or strateg$ or activit$ or mobili$)).ti,ab.
16	(walk or walks or walking).ti,ab.
17	mobili?ation strateg$.ti,ab.
18	(ambulate$ or ambulation$ or ambulating$).ti,ab.
19	(exerci$ adj3 (rehab$ or habilitat$ or recover$ or therap$ or treat$ or medicine$ or intervention$ or technique$ or strateg$)).ti,ab.
20	((walk$ or mobil$ or mov$ or motor$ or physi$) adj3 (rehab$ or habilitat$ or recover$ or therap$ or treat$ or medicine$ or intervention$ or technique$ or strateg$)).ti,ab.
21	(extend$ adj2 care$ adj3 (facilit$ or service$ or unit$ or center$ or clinic$ or program$ or residen$ or home$ or hous$)).ti,ab.
22	((residen$ or intermediate$ or assist$ liv$) adj3 (facilit$ or care$ or service$ or unit$ or center$ or clinic$ or program$ or residen$ or home$ or hous$)).ti,ab.
23	((halfway or transition$) adj3 (home$ or hous$ or facilit$ or care$ or residen$ or service$ or unit$ or center$ or clinic$ or program$)).ti,ab.
24	(nurs$ adj2 home$).ti,ab.
25	(geriatr$-orthop$ or orthop?edic-geriatr$ or ortho$-geriatr$ or orthogeriatr$ or goru).ti,ab.
26	(orthop$ adj2 geriatr$).ti,ab.
27	rehabilitation unit$.ti,ab.
28	(mixed assessment or maru).ti,ab.
29	(geriatric hip fracture program$ or ghfp).ti,ab.
30	(day adj (hospital$ or care or unit$)).ti,ab.
31	((home-based or home based) adj care).ti,ab.
32	carer$ involve$.ti,ab.
33	(esd or early supported discharge).ti,ab.
34	sequential care.ti,ab.
35	or/1-34

Surgeon seniority

Surgeon seniority terms – Cochrane Library

1	MeSH descriptor Clinical Competence explode all trees
2	(surgeon* NEAR/3 (senior* or experience* or supervision* or volume* or grade*)):ti,ab,kw
3	(consultant* or registrar* or spr or staff grade or trust grade or associate specialist*):ti,ab,kw
4	(surg* NEAR (team* or list*)):ti,ab,kw
5	(list* NEAR (organise* or organize* or consultant-led or consultant led)):ti,ab,kw
6	#1 or #2 or #3 or #4 or #5

Surgeon seniority terms – EBSCO CINAHL

1	surgeon* n3 senior* or surgeon* n3 volume* or surgeon* n3 supervision* or surgeon* n3 experience* or surgeon* n3 grade* or surg* n1 team* or surg* n1 list* or list* n1 organise* or list* n1 organize* or list* n1 consultant-led or list* n1 consultant led
2	consultant* or spr or registrar* or staff grade or trust grade or associate specialist* or mh clinical competence+
3	S1 or S2

Surgeon seniority terms - OVID Embase

1	exp clinical competence/
2	(surgeon$ adj3 (senior$ or experience$ or supervision$ or volume$ or grade$)).ti,ab.
3	(consultant$ or registrar$ or spr or staff grade or trust grade or associate specialist$).ti,ab.
4	(surg$ adj1 (team$ or list$)).ti,ab.
5	(list$ adj1 (organise$ or organize$ or consultant-led or consultant led)).ti,ab.
6	or/1-5

Surgeon seniority terms - OVID Medline

1	Clinical Competence/
2	(surgeon$ adj3 (senior$ or experience$ or supervision$ or volume$ or grade$)).ti,ab.
3	(consultant$ or registrar$ or spr or staff grade or trust grade or associate specialist$).ti,ab.
4	(surg$ adj1 (team$ or list$)).ti,ab.
5	(list$ adj1 (organise$ or organize$ or consultant-led or consultant led)).ti,ab.
6	or/1-5

Surgical Interventions

Surgical Interventions terms – Cochrane Library

1	MeSH descriptor Fracture Fixation, Internal explode all trees
2	MeSH descriptor Internal Fixators explode all trees
3	MeSH descriptor Bone Nails explode all trees
4	MeSH descriptor Bone Screws explode all trees

5	MeSH descriptor Bone Plates explode all trees
6	MeSH descriptor Bone Cements explode all trees
7	MeSH descriptor Arthroplasty explode all trees
8	(pin* or nail* or screw* or plate* or arthroplast* or fix* or prosthes* or ((cement* or glue* or paste*) NEAR/3 bone*)):ti,ab,kw
9	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8

Surgical interventions terms - OVID Embase

1	(pin$ or nail$ or screw$ or plate$ or arthroplast$ or hemiarthroplast$ or fix$ or prosthes$).ti,ab.
2	arthroplasty/ or hip arthroplasty/
3	((cement$ or glue$ or paste$) adj3 bone$).ti,ab.
4	Fracture Treatment/ or Hip Surgery/ or Femur Intertrochanteric Osteotomy/ or Hip Osteotomy/ or exp Fracture Fixation/ or Bone Screw/ or Bone Plate/ or Bone Nail/ or ender Nail/ or Interlocking Nail/ or Osteosynthesis Material/ or external fixator/ or exp bone cement/
5	or/1-4

Surgical interventions terms - OVID Medline

1	(pin$1 or nail$ or screw$1 or plate$1 or arthroplast$ or fix$ or prosthes$).ti,ab.
2	Internal Fixators/ or Bone Screws/ or Fracture Fixation, Internal/ or Bone Plates/ or Bone Nails/ or Bone Cements/
3	((cement$ or glue$ or paste$) adj3 bone$).ti,ab.
4	Arthroplasty/ or Arthroplasty, Replacement, Hip/
5	or/1-4

Systematic review filter

Systematic review filter - OVID Medline

1	meta-analysis/
2	(metaanalys$ or meta-analys$ or meta analys$).tw.
3	exp "review literature"/
4	(systematic$ adj3 (review$ or overview$)).tw.
5	(selection criteria or data extraction).ab. and review.pt.
6	(cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or cinhal or science citation index or bids or cancerlit).ab.
7	(reference list$ or bibliograph$ or hand search$ or hand-search$ or manual search$ or relevant journals).ab.
8	or/1-7

Systematic review filter - OVID Embase

1	meta analysis/
2	(metaanalys$ or meta-analys$ or meta analys$).tw.
3	systematic review/
4	(systematic$ adj3 (review$ or overview$)).tw.
5	(selection criteria or data extraction).ab. and Review.pt.
6	(cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or cinhal or science citation index or bids or cancerlit).ab.
7	(reference list$ or bibliograph$ or hand search$ or manual search$ or relevant journals).ab.

8 or/1-7

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Abbreviations

CI	Confidence interval
IQR	Interquartile range
ITT	Intention to treat analysis
LOS	Length Of Stay
LR+	Positive likelihood ratio
LR-	Negative likelihood ratio
M/F	Male/female
N	Total number of patients randomised
NA	Not Applicable
NPV	Negative predictive value
NR	Not reported
PPV	Positive predictive value
QALY	Quality-Adjusted Life Years
QoL	Quality of life
RCT	Randomised controlled trial
RR	Relative risk
SD	Standard Deviation
SE	Standard Error
Sig	Statistically significant at 5%

17.1 Evidence Table 1: Imaging options in occult hip fracture

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Safran et al., 2009[296,297] **Study design:** Prospective cross-sectional study **Duration of follow up:** Not reported	**Patient group:** Patients with painful hips after low energy trauma (e.g. fall from a sitting or standing position) **Inclusion criteria:** • Difficulty or inability to bear weight after a fall • Tenderness around the hip with painful hip motion • Negative pelvic and hip radiographic finding **Exclusion criteria:** • Prior ipsilateral hip fractures or surgery • Contraindications to MRI **<u>All patients</u>** **N:** 30 **Mean age (range):** 73 (26-94) **M/F:** 6/24 **Drop outs:** 0	**Assessment tool under investigation:** Sonography (HDI 5000 ultrasound device) Bilateral hips were examined and saggital, axial and coronal planes and particular attention was paid to the hip joint and greater trochanteric regions searching for fracture lines, joint and bursal effusions and peritrochaneric oedema The findings were recorded before the MRI examination **Reference standard:** MRI within 72 hours of admission on a 1.5-T Sigma scanner or a 1.5-T Avanto scanner. Scans were performed in the axial and coronal planes with a T1 weighted fast spin echo sequence and with Short Tau inversion recovery with magnitude display sequence. The scans were performed in the axial plane from the level of the anterior superior iliac spine to 5 cm below the level of the lesser trochanter. In the coronal plane, the scans were performed from the symphysis pubis to the sacrum. The MRI scans were read by a radiologist with 15 years experience in musculoskeletal MRI, who was blinded to the sonographic findings	**Sensitivity** **Specificity** **PPV** **NPV** **LR+** **LR-** **Prevalence**	100% 65% 59% 100% 2.85 0 33%	**Funding:** Not reported **Limitations:** Sonographic examinations performed by 2 musculoskeletal radiologists who may not always be available at community hospitals 72 hours delay before MRI was given The time from injury to admission ranged from 0 to 14 days (average 1.7 days) **Notes:** An overall well conducted and well reported study with low risk of bias

Evidence tables – imaging

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Rizzo et al., 1993[286,286] **Study design:** Prospective Cross sectional **Duration of follow-up:** 6 months	**Patient group:** Patients whose history and clinical examination suggestive of a hip fracture but whose radiographs were negative **Inclusion/exclusion criteria:** Not reported **All patients** **N:** 62 **Mean age (range):** 73 (26-93) **M/F:** 23/39 **Drop outs:** 0	**Assessment tool under investigation:** bone scanning 72 hours after admission using a technetium-99m bone scan **Reference standard:** MRI within 24 hours after admission. Only T1-weighted coronal spin-echo pulse sequences were obtained	**Sensitivity**	97.3%	**Funding:** None **Limitations:** Patients had MRI within 24 hours of admission whereas bone scanning was carried out 72 hours after admission **Notes:** 1 patient had an initial negative CT scan bit a positive MRI scan. CT scanning after 6 days showed a positive result. This patient has been considered as a false negative in this analysis
			Specificity	100%	
			PPV	100	
			NPV	95.8	
			LR+	0	
			LR-	0.02	
			Prevalence	60	

Evidence tables – imaging

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Evans et al., 1994[87,88] **Study design:** Prospective cross sectional study **Duration of follow-up:** 3 months	**Patient group:** Elderly patients admitted to hospital with hip pain after a fall and whose radiographs were normal or showed a fracture of the greater trochanter **Inclusion/exclusion criteria:** Not reported **<u>All patients</u>** **N:** 37 **Mean age (range):** not reported **Drop outs: 0**	**Assessment tool under investigation:** Isotope scanning Tecnitium 99m, 48 hours after MRI scan **Reference standard:** MRI, 5 minute sequence of T1-weighted coronal images. Where necessary Short tau inversion recovery and/or T2 weighted images were also obtained	**Sensitivity**	75%	**Funding:** None **Limitations:** Relatively small patient numbers Isotope scans given 48 hours after the fall to avoid false positives Not clear who interpreted the results and whether they were blind to the results of the reference standard test Authors did not report any information on patient demographics **Notes:**
			Specificity	100%	
			PPV	100	
			NPV	93	
			LR+	0	
			LR-	0.25	
			Prevalence	22	

17.2 Evidence Table 2: Timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Alani et al., 2008[4] **Country of study:** Sweden **Study design:** *Prospective cohort* **Duration of follow-up:** Hospital stay	**Patient group:** Patients with hip fracture **Setting:** Danderd and Huddinge hospitals, Stockholm, Sweden. **Inclusion criteria:** • Patients with acute hip fracture aged 50 years or older **Exclusion criteria:** • Patients with a pathological fracture and patients who arrived at the hospital one calendar day after the time of injury. **<u>All patients</u>** **N:** 744 **Lost to follow up:** 22 patients (missing data for return to independent living) **Age (mean ±SD):** 81 **M/F:** 200/544 Diagnosis of dementia: 209 (28%) N for time to surgery: ≤24h = 359 >24 = 385 ≤36 = 550 >36 = 194	**<u>Group 1</u>** Early surgery. ≤48 hours **<u>Group 2</u>** Late surgery. >48 hours	**Return to independent living** Adjusted odds ratio adjusted for age, sex, prefracture walking ability, whether patient was living with someone, ASA score, treatment modality, reoperation, and reason for delay of surgery.	**Unadjusted (patients without dementia):** **Group 1**: 320/375 **Group 2:** 43/59 Missing data: 22 (5%) **<24 hours:** 178/209 **≥24 hours:** 185/225 Missing data: 22 (5%) **<36 hours:** 282/329 **≥36 hours:** 81/105 Missing data: 22 (5%) **Adjusted odds ratio:** Delay >24h: 0.86 (0.45 to 1.65) NS Delay >36h: 0.44 (0.21 to 0.90) P<0.05 Delay >48h: 0.33 (0.14 to 0.78) P<0.01	**Funding:** One or more authors received, in any one year, outside funding or grants in excess of $10,000 from the Stockholm County Council Research Fund for clinical studies. No benefits received from commercial entities. **Limitations:** Impact of comorbidity on mortality (unadjusted data). **Additional outcomes reported**: None **Notes:** None
			Pressure ulcers Adjusted odds ratio adjusted for age, prefracture walking ability, dementia, ASA score, and duration of surgery.	**Unadjusted:** **Group 1**: 41/646 **Group 2:** 20/98 **<24 hours:** 53/354 **≥24 hours:** 60/345 p<0.05 **<36 hours:** 31/550 **≥36 hours:** 30/194 p<0.0001	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	≤48 = 646 >48 = 98 **<u>Group 1 Early</u>** **No.:** 646 **No. of dropouts:** not stated **Age (mean):** 81 **M/F:** 166/480 **Other factors**: **Diagnosis of dementia:** 181 (28%) **<u>Group 2 Late</u>** **No. :** 98 **No. of dropouts:** not stated **Age (mean):** 81 **M/F:** 34/64 **Other factors**: **Diagnosis of dementia:** 28 (29%) Delay due to: Patient related (e.g. medical): 57 (58%) System related (e.g. no available operating room): 41 (42%)			**Adjusted odds ratio:** Delay >24h: 2.19 (1.21 to 3.96) P<0.01 Delay >36 hours: 3.42 (1.94 to 6.04) P<0.001 Delay >48 hours: 4.34 (2.34 to 8.04) P<0.001	
			Length of hospital stay – median (including rehab)	**Unadjusted:** **Group 1**: 15 **Group 2:** 21 **<24 hours:** 14 **≥24 hours:** 18 p <0.001 **<36 hours:** 15 **≥36 hours:** 19 p <0.001	
			Length of hospital stay – median (including rehab), excluding days prior to surgery	**Unadjusted:** **Group 1**: 13 **Group 2:** 16 p <0.01 **<24 hours:** 14 **≥24 hours:** 17 p <0.05 **<36 hours:** 15 **≥36 hours:** 18 p <0.05	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Mortality rate – 4 months Adjusted odds ratio adjusted for age, sex, prefracture walking ability, dementia and ASA score.	**Adjusted odds ratio:** Delay >24h: 1.07 (0.67 to 1.70) NS Delay >36h: 1.05 (0.63 to 1.74) NS Delay >48h: 0.86 (0.44 to 1.69) NS	

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Bergeron et al., 2006[19,19] **Country of study:** Canada **Study design:** *Retrospective cohort* **Duration of follow-up:** Hospital stay	**Patient group:** Patients with hip fracture **Setting:** Analysis of hospital administrative database. **Inclusion criteria:** • Consecutive patients aged 15 years and older admitted with a diagnosis of fracture of the proximal femur from April 1, 1993 to March 31, 2003. • Patients with a low velocity fall from a maximum of standing height. **Exclusion criteria:** • A preadmission delay >24 hours, no surgery, other associated injuries with Abbreviated Injury Scale of 2 or more, and inter hospital transfers. **<u>All patients</u>** **N:** 977 **Age (mean ±SD):** 81.4 (32 – 104) **M/F:** 332/645 **Comorbidity:** Cardiac disease: 40.1% Neurologic disease and dementia: 36.5% Pulmonary disease: 20.6%	**<u>Group 1</u>** Early surgery. ≤48 hours **<u>Group 2</u>** Late surgery. > 48 hours	**In hospital mortality**	**All** **Group 1**: 99/848 **Group 2:** 20/129 With comorbidity **Group 1**: 93/600 **Group 2:** 20/99 **<24 hours:** 53/354 **≥24 hours:** 60/345 Without comorbidity **Group 1**: 6/248 **Group 2:** 0/30 **<24 hours:** 6/169 **≥24 hours:** 0/109 **Adjusted Odds ratio:** 24-48hs (vs.24h): 0.88 (0.55-1.41) >48 hours (vs. 24h): 1.16 (0.64-2.13)	**Funding:** Not stated **Limitations:** Comparison is >48h vs. 0-24 h time to surgery
			Postoperative length of stay in days (median)	**All** **Group 1**: <24 hrs: 18 24-48 hrs: 19 **Group 2**: 28 With comorbidity **Group 1**: <24 hrs: 20 24-48 hrs: 22 **Group 2**: 30 Without comorbidity	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Diabetes: 16.4% Anticoagulation:6.6% Chronic renal dialysis: 2.1% Active cancer:2.1% Cirrhosis: 0.3% **Fall occurred at:** Home: 58.2% Nursing home: 21.5% Outdoor: 19% In-hospital: 1.2% **Time of surgery:** **<24h:** 523 **24-48h:** 325 **>48h:** 129 **<u>Group 1 Early</u>** **No.:** 848 **No. of dropouts:** not stated **Age (mean):** <24 hrs: 79 24-48 hrs: 80 **M/F:** <24 hrs: 25%/75% 24-48 hrs: 21.5%/78.5% **Sever complications:** 17.2% Dementia: 308/848 **<u>Group 2 Late</u>** **No. :** 129 **No. of dropouts:** not stated **Age (mean):** 80 **M/F:** 24%/76% **Sever complications:** 24.8% Dementia: 49/129			**Group 1**: <24 hrs: 16 24-48 hrs: 15 **Group 2**: 20	
			Severe complications (Cerebrovascular accident, cardiovascular complication, digestive complication – except unspecified paralytic ileus- dialysis)	**All** **Group 1**: 147/848 **Group 2:** 40/129 **<24 hours:** 88/523 **≥24 hours:** 90/454 **Adjusted Odds ratio:** 24-48hs (vs. 24h): 0.87 (0.58-1.29) >48 hours (vs. 24h): 1.32 (0.79-2.20)	

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Bottle et al., 2006[30,31] **Country of study:** England **Study design:** *Retrospective cohort* **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** NHS hospital trusts in England with at least 100 admissions for fractured neck of femur **Inclusion criteria:** • Patients aged ≥65 admitted with a primary diagnosis of fractured neck of femur admitted from their own home. • Patients with a first hip fracture only were included. **Exclusion criteria:** • Patients admitted from nursing and residential homes **<u>All patients</u>** **N:** 114,942 **<u>Group 1 Early</u>** **No.:** 90551 **No. of dropouts:** not stated **Age (mean <u>+</u>SD):** not stated **<u>Group 2 Late</u>** **No. :** 24391 **No. of dropouts:** not stated **Age (mean <u>+</u>SD):** not stated	Patients underwent one of 4 types of surgery: fixation, prosthetic replacement of head of femur, other procedure (including non-orthopaedic) and no procedure recorded (medical management). **<u>Group 1</u>** Early surgery. < 2days **<u>Group 2</u>** Late surgery. > 2 days	**30 day mortality** **30 day mortality Adjusted Odds ratios (**adjusted for age, sex, deprivation fifth and comorbidity) **Emergency readmission within 28 days (**adjusted for age, sex, deprivation fifth and comorbidity)	**Group 1**: 6366/90551 **Group 2:** 2625/24391 **>1 day vs. ≤1 day:** 1.25 (1.19 to 1.31) **>2 day vs. ≤2 day:** 1.36 (1.29 to 1.43) **>1 day vs. ≤1 day:** 1.04 (0.99 to 1.08) **>2 day vs. ≤2 day:** 1.04 (0.99 to 1.10)	**Funding:** The unit is funded by a grant from Dr Foster Ltd (an independent health service research organisation). **Limitations:** Baseline characteristics given for entire cohort, which includes patients who did not receive surgery. **Additional outcomes reported**: Adjusted effect of operative delay on mortality, excess risk of death

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Grimes et al.,2002[125] **Country of study:** USA **Study design:** *Retrospective cohort* **Duration of follow-up:** 5 – 10 years	**Patient group:** Patients with hip fracture **Setting:** 20 hospitals in New Brunswick, New Jersey; San Antonio, Texas; Philadelphia, Pennsylvania; and Richmond, Virginia – and represented university, community, and Veterans Affairs medical centers. **Inclusion criteria:** • Consecutive patients with hip fracture who were aged 60 years or older and who underwent surgical repair between 1983 and 1993. **Exclusion criteria:** • Patients were excluded if they had metastatic cancer, trauma resulting in multiple injuries requiring surgery, or declined blood transfusion for religious reasons. • Patients with a fracture occurring >48 hours before admission to the hospital. **<u>All patients</u>** **N:** 8383 **Lost to follow up:** Not stated	Time from admission to surgery. **<u>Group 1</u>** Early surgery **<u>Group 2</u>** Late surgery	**30 day mortality**	**Group 1**: 175 **Group 2**: Active medical problems: 56 No medical problems:166	**Funding:** Not stated **Limitations:** No baseline data provided
			30 day mortality (adjusted odds ratio)	>48-72h: 0.71 (0.45-1.10) n = 3805	
			Decubitus Ulcer (adjusted odds ratio)	>48-72h: 1.2 (0.9-1.6) n = 3579	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (mean ±SD): 80.4 ±8.6 **M/F:** 1751/6632 **Group 1 Early (≤ 24 hours)** **No.:** 4578 **No. of dropouts:** not stated **Age (mean ±SD):** 60-69: 590 70-79: 1356 80-89: 1972 ≥90: 3683 **M/F:** 895/3683 **Other factors**: ASA class: 1 or 2: 1341 3: 2852 4 or 5: 385 **Group 2 Late (≥ 24 hours)** **No. :** 3805 **No. of dropouts:** not stated **Age (mean ±SD):** 60-69: 485 70-79: 1089 80-89: 1683 ≥90: 549 **M/F:** 858/2949 **Other factors**: ASA class: 1 or 2: 974 3: 2279 4 or 5: 552				

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Lefaivre et al., 2009[189,189] **Country of study:** Canada **Study design:** *Retrospective cohort* **Duration of follow-up:** In hospital	**Patient group:** Patients with hip fracture **Setting:** Vancouver General Hospital **Inclusion criteria:** All patients over the age of 65 who had been admitted with an isolated fracture of the proximal femur between 1998 and 2001. **<u>All patients</u>** **N:** 607 **M/F:** 125/482 **Delay to surgery** **<24h:** 245 **24 to 48:** 264 **>48:** 98 Age: <75: 102, 76 – 85: 262 86 – 95: 212, 96 – 105: 30 106 – 115: 1 Medical comorbidities: 0: 141 1 to 2: 405 ≥3: 61	Pre-existing medical comorbidity was quantified by listing the pre-injury medical diagnoses by a body system such as cardiac, pulmonary, autoimmune, substance dependence etc. Patients were catagorised into no major comorbidity, those with one to two body systems with major comorbidity and those with ≥3 body systems with major comorbidities.	**Logistic regression model (adjusted for medical comorbidity age, gender and fracture type)** **24 to 48h** **Odds ratio (95% CI)**	**Death** 0.82 (0.42 to 1.62) p = 0.5713 **Major medical complication** 0.96 (0.52 to 1.75) p = 0.8868 **Minor medical complication** 1.53 (1.05 to 2.22) p = 0.0257 **Pressure sores** 1.23 (0.71 to 2.12) p = 0.4700	**Funding:** None **Limitations:** **Notes:** 690 patients added to the database, of these they were only able to review the complete medical records of 607 patients.
		Logistic regression model (adjusted for medical comorbidity age, gender and fracture type) **> 48h**	**Death** 0.93 (0.38 to 2.33) p = 0.8840 **Major medical complication** 2.21 (1.01 to 4.34) p = 0.0260 **Minor medical complication** 2.27 (1.38 to 3.72) p = 0.0012 **Pressure sores** 2.29 (1.19 to 4.40) p = 0.0128	

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Majumdar et al., 2006[200,200] **Country of study:** Canada **Study design:** *Retrospective cohort* **Duration of follow-up:** 30 days	**Patient group:** Patients with hip fracture **Setting:** Tertiary care hospitals in Edmonton, Alberta, Canada **Inclusion criteria:** Consecutive patients with hip fracture during March 1994 to February 2000 Patients aged 60 years or older Hip fracture patients included femoral neck, intertrochanteric, subtrochanteric or subcapital fractures. **Exclusion criteria:** Patients with multiple traumatic fractures, pathologic hip fractures, or bilateral hip fractures. **<u>All patients</u>** **N:** 3981 (3846 – had surgery) **Age (mean ±SD):** 82 (±8.52) **M/F:** 1154/2827 **Time of surgery:** **<24h**: 1048 **24 – 48h**: 2152 **>48h:** 664 **<u>Group 1 Early</u>** **No.:** 3200	Timing of surgery was based on the calendar date of hospital admission and calendar date of surgical repair. **<u>Group 1</u>** Early surgery. Within 48 hours of admission **<u>Group 2</u>** Late surgery. After 48 hours of admission	**In hospital mortality**	**Group 1**: 160/3200 **Group 2**: 66/664 **<24 hours:** 5/1046 **≥24 hours:** 36/2933 Adjusted odds ratio: **24 -48hr vs. <24:** 0.90 (0.85-1.99) P = 0.59 **>48hr vs. <24h:** 1.30 (0.86-2) p = 0.21	**Funding:** None **Limitations:** Adjusted odds ratios compare <24h to >48h time to surgery. **Additional outcomes reported**: Type of fracture, % with dementia, prefracture comorbidities **Notes:**
			1 year mortality	**Group 1**: 970/3200 **Group 2**: 219/664 **<24 hours:** 5/1046 **≥24 hours:** 35/497	
			Length of stay (after surgery) (in days, median, with interquartile range)	**Group 1**: <24h: 7 (1-13) 24-48h: 8 (2-14) **Group 2**: 11 (0-24)	
			Complications (Myocardial infarction, heart failure, cardiac arrhythmia, electrolytes abnormal, anaemia, pneumonia, urinary tract infection).	**Group 1**: 614/3200 **Group 2**: 130/664 **<24 hours:** 235/1046 **≥24 hours:** 509/497	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	No. of dropouts: not stated **Age (mean ±SD):** 82 **M/F:** 892/2308 **Group 2 Late** **No. :** 664 **No. of dropouts:** not stated **Age (mean ±SD):** 81 **M/F:** 214/450				

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Moran et al., 2005[215,215] **Country of study:** UK **Study design:** *Prospective cohort* **Duration of follow-up:** 30 days	**Patient group:** Patients with hip fracture **Setting:** University hospital Nottingham **Inclusion criteria:** • All adult patients with a fracture of the femoral neck. **Exclusion criteria:** • Isolated femoral head fractures and acetabular fractures • 140 patients who did not have surgery were excluded **All patients** **N:** 2148 **Lost to follow up:** **Age (mean ±SD):** 80 **M/F:** 684/2219 **Group 1 Early** **No.:** 982 **No. of dropouts:** not stated **Age (mean ±SD):** not stated **Group 2 Late** **No. :** 1166 **No. of dropouts:** not stated **Age (mean ±SD):** not stated	**Group 1** Early surgery. No delay, surgery performed in less than one day of admission **Group 2** Late surgery. Surgery after 1 day or more from admission	**30 day mortality of patients fit for surgery:**	**No delay**: 85/982 **Delay 1 day**: 85/1166 p = 0.51 **No delay**: 134/1651 **Delay 2 day**: 36/497 **No delay**: 158/1978 **Delay 3 day**: 12/170 **No delay**: 166/2092 **Delay 4 day**: 4/56	**Funding:** Not stated **Limitations:** No protocol for determining which patients were unfit for surgery and anaesthesia, therefore variation between clinicians. **Notes:** Delay to surgery was most frequently due to acute medical comorbidity (206 patients). The subgroup of patients who were fit for surgery is given; any delay here is due to logistical reasons.

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Orosz et al., 2004[250,250] **Country of study:** USA **Study design:** Prospective cohort **List who was masked to interventions**: Nurses identifying complications were not aware of the study hypothesis, but physicians categorising complications were not blinded. **Duration of follow-up:** 6 months	**Patient group:** Patients with hip fracture **Setting:** 4 hospitals in the New York City metropolitan area (an academic medical centre, an urban teaching hospital, and a suburban hospital) **Inclusion criteria:** Patients with hip fracture aged 50 and over. **Exclusion criteria:** Patients aged younger than 50 years, fractures that occurred as an inpatient, transfers from another hospital, multiple trauma, pathological fractures, distal and femoral shaft fractures, bilateral hip fractures, or previous fracture or surgery on the currently fractured site. **<u>All patients</u>** **N:** 1203 **Age (mean ±SD):** **M/F:** **<u>Group 1 Early</u>** **No.:** 398 **No. of dropouts:** not stated	Patients enrolled as early in the admission as possible (69% on or before the day of surgery). **<u>Group 1</u>** Surgery within 24 hours **<u>Group 2</u>** Surgery after 24 hours Adjustments to odd ratios were based on age, sex, nursing home residence, needing a proxy for consent, delirium on admission, prefracture FIM locomotion score, fracture type, history of diabetes, COPD, stroke syndrome, dementia, cardiac disease,	**Major postoperative complications** (those that pose a threat to life or bodily functions and that typically are treated with parenteral medications, procedures, or intensive monitoring e.g. pneumonia or arrhythmias. Data for patients enrolled in 1st 12 months only.	**Adjusted OR =** 0.26 (0.07to 0.95) **p =** 0.04	**Funding:** Grants were received from the Agency for Healthcare Research and Quality **Limitations:** Baseline data given for study arms, but not for reported separately for the restricted cohort. **Additional outcomes reported**: **Notes:** Restricted cohort excluded patients who might not be candidates for early surgery because of markedly abnormal clinical findings or the need for additional time for preoperative evaluation. This, the restricted cohort excludes patients admitted with
			Mean pain scores over the first 5 hospital days. Data for patients enrolled in 1st 12 months only. Score from 1 (none) - 5 (very severe pain).	**Group 1:** 2.52 **Group 2:** 2.90 **Difference (95% CI) =** -0.38 (-0.61 to -0.16) **p =** 0.001	
			Number of days of severe pain over hospital days 1-5 (assessed by asking if they were experiencing no pain, or mild, moderate or severe pain). Data for patients enrolled in 1st 12 months only.	**Group 1:** 0.50 **Group 2:** 0.80 **Difference (95% CI) =** -0.30 (-0.50 to -0.08) **p =** 0.007	
			Length of stay, mean stay in days and adjusted odds ratio	**Group 1:** 6.94 **Group 2:** 7.85 **Difference (95% CI) =** -0.91 (-1.81 to -	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (mean ±SD): 82 (9.2) **M/F:** 82/316 **Delirium at admission:** 10 **Admitted from nursing home :** 63 **Group 2 Late** **No. :** 780 **No. of dropouts:** **Age (mean ±SD):** 82 (8.6) **M/F:** 147/633 **Delirium at admission:** 20 **Admitted from nursing home :** 90 The restricted cohort is a subset of the groups shown above, which is described in the notes section.	hypertension, hospitalisation within 6 months, hospital site, day and time of admission and abnormal clinical findings.		0.01) **p =** 0.05	abnormal clinical findings, aortic stenosis, dementia, and endstage renal disease on dialysis.
			FIM locomotion score at 6 months (2-item subscale focusing on walking and climbing stairs)	**Group 1:** 9.94 **Group 2:** 9.97 **Difference (95% CI) =** -0.03 (-0.60 to 0.54) **p =** 0.91	
			FIM self care (6 item scale of self-care activities including bathing and dressing)	**Group 1:** 34.8 **Group 2:** 35.4 **Difference (95% CI) =** -0.60 (-1.98 to 0.65) **p =** 0.32	
			FIM transferring (3 item scale focusing on transfers from the bed, toilet and bath tub)	**Group 1:** 15.7 **Group 2:** 15.7 **Difference (95% CI) =** 0 (-0.64 to 0.77) **p =** 0.85	
			Dead or needing total assistance in locomotion at 6 months	**Adjusted OR =** 0.62 (0.35 to 1.08) **p =** 0.09	

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Siegmeth et al., 2005A[308,308] **Country of study:** England **Study design:** *Prospective cohort* **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Peterborough District Hospital **Inclusion criteria:** Patients with hip fracture admitted to the Peterborough Hip fracture service **Exclusion criteria:** • Patients aged younger than 60 years, those treated conservatively and those with a pathological fracture or a fracture of the shaft or distal femur. • Patients who were delayed for any medical reason when orthopaedic or anaesthetic staff felt that operation should be delayed in order to improve the patient's fitness for surgery **<u>All patients</u>** **N:** 3628 **Lost to follow up:** 2 **Age (mean ±SD):** 81 (8.06) **<u>Group 1 Early (≤ 48 hours)</u>** **No.:** 3454 **Age (mean ±SD):** **M/F:** 656/2798	Surgical treatment involved either internal fixation with cannulated screws or hemiarthroplasty for intracapsular fixation. Those with extracapsular fractures were operated on with a dynamic hip screw or an intramedullary nail device. **<u>Group 1</u>** Early surgery **<u>Group 2</u>** Late surgery	**Mean hospital stay in days (95% CI)** (includes time spent on orthopaedic ward and any other hospital wards or convalescent units until eventual discharge to a permanent place of residence)	**Group 1**: 21.6 **Group 2**: 36.5 (5.7-16) **P value(s)**: <0.0001	**Funding:** No benefits in any form were/will be received from a commercial party related directly or indirectly to the subject of the article. **Limitations:** Baseline data reported for 6 individual groups, but not split according to <48 or >48 hours delay. **Outcomes not reported**: *List the outcomes in which we are interested that are not reported here* **Additional outcomes reported**: N/A **Notes:** Delay for non-medical reasons was because of lack of operating theatre space, equipment or available staff.
			Return to original residence (%)	**Group 1**: 2974 (86.1%) **Group 2**: 128 (73.6%) **P value(s)**: <0.0001	
			Change in residence (admitted to a more dependent accommodation)	**Group 1**: 240 (6.9%) **Group 2**: 22 (12.6%) **P value(s)**: <0.0007	
			Mortality at 1 year	**Group 1**: 238 (6.9%) **Group 2** 24 **(**13.8%) **P value(s)**: <0.001	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Group 2 Late (> 48 hours) **No. :** 174 **Age (mean ±SD):** **M/F:** 39/135				

Evidence tables – timing of surgery

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Weller et al., 2005[351,351] **Country of study:** Canada **Study design:** *Retrospective cohort* **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** **Inclusion criteria:** • Patients aged over 50 years who were admitted to hospital in Ontario, Canada between 1993 and 1999 for surgical treatment of a hip fracture from the Canadian Institute for Health Information Discharge Abstracts Database **Exclusion criteria:** • Delay to surgery ≥ 7 days. **All patients** **N:** 57,315 **Lost to follow up:** Not stated **Age (mean ±SD):** Men: 77.7 ±10.2 Woman: : 81.4 ±8.8 **M/F:** 14,329/42,986 **Group 1 Early (≤ 2 days)** **No.:** 52,937 **No. of dropouts:** not stated **Age (mean ±SD):** not stated **M/F:** not stated	**Group 1** Early surgery < 2 days **Group 2** Late surgery >2 days	**In-hospital mortality**	**Group 1**: 3509 (6.6%) **Group 2**: 433 (10%) **<24hr:** 1177/20303 **≥24hr:** 2765/37012 Adjusted Odds Ratio: 1 day: 1.17 (1.08-1.26) 2 days: 1.36 (1.23 – 1.52) >2 days: 1.60 (1.42 to 1.80)	**Funding:** N/R **Limitations:** One aim of the study was to determine whether mortality after hip fracture is related to type of hospital (teaching or non teaching and urban or rural) in which the patient is treated. **Notes:** A modified Charlson-Deyo index was used to adjust for comorbidity. An algorithm was used in order to identify any major complications after hip fracture surgery, including infection deep vein thrombosis, intra-operative surgical complications and
			3 -month mortality	**Group 1**: 7277 (13.7%) **Group 2:** 790 (18%) **<24hr:** 2552/20303 **≥24hr:** 5515/37012 Adjusted Odds Ratio: 1 day: 1.11 (1.05 – 1.17) 2 days: 1.27 (1.17 – 1.37) >2 days: 1.40 (1.27 to 1.53)	
			6-month mortality	**Group 1**: 9441 (17.8%) **Group 2**: 1038 (24%) **<24hr:** 3361/20303 **≥24hr:** 7118/37012 Adjusted Odds Ratio: 1 day: 1.09 (1.04 – 1.15) 2 days: 1.20 (1.12 – 1.29) >2 days: 1.42 (1.31 to 1.55)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Other factors: **<u>Group 2 Late (> 2 days)</u>** **No. :** 4378 **No. of dropouts:** not stated **Age (mean ±SD):** not stated **M/F:** not stated Data given by type of hospital, not by delay to surgery.		**1-Year mortality**	**Group 1**: 12233 (23.1%) **Group 2**: 1313 (30%) **<24hr:** 4366/20303 **≥24hr:** 9180/37012 Adjusted Odds Ratio: 1 day: 1.13 (1.05 – 1.22) 2 days: 1.26 (1.11 – 1.44) >2 days: 1.58 (1.26 to 1.99)	significant medical complications.

17.3 Evidence Table 3: Optimal analgesia

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker et al.,2002[262,270] **Study design:** Cochrane systematic review. The review includes 17 randomised and quasi randomised studies **Setting:** Hospitals in Europe, Turkey, South Africa and Israel. **Duration of follow-up:** Range: 24 hours-6 months. Also includes: length of	**Patient group:** Hip fracture **Inclusion criteria:** Skeletally mature patients with a proximal femoral fracture undergoing nerve blocks (including epidurals) versus no nerve blocks. **Exclusion criteria:** Not stated **<u>All patients</u>** **N (range):** 888 (19-100) **Age range:** 59-86 **M/F:** 70-95% **Drop outs:** Most trials report 0%. 1 trial reported 2% and 3 did not state the number lost to follow up.	**Group 1** Nerve blocks (any type, subcostal, lateral cutaneous, femoral, triple, psoas) **Group 2** no block (either systemic analgesics or placebo)	**Pain**	**Group 1:** 106 **Group 2:** 104 **SMD** -0.52 (-0.8 to -0.25) **p value:** p = 0.0002	**Funding:** Supported internally by Peterborough and Stamford NHS Foundation Trust, UK and externally by Scottish Home and Health Department, UK. **Additional outcomes:** Length of operation, operative hypotension, intra-operative blood gases, complications specific to methods of treatment, allergic reactions, cerebrovascular accident, congestive cardiac failure, renal failure **Notes:**
			Unsatisfactory pain control preoperatively or need for 'breakthrough' analgesia	**Group 1:** 18/150 (12%) **Group 2:** 47/148 (31.8%) **Relative risk:** 0.37 **95% CI:** (0.23-0.61) **p value:** p<0.0001	
			Nausea and/or vomiting	**Group 1:** 18/141 (12.8%) **Group 2:** 25/159 (15.7%) **Relative risk:** 1.05 **95% CI:** (0.63-1.75) **p value:** 0.84	
			Need for anti-emetics	**Group 1:** 0/20 (0%) **Group 2:** 5/20 (25%) **Relative risk:** 0.09 **95% CI:** (0.01-1.54) **p value:** not reported	
			Wound infection	**Group 1:** 0/28 (0%) **Group 2:** 2/27(7.4%) **Relative risk:** 0.019 **95% CI:** (0.01-3.85) **p value:** p= 0.14	
			Pneumonia	**Group 1:** 12/129 (9.3%) **Group 2:** 25/130 (19.2%) **Relative risk:** 0.49 **95% CI:** (0.26-0.94)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
hospital stay and duration of time in emergency department				**p value:** 0.03	
			Any cardiac complication	**Group 1:** 3/62 (4.8%) **Group 2:** 12/62 (19.4%) **Relative risk:** 0.25 **95% CI:** (0.07-0.84**)** **p value:** 0.02	
			Myocardial infarction	**Group 1:** 1/34 **Group 2:** 4/34 **Relative risk:** 0.25 **95% CI: (**0.03-2.12) **p value:** Not significant	
			Puritis	**Group 1:** 0/20 **Group 2:** 5/20 **Relative risk:** 0.09 **95% CI:** (0.01-1.54) **p value:**	
			Pulmonary embolism	**Group 1:** 1/53 (1.9%) **Group 2:** 2/52 (3.8%) **Relative risk:** 0.66 **95% CI:** (0.11-3.86) **p value:** 0.64	
			Deep vein thrombosis	**Group 1:** 7/116 (6%) **Group 2:** 7/137 (5.1%) **Relative risk:** 1.12 **95% CI:** (0.43-2.93) **p value:** 0.82	
			Mortality	**Group 1:** 9/189 (4.8%) **Group 2:** 19/205 (9.3%) **Relative risk:** 0.59 d **95% CI:** (0.29-1.21)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				p value: 0.15	
			Pressure sores	**Group 1:** 3/86 (3.5%) **Group 2:** 9/106 (8.5%) **Relative risk:** 0.51 **95% CI:** (0.11-2.39) **p value**: 0.39	
			Confusional state	**Group 1:** 15/77 (19.5%) **Group 2:** 34/101 (33.7%) **Relative risk:** 0.63 **95% CI:** (0.37-1.06) **p value:** 0.08	

17.4 Evidence Table 4: Anaesthesia

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker et al., 2004[266,270] **Study design:** Cochrane systematic review. Includes 22 randomised and quasi randomised controlled trials **Duration of follow-up:** Range: 2 days to 30 months	**Patient group:** Hip fracture patients **Inclusion criteria** Skeletally mature patients undergoing hip fracture surgery **Exclusion criteria** Not stated **All patients** **N (range):** 2567 **Age range:** 60-91 **Drop outs:** 0-7%. Not stated **Setting:** Hospitals in Europe, Hong Kong, New Zealand, Japan	**Group 1** Regional (spinal or epidural) anaesthesia **Group 2** General anaesthesia	**Mortality (early up to 1 month)**	**Group 1:** 64/912 (7%) **Group 2:** 93/966 (9.6%) **Relative risk:** RR 0.73 **95% CI:** (0.54-0.99) **p value:** 0.04	**Funding:** Supported internally University of Teesside, Middlesbrough, UK and Peterborough and Stamford Hospitals NHS Foundation Trust, Peterborough, UK. **Limitations:** **Additional outcomes:** Length of operation, operative hypotension, operative blood loss, patients receiving blood transfusion, transfusion requirements, postoperative hypoxia, cerebrovascular accident, congestive cardiac failure, renal failure, urine retention. **Notes:** All results reported in this table have been obtained using a fixed
			Mortality at 1 month	**Group 1:** 56/811 (6.9%) **Group 2:** 86/857 (10%) **Relative risk:** 0.69 **95% CI:** (0.50-0.95) **p value:** 0.02	
			Mortality at 3 months	**Group 1:** 86/726 (12%) **Group 2:** 98/765 (13%) **Relative risk:** 0.92 **95% CI:** (0.92-1.21) **p value:** 0.55	
			Mortality at 6 months	**Group 1:** 103/613 (17%) **Group 2:** 105/651 (16%) **Relative risk:** 1.04 **95% CI:** (0.81-1.33) **p value:** 0.76	
			Mortality at 12 months	**Group 1:** 80/354 **Group 2:** 78/372 **Relative risk:** 1.07 **95% CI:** (0.82-1.33) **p value:** 0.61	
			Length of stay in hospital	**Group 1:** n=108 **Group 2:** n=110 **Mean Difference:** -0.21	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				95% CI: -5.21-4.78 **p value:** (If no p-value: Sig/Not sig/NR)	effect model. Where there was heterogeneity a random effects model was used the results of which have not been reported here (please refer to forest plots).
			Vomiting	**Group 1:** 2/46 (4.3%) **Group 2:** 3/49 (6.1%) **Relative risk:** 0.7 **95% CI:** (0.12-3.94) **p value:** 0.68	
			Acute confusional state	**Group 1:** 11/117 (9.4%) **Group 2:** 23/120 (19.2%) **Relative risk:** 0.5 **95% CI:** (0.26-0.95) **p value:** 0.03	
			Pneumonia	**Group 1:** 21/574 (3.7%) **Group 2:** 29/612 (4.7%) **Relative risk:** 0.76 **95% CI:** (0.44-1.3) **p value:**0.32	
			Myocardial infarction	**Group 1:** 5/502 (1%) **Group 2:** 11/531 (2.1%) **Relative risk:** 0.55 **95% CI:** (0.22-1.37) **p value:** 0.2	
			Pulmonary embolism	**Group 1:** 9/605 (1.5%) **Group 2:** 13/640 (2%) **Relative risk:** 0.88 **95% CI:** (0.32-2.39) **p value:** 0.8	
			Deep vein thrombosis	**Group 1:** 39/129 (30.2%) **Group 2:** 61/130 (36.9%) **Relative risk:** 0.64 **95% CI:** (0.48-0.86)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				p value: 0.003	

17.5 Evidence Table 5: Surgeon seniority

Study details	Patients	Exposure	Outcome measures	Effect size	Comments
Enocson et al., 2008[85,85] **Country of study:** Sweden **Study design:** Historical cohort **List who was masked to interventions**: Not applicable **Duration of follow-up:** Median 2.3 (0-10) years	**Patient group:** Consecutive patients who had a hemiarthroplasty for non-pathological displaced femoral neck fracture **Setting:** Orthopaedics department **Inclusion criteria:** • Not reported **Exclusion criteria:** • None reported **All patients** **N:** 739 hips in 720 patients **No. of dropouts:** not reported **Age (mean ±SD):** women: 84 (54-103) , men 82 (55-97) years **M/F:** 147/592	Surgeon experience Group 1 Post registrar: 604 operations Group 2 Registrar: 135 operations 59 surgeons in total - number of surgeons by grade not reported	**Number of dislocations**	**Group 1:** 37/404 (9.2%) **Group 2:** 8/135 (5.9%)	**Funding:** None reported **Limitations:** No details about surgeons and the number in each group. Not reported how patients were allocated to surgeons, no mention of anaesthetists grade/experience involved in operations. **Outcomes not reported**: Mortality, length of stay in secondary care, reoperations, quality of life, functional status, wound infection.
			Dislocation by 'post registrars' compared to 'Registrars'. Logistic regression **univariate analysis**	Odds ratio: 1.0 (0.4, 2.2) P=0.9	
			Dislocation by 'post registrars' compared to 'Registrars'. Logistic regression **multivariate analysis** adjusted for age, sex, indication for surgery, surgical approach and type of hemiarthroplasty	Odds ratio: 1.3 (0.6, 3.0) P=0.5	

Evidence tables – surgeon seniority

Study details	Patients	Exposure	Outcome measures	Effect size	Comments
Enocson et al., 2009[83,85] **Country of study:** Sweden **Study design:** Historical cohort **List who was masked to interventions**: Not applicable **Duration of follow-up:** Median 4.3 (0-11) years	**Patient group:** Consecutive patients who had a primary total hip replacement for non-pathological displaced femoral neck fracture (Garden III or IV) or secondary total hip replacement due to a fracture healing complication (non-union or avascular necrosis) after internal fixation. **Setting:** Orthopaedics department **Inclusion criteria:** • Not reported **Exclusion criteria:** • None reported **All patients** **N:** 713 hips in 698 patients **No. of dropouts:** not reported **Age (mean ±SD):** women: 78 ±8.6 (46-96) , men 74 ±9.8 (45-90) years **M/F:** 140/573	Surgeon experience Group 1 Post registrar: 636 operations Group 2 Registrar: 77 operations 54 surgeons in total - number of surgeons by grade not reported	**Number of dislocations**	**Group 1:** 38*/636 (6%) **Group 2:** 3*/77 (3.9%)	**Funding:** None reported **Limitations:** No details about surgeons and the number in each group. Not reported how patients were allocated to surgeons, no mention of anaesthetists grade/experience involved in operations. **Outcomes not reported**: Mortality, length of stay in secondary care, reoperations, quality of life, functional status, wound infection.
			Dislocation by 'post registrars' compared to 'Registrars'. Cox regression **univariate analysis**	Hazard ratio: 1.4 (0.4, 4.5) P=0.6	
			Dislocation by 'post registrars' compared to 'Registrars'. Cox regression **multivariate analysis** adjusted for age, sex, indication for surgery, surgical approach and femoral head size	Hazard ratio: 0.9 (0.3, 2.8) P=0.8	
				* number calculated by NCGC	

Evidence tables – surgeon seniority

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Palm et al., 2007[256,257] **Country of study:** Denmark **Study design:** Prospective cohort **List who was masked to interventions**: None **Duration of follow-up:** 6 months	**Patient group:** Consecutive patients with proximal fracture of the femur. Various classifications of fracture. **<u>All patients</u>** **N:** 600 **No. of dropouts:** none **<u>Group 1</u>** **No.:** 137 **No. of dropouts:** 0 **Age (mean ±SD):** 81 (72-87) **M/F:** 12/44 **Types of fracture:**: Technically demanding fractures ○ Posterior angulated Garden I-II (n=8) ○ Garden III-IV (n=23) ○ Petrotrochanteric (Evans type 5) (n=23) ○ Per-/subtrochanteric (n=2) ○ Subtrochanteric (n=0) ○ Pathological (n=0) Technically undemanding fractures ○ Garden I-II (n=13) ○ Basocervical (n=4) ○ Petrotrochanteric (Evans type 1-4)	Surgeon experience. Number of surgeons not reported. **Group 1** Unsupervised orthopaedic junior surgeon (<3 years orthopaedic surgical experience) 137 operations (56 classified as technically demanding). **Group 2** Experienced surgeon (> 3 years orthopaedic surgical experience) 463 operations (309 classified as technically demanding.	**Reoperation at 6 months for technical demanding fractures** (unadjusted for other factors)	**Group 1:** 16/56 (29%) **Group 2:** 47/309 (15%) P=0.015	**Funding:** Supported by grant from IMK Fonden **Limitations:** Not stated how patients were allocated to surgeons, no mention of anaesthetists grade/experience involved in operations. Senior surgeons operated on significantly more patients with a poor prefracture mobility score **Outcomes not reported**: Mortality, length of stay in secondary care, requirement for surgical revision, wound infection. **Additional outcomes reported**:
			Reoperation at 6 months for technical demanding fractures (multivariate analysis combining age >85, female gender, ASA score III-IV, Pre fracture New Mobility score 0-5 (poor score), time to surgery >1 day from admission & type of implant (arthroplasty or osteosynthesis)).	**Odds ratio** 2.01 (1.01, 4.02) P=0.048	
			Prefracture New Mobility Score of 0-5 (scale 0f 0-9, score of 0 means patient is unable do any of the following: to get around the house, get out of the house or go shopping. Score of 9 means the patient can do all 3 with no difficulty)	**Group 1:** 173/309 (56%) **Group 2:** 21/56 (38%) P=0.011	
			Number of patients receiving arthroplasty	**Group 1:** 166/309 (54%) **Group 2:** 12/56 (21%) P<0.0001	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	(n=64) **<u>Group 2</u>** **No.:** 463 **No. of dropouts:** 0 **Age (mean ±SD):** 83 (77-88) **M/F:** 63/246 **Types of fracture:** Technically demanding fractures ○ Posterior angulated Garden I-II (n=18) ○ Garden III-IV (n=176) ○ Petrotrochanteric (Evans type 5) (n=73) ○ Per-/subtrochanteric (n=18) ○ Subtrochanteric (n=20) ○ Pathological (n=4) Technically undemanding fractures ○ Garden I-II (n=43) ○ Basocervical (n=11) ○ Petrotrochanteric (Evans type 1-4) (n=100)				multivariate analysis for age >85, female gender, ASA score III-IV, Pre fracture New Mobility score 0-5 (poor score), time to surgery >1 day from admission & type of implant. **Notes:** Only technically demanding fractures were analysed by logistic regression.

17.6 Evidence Table 6: Displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker et al., 2010[263,265,270] **Country of study:** **Study design:** Systematic review including 6 out of the 19 RCTs from the review with 734 participants. The remaining RCTs were not relevant to this comparison. **Duration of follow-up:** Average ranged from 6 months to 4 years	**Patient group:** Skeletally mature patients with a proximal femoral fracture. **Setting:** Hospital	**Group 1** Hemiarthroplasty (cemented or uncemented) **Group 2** Total hip replacement **Additional non-comparative prophylaxis**: Not applicable	**Outcomes extracted**	Results reported in forest plots for: - Mortality at 3 to 4 months, 1 year & 2 to 4 years - Number of reoperations - Pain – residual pain and Harris Hip Score for pain at 1 year - Failure to regain mobility at final follow up - Functional scores: Oxford Hip Score, Harris Hip Score, Barthel Score, Hip Rating Questionnaire, Short Form 36 physical function score - Self reported walking distance at end of study. - Quality of Life – Eq-5d index score - All medical complications - Length of hospital stay	**Funding:** supported internally at Peterborough and Stamford Hospitals NHS Trust, UK. No external source of funding. **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: length of surgery, hypotension during surgery, operative blood loss, postoperative blood transfusion, cost of treatment, leg shortening, external rotation deformity **Notes:**

Evidence tables – displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker et al., 2006[264,270] **Country of study:** **Study design:** Systematic review including 17 RCTs with 2694 participants. **Duration of follow-up:** Average ranged from 1 to 13 years	**Patient group:** Skeletally mature patients with a intracapsular proximal femoral fracture. **Setting:** Hospital 12 trials involving 1973 participants compared internal fixation to hemiarthroplasty. 6 trials involving 881 participants compared internal fixation to total hip replacement. The numbers do not add up to 17 trials and 2694 participants as: 1 trial of 409 patients was not included in our analysis as it did not distinguish between hemiarthroplasty and total hip replacement; and two trials investigated a three way comparison of internal fixation, hemiarthroplasty and total hip replacement .	**Group 1** Internal fixation **Group 2** a. Hemi-arthroplasty b. total hip replacement **Additional non-comparative prophylaxis**: Not applicable	**Outcomes extracted**	Results in forest plots for: - Mortality at 1 month, 3 months, 1 year & 2 to 4 years - Number of reoperations split into major, moderate, minor and total number of reoperations - Pain at 1 year and 2 to 3 years - Failure to return to same place of residence by final follow up - Failure to regain mobility at final follow up - All medical complications - Length of hospital stay	**Funding:** supported internally at Peterborough and Stamford Hospitals NHS Trust, UK. No external source of funding. **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: length of surgery, hypotension during surgery, operative blood loss, postoperative blood transfusion, cost of treatment, leg shortening, external rotation deformity **Notes:**

Evidence tables – displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Frihagen et al., 2007[102,103] **Country of study:** Norway **Study design:** RCT **List who was masked to interventions**: Investigators of functional outcomes were blinded to interventions. Unclear if anyone else was masked to the intervention after randomisation. **Duration of follow-up:** 24 months	**Patient group:** Patients with a intracapsular femoral neck fracture with angular displacement in either radiographic plane. **Inclusion criteria** - age ≥60 - ability for independent ambulation before fracture - displaced femoral neck fracture **Exclusion criteria** - unfit for arthroplasty according to anaesthesiologist - previous symptomatic hip pathology such as arthritis - pathological fracture - delay of more than 96 hours from injury to treatment - living outside hospital's designated area **Setting:** Hospital **All patients** **N:** 222 **No. of dropouts:** 0	**Group 1** Closed reduction and internal fixation with two parallel cannulated screws (Olmed, DePuy/Johnson and Johnson, Sweden) **Group 2** Charnley-Hastings bipolar cemented hemiarthroplasty (DePuy/Johnson and Johnson, Sweden).	**Mortality at 30 days**	**Group 1**: 7/112 **Group 2**: 10/110 **P value(s)**: 0.42	**Funding:** Norwegian Foundation for Health and Rehabilitation through the Norwegian Osteoporosis Society and the Norwegian Research Council, Nycomed, Smith and Nephew, and OrtoMedic **Limitations:** Functional outcome ata not available for all patients. **Outcomes not reported**: length of superspell, place of residence 12 months after fracture, pain **Additional outcomes reported**: time from admission to surgery, time in operation theatre, time of surgery,
			Mortality at 90 days	**Group 1**: 16/112 **Group 2**: 20/110 **P value(s)**: 0.43	
			Mortality at 12 months	**Group 1**: 24/112 **Group 2**: 29/110 **P value(s)**: 0.39	
			Mortality at two years	**Group 1**: 39/112 **Group 2**: 39/110 **P value(s)**: 0.92	
			Any medical complication	**Group 1**: 28/111 **Group 2**: 30/109 **P value(s)**: 0.70	
			Total number of reoperations at 24 months	**Group 1**: 70/111 **Group 2**: 13/108 **P value(s)**: <0.001	
			Total number of hips with any reoperation at 24 months	**Group 1**: 47/111 **Group 2**: 11/108 **P value(s)**: <0.001	
			Total number of hips with major reoperation at 24 months	**Group 1**: 44/111 **Group 2**: 11/108 **P value(s)**: <0.001	
			Length of hospital stay (mean ±SD)	**Group 1**: 8.2 ±7.35 (n= 111) **Group 2**: 10.2 ±11.95 (n= 109) **P value(s)**: 0.14	
			Harris hip score (mean ±SD) at 4 months	**Group 1**: 59.6 ±19.5 (n= 89) **Group 2**: 67.7 ±15.8 (n= 84) **P value(s)**: 0.003	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Group 1: internal fixation **No. randomised:** 112 **No. of dropouts:** 0 **Mean age (SD):** 83.2 (7.65) **M/F:** 25/87 **Other factors**: **Concurrent symptomatic medical disease**: 52 **Previously recognised cognitive failure**: 40 **Ability to walk without any aid**: 67 **Mean time from injury to admission**: 8 hours **Group 2:** hemiarthroplasty **No. randomised:** 110 **No. of dropouts:** 0 **Mean age (SD):** 82.5 (7.32) **M/F:** 32/78 **Other factors**: **Concurrent symptomatic medical disease**: 64 **Previously recognised cognitive failure**: 29 **Ability to walk without any aid**: 60 **Mean time from injury to admission**: 5.5 hours		**Harris hip score (mean ±SD) at 12 months**	**Group 1**: 65.8 ±15.9 (n= 87) **Group 2**: 72.6 ±17.5 (n= 74) **P value(s)**: 0.01	intraoperative blood loss, main surgeons with >3 years experience with procedure, spinal anaesthesia, no. receiving blood transfusion while admitted, postoperative confusion, cognitive failure at 4 months, type of reoperation **Notes:**
			Harris hip score (mean ±SD) at 24 months	**Group 1**: 67.3 ±15.5 (n= 71) **Group 2**: 70.6 ±19.1 (n= 68) **P value(s)**: 0.26	
			Eq-5d index score (mean ±SD) at 4 months	**Group 1**: 0.53 ±0.29 (n= 79) **Group 2**: 0.61 ±0.30 (n= 70) **P value(s)**: 0.06	
			Eq-5d index score (mean ±SD) at 12 months	**Group 1**: 0.56 ±0.33 (n= 70) **Group 2**: 0.65 ±0.30 (n= 62) **P value(s)**: 0.07	
			Eq-5d index score (mean ±SD) at 24 months	**Group 1**: 0.61 ±0.31 (n= 52) **Group 2**: 0.72 ±0.23 (n= 52) **P value(s)**: 0.03	
			Eq-5d visual analogue scale (mean ±SD) at 4 months	**Group 1**: 53 ±18.5 (n= 69) **Group 2**: 62 ±21.0 (n= 60) **P value(s)**: 0.01	
			Eq-5d visual analogue scale (mean ±SD) at 12 months	**Group 1**: 57 ±21.6 (n= 59) **Group 2**: 63 ±24.3 (n= 54) **P value(s)**: 0.16	
			Eq-5d visual analogue scale (mean ±SD) at 24 months	**Group 1**: 60 ±18.0 (n= 45) **Group 2**: 60 ±21.0 (n= 43) **P value(s)**: 0.84	
			No. patients with Barthel Index Score of 95 or 100 at 4 months	**Group 1**: 41/88 **Group 2**: 40/80 **P value(s)**: 0.66	
			No. patients with Barthel Index Score of 95 or 100 at 12 months	**Group 1**: 31/87 **Group 2**: 39/73 **P value(s)**: 0.02	
			No. patients with Barthel	**Group 1**: 24/69	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Index Score of 95 or 100 at 24 months	**Group 2**: 26/68 **P value(s)**: 0.02	
			Total number of complications at 24 months	**Group 1**: 70/111 **Group 2**: 16/108 **P value(s)**: <0.001	
			Total number of hips with any complication at 24 months	**Group 1**: 56/111 **Group 2**: 16/108 **P value(s)**: <0.001	
			Total number of hips with major complication at 24 months	**Group 1**: 47/111 **Group 2**: 11/108 **P value(s)**: <0.001	
			Complications at 24 months – deep infection	**Group 1**: 7/111 **Group 2**: 7/108 **P value(s)**:	
			Complications at 24 months – mechanical failure of internal fixation/non-union	**Group 1**: 40/111 **Group 2**: 3/108 **P value(s)**:	
			Complications at 24 months – dislocation of hemiarthroplasty	**Group 1**: 6/111 **Group 2**: 1/108 **P value(s)**:	
			Complications at 24 months – avascular necrosis	**Group 1**: 6/111 **Group 2**: 0/108 **P value(s)**:	
			Median (range) time to complication	**Group 1**: 137.5 (8-730) days (n= 111) **Group 2**: 18 (6-730) days (n= 109) **P value(s)**: 0.01	

Evidence tables – displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Macauley et al., 2008[197,197] **Country of study:** USA **Study design:** RCT **List who was masked to interventions**: Unclear if anyone was masked to the intervention after randomisation. **Duration of follow-up:** 24 months	**Patient group:** Patients with a displaced intracapsular proximal femoral fracture. **Inclusion criteria** - age ≥50 - ability for independent ambulation before fracture - displaced femoral neck fracture (Garden III or IV which the surgeon considered not amenable to treatment with open reduction internal fixation (ORIF)) - ability to comprehend either English or Spanish **Exclusion criteria** - chronic severe dementia (defined as <23 of 30 on Folstein Mini Mental State Examination (MMSE)) - pathological fracture - other concomitant long bone fractures or fractures requiring surgical repair - preexisting arthritis of the ipsilateral hip **Setting:** Hospital	**Group 1** Hemiarthroplasty (unipolar or bipolar, cemented or uncemented stem). **Group 2** Total hip replacement with a femoral head of 28mm or more (cemented or uncemented stem).	**Mortality at 6 months after surgery**	**Group 1**: 5/23 **Group 2**: 1/17 **P value(s)**: 0.21	**Funding:** American Association of Hip and Knee Surgeons, Orthopaedic Research and Education Foundation **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: duration of operation **Notes:** study designed to demonstrate the feasibility of a large randomised, multicentre trial with multiple surgeons treating subjects with displaced intracapsular femoral neck fractures.
			Mortality at mean follow up of 34 months (29 to 42 months)	**Group 1**: 9/23 **Group 2**: 5/17 **P value(s)**: 0.53	
			Bodily pain at 12 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 42.4 ±11.5 (n= 23) **Group 2**: 53.2 ±10.2 (n= 17) **P value(s)**: 0.02	
			Pain on injured side at 12 months (WOMAC 1-100) (mean ±SD)	**Group 1**: 88.5 ±13.6 (n= 23) **Group 2**: 92.5 ±14.6 (n= 17) **P value(s)**: 0.50	
			Bodily pain at 24 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 44.7 ±10.5 (n= 23) **Group 2**: 54.8 ±7.9 (n= 17) **P value(s)**: 0.03	
			Pain on injured side at 24 months (WOMAC 1-100) (mean ±SD)	**Group 1**: 77.8 ±20.9 (n= 23) **Group 2**: 94.4 ±6.8 (n= 17) **P value(s)**: 0.05	
			Physical function at 12 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 32.8 ±10.0 (n= 23) **Group 2**: 33.5 ±12.0 (n= 17) **P value(s)**: 0.87	
			Function at 12 months (WOMAC 1-100) (mean ±SD)	**Group 1**: 78.7 ±16.8 (n= 23) **Group 2**: 75.9 ±19.8 (n= 17) **P value(s)**: 0.71	
			Physical function at 24 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 35.1 ±12.9 (n= 23) **Group 2**: 38.6 ±8.9 (n= 17) **P value(s)**: 0.52	
			Function at 24 months (WOMAC 1-100) (mean	**Group 1**: 65.1 ±18.1 (n= 23) **Group 2**: 81.8 ±10.2 (n= 17)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	All patients **N:** 41 **No. of dropouts:** 1 (2.5%) **Group 1:** hemiarthroplasty **No. randomised:** 23 **No. of dropouts:** 0 **Mean age (SD):** 77 (9) **M/F:** 9/14 **Other factors**: **Average no. comorbid conditions**: 4.2 (1-11) **Group 2:** total hip replacement **No. randomised:** 18 **No. of dropouts:** 1 **Mean age (SD):** 82 (7) **M/F:** 10/7 **Other factors**: **Average no. comorbid conditions**: 3.5 (0-7)		**±SD)**	**P value(s)**: 0.66	
			Physical component summary score at 12 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 36.4 ±9.2 (n= 23) **Group 2**: 40.2 ±9.9 (n= 17) **P value(s)**: 0.35	
			Physical component summary score at 24 months (SF-36 subscales 1-100) (mean ±SD)	**Group 1**: 40.9 ±12.3 (n= 23) **Group 2**: 43.0 ±7.5 (n= 17) **P value(s)**: <0.68	
			Harris Hip Score on injured side at 12 months (1-100) (mean ±SD)	**Group 1**: 80.6 ±14.3 (n= 23) **Group 2**: 84.2 ±12.0 (n= 17) **P value(s)**: 0.55	
			Harris Hip Score on injured side at 24 months (1-100) (mean ±SD)	**Group 1**: 81.1 ±11.7 (n= 23) **Group 2**: 84.0 ±12.2 (n= 17) **P value(s)**: 0.64	
			TUG score (Take "Up and Go"score at 12 months (mean ±SD)	**Group 1**: 16.5 ±10.1 (n= 23) **Group 2**: 17.2 ±13.5 (n= 17) **P value(s)**: 0.89	
			TUG score (Take "Up and Go")score at 24 months(mean ±SD)	**Group 1**: 16.9 ±10.1 (n= 23) **Group 2**: 14.7 ±7.2 (n= 17) **P value(s)**: 0.64	
			Length of stay in hospital (mean ±SD days)	**Group 1**: 7.7 ±5.5 (n= 23) **Group 2**: 5.4 ±2.8 (n= 17) **P value(s)**: 0.18	
			Length of stay in hospital (median days)	**Group 1**: 7 (n= 23) **Group 2**: 6 (n= 17)	

Evidence tables – displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Mouzopoulos et al., 2008[218,218] **Country of study:** Greece **Study design:** RCT **List who was masked to interventions**: **Duration of follow-up:** 4 years	**Patient group:** Patients with a displaced subcapital hip fractures (Garden III or IV) **Inclusion criteria** - displaced femoral neck fracture (Garden III or IV) **Exclusion criteria** - previous hip surgery - history of cancer or Paget's disease - rheumatic arthritis **Setting:** Hospital **All patients** **N:** 129 **No. of dropouts:** 34 at 1 year, 67 at 4 years **Group 1:** internal fixation **No. randomised:** 43 **No. of dropouts:** 11 at 1 year, 24 at 4 years **Mean age (SD):** 75.38 (4.62)* **M/F:** 12/26* **Other factors**: **Average no. comorbid conditions**: 4.2 (1-11)	**Group 1** Internal fixation (Richards plate screw, Smith & Nephew, Memphis, TN, USA) **Group 2** Hemiarthroplasty (Merete, Berlin, Germany). **Group 3** Total hip replacement (Plus; DePuy, Warsaw, IN, USA).	**Mortality at 1 year**	**Group 1**: 6/43 **Group 2**: 6/43 **Group 3**: 5/43 **P value(s)**:	**Funding:** not reported **Limitations:** method of randomisation unclear study: patients assigned in order of type of fixation: hemiarthroplasty, total hip replacement, internal fixation. No indication that anyone was masked to the intervention. **Outcomes not reported**: **Additional outcomes reported**: mentions but provides no figures for range of passive motion, and walking speed. Barthel Index score prefracture **Notes:**
			Mortality at 4 years	**Group 1**: 15/43 **Group 2**: 13/43 **Group 3**: 11/43 **P value(s)**:	
			Prefracture function according to the Barthel Index Score	**Group 1**: 85.2 ±4.8 (n= 43) **Group 2**: 81.05 ±8.95 (n= 43) **Group 3**: 87.4 ±17.4 (n= 43)	
			Function according to the Barthel Index Score at 1 year	**Group 1**: 77.1 ±7.1 (n= 32) **Group 2**: 76.8 ±6.8 (n= 30) **Group 3**: 84.8 ±14.8 (n= 33)	
			Function according to the Barthel Index Score at 4 years	**Group 1**: 80.1 ±5.3 (n= 19) **Group 2**: 79.6 ±6.3 (n= 20) **Group 3**: 85.3 ±11.6 (n= 23)	
			Harris Hip Score at 1 year	**Group 1**: 71.3 ±5.3 (n= 32) **Group 2**: 77.81 ±9.6 (n= 30) **Group 3**: 83.7 ±4.8 (n= 33) P value <0.05 for comparison between group 1 and 3	
			Harris Hip Score at 4 years	**Group 1**: 73.6 ±6.7 (n= 19) **Group 2**: 79.5 ±6.5 (n= 20) **Group 3**: 83.7 ±4.8 (n= 23) P value <0.05 for comparison between group 1 and 3	
			Number of revisions	**Group 1**: 12/43 **Group 2**: 5/43 **Group 3**: 1/43	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				P value(s):	
	Group 2: hemiarthroplasty **No. randomised:** 43 **No. of dropouts:** 13 at 1 year, 23 at 4 years **Mean age (SD):** 74.24 (3.77)* **M/F:** 10/24* **Other factors**: **Average no. comorbid conditions**: 3.5 (0-7) **Group 3:** total hip replacement **No. randomised:** 43 **No. of dropouts:** 10 at 1 year, 20 at 4 years **Mean age (SD):** 73.07 (4.93)* **M/F:** 9/28* **Other factors**: **Average no. comorbid conditions**: 3.5 (0-7) * data not provided for all patients				

17.7 Evidence Table 7: Surgery – Cement versus no cement

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker et al., 2010[265] **Country of study:** UK **Study design:** Systematic review including 19 RCTs, 6 relating to cemented stems in old designs of hemi-arthroplasty with 899 participants, 1 relating to new styles of stems with 220 participants **Duration of follow-up:** Average ranged from 6 months to 4 years	**Patient group:** Skeletally mature patients with a proximal femoral fracture. **Setting:** Hospital	**Group 1** Cemented prostheses **Group 2** Uncemented prostheses **Additional non-comparative prophylaxis**: Not applicable	**Outcomes extracted for older designs of hemiarthroplasty**	Results reported in forest plots for: - Mortality at up to 1 month, 1 to 3 months, 1 year & 3 years - Number of reoperations at 8 to 20 months - Failure to regain mobility at 12 to 17 months - Change in mobility score at 12 months - Length of hospital stay - Number of patients failing to return home at 1.5 to 5 years - Pain at 3 months and 1 to 2 years - Pain score at 6 months - Number of reoperations at 8 to 20 months - Deep sepsis at 1 to 5 years - Wound haematoma at 1 to 5 years - All medical complications	**Funding:** Not reported **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: length of surgery, hypotension during surgery, operative blood loss, postoperative blood transfusion, cost of treatment, leg shortening, external rotation deformity **Notes:** Review also compares: different types of unipolar or bipolar hemiarthroplasties, unipolar vs. bipolar hemiarthroplasty, uncemented
			Outcomes extracted for new designs of hemiarthroplasty	Results reported in forest plots for: - Mortality at 30 days, 9 days, 1 year & 2 years - Number of reoperations at 12 months - Need for pain medication at 12 months - Unable to walk without aids at 12 to months - Functional scores: Barthel Index,	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				Harris Hip Score and Eq-5d at 12 months - Length of hospital stay	hemiarthroplasty vs. total hip replacement, cemented hemiarthroplasty vs. total hip replacement, different types of total hip replacement.

17.8 Evidence Table 8: Extracapsular fixation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Ahrengart et al., 2002[3,3] **Country of study:** Sweden and Finland **Study design:** RCT **List who was masked to interventions**: Not reported. **Duration of follow-up:** 6 months	**Patient group:** Patients with intertrochanteric fractured femur. **Setting:** 5 hospitals. **Inclusion criteria:** • Fracture types 1 to 5 of the Evans' classification of intertrochanteric fractures, as modified by Jensen and Michaelsen. **Exclusion criteria:** • Subtrochanteric and pathologic fractures, earlier fractures or operations on the same hip, or if the surgeon was unfamiliar with the Gamma nail technique. **All patients** **N:** 492 **No. of dropouts:** 66 (13%) **Group 1: Gamma nail** **No. randomised:** 210 **No. of dropouts:** **Mean age (range):** F: 82 (48-96) M: 77 (44-90) **M/F:** 63/147 **Other factors**:	96% of patients were operated on within 2 days. **Group 1 Gamma nail** The 12mm diameter Gamma nail was used in 73%, the 14mm nail in 20% and the 16mm nail in 7% of patients. The proximal femur was reamed to a 2mm larger diameter than the diameter of the nail. In patients with stable fractures, distal locking was used in 68% of patients, and in unstable fractures 74% of patients. **Group 2 Compression hip screw** The Richard's classic or the Dynamic hip screw was used. 2 hole plates were used in 5%, 4 hole in 67%, 5 hole in 20%, 6 hole in 7%, and 8 or 10 in 2% of patients in whom a compression screw was used.	**Additional fissure/fracture perioperatively**	**Group 1**: 5 **Group 2**: 2	**Funding:** The Karolinska Institute Foundation, Lund University, Skane County Council and Stryker-Howmedica. **Outcomes not reported**: Place of residence **Additional outcomes reported**: Radiological parameters, operation time, blood loss, % of fractures healed in preoperative position, hip rotation **Notes:** Of the 5 hospitals participating in the study, 1 centre was active for 3 years, whereas the others participated for 2
			Other technical/surgical problems	**Group 1**: 5 **Group 2**: 2	
			Duration of hospital stay, mean (range)	**Group 1**: 10 (1 – 100) **Group 2**: 10 (1 – 100)	
			Wound infection	**Group 1**: 10 (1 – 100) **Group 2**: 10 (1 – 100)	
			Cut out of lag screw	**Group 1**: 14 **Group 2**: 4	
			Mortality of 6 months	**Group 1**: 41 **Group 2**: 37	
			Healed fracture at 6 months	**Group 1**: 89% **Group 2**: 88%	
			Lateral pain over the femoral head screw at 6 months	**Group 1**: 27% **Group 2**: 26%	
			Pain at the top of the greater trochanter at 6 months	**Group 1**: 20% **Group 2**: 6% **p<0.001**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	ASA score: 1: 16% 2: 42% 3: 34% 4: 8% 5: 0 **Group 2: Compression hip screw** **No. randomised:** 216 **No. of dropouts:** **Age (mean ±SD):** F: 81 (54-99) M: 74 (32-98) **M/F:** 60/156 **Other factors**: ASA score: 1: 20% 2: 39% 3: 36% 4: 6% 5: 0	**Additional non-comparative prophylaxis**: 81% of patients received antibiotic prophylaxis. Prophylactic anticoagulants were given to 75% of the patients; 56% received dextran and 18% received heparin preparations or warfarin.	**Needs walking aid**	**Group 1**: 72% **Group 2**: 70%	years each. In most cases patient who were lost to follow up were absent at the final exam due to advanced age, other physical illness, or dementia. Spinal anaesthesia used in 90% of patients.
			Lives at home	**Group 1**: 65% **Group 2**: 62%	
			Internal hip rotation of the fractured leg	**Group 1**: 15˚ (0 – 50˚) **Group 2**: 15˚ (0 – 45˚)	
			External hip rotation of the fractured leg	**Group 1**: 20˚ (0 – 70˚) **Group 2**: 30˚ (0 –60˚) **p = p<0.001**	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Aune et al., 1994[9,9] **Country of study:** Norway **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** Median follow-up was 17 months (10-27)	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospitals, Norway **Inclusion criteria:** • Trochanteric or subtrochanteric femoral fractures **Exclusion criteria:** • None stated **<u>All patients</u>** **N:** 378 **No. of dropouts:** 0 **<u>Group 1: Gamma nail</u>** **No. randomised:** 177 **Mean age (range):** 82 (49-96) **M/F:** 66/109 **Other factors**: Stable trochanteric = 84 Unstable trochanteric = 76 Subtrochanteric = 14 **<u>Group 2: Hip compression screw (HCS)</u>** **No. randomised:** 201 **Age (mean ±SD):** **M/F:** 89/114 **Other factors**: Stable trochanteric = 89 Unstable trochanteric = 98 Subtrochanteric = 17	**<u>Group 1</u>** All the Gamma nails (Howmedica) were modified to a 6 degree valgus angle, 4 degrees less than in the standard nail. The slot for the lag screw had a 131 degree angle in relation to the shaft. The diameters of the nails used were 12 or 14mm. The medullary canal was over-reamed 2mm. In 119 of 177 nailings distal locking screws were inserted through a jig. **<u>Group 2</u>** Hip compression screw (Smith and Nephew)	**Requirement for reoperation**	**Group 1**: 13/177 – Stable trochanteric =5 femoral shaft fractures and 2 cut out of the lag screw – Unstable trochanteric =4 femoral shaft fractures and 1 cut out of the lag screw – Subtrochanteric = 1 femoral shaft fracture **Group 2**: 2/201 – Stable trochanteric = 1 cut out of the lag screw – Unstable trochanteric = 1 cut out of the lag screw – Subtrochanteric = 0 **P value(s)**: $P < 0.003$	**Funding:** Not reported **Limitations:** Small study, little detail about randomization and few outcomes reported e.g. mortality etc. **Outcomes not reported**: Mortality, length of stay in hospital, place of residence, functional status. **Additional outcomes reported**: Further details of the 15 patients requiring reoperation, including time from operation to reoperation. **Notes:** Fracture type assessed by methods of Jenson and Zickel.

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Barton et al., 2010[14,14] **Country of study:** UK **Study design:** RCT **List who was masked to interventions**: No blinding of assessor or patients. **Duration of follow-up:** 1 year	**Patient group:** Patients with fracture of the proximal femur **Setting:** Dept Trauma and Orthopaedics, Frenchay Hospital, Bristol. **Inclusion criteria:** Patients aged over 18 with AO/OTA 31-A2 fracture of the proximal femur. **Exclusion criteria:** Pathological fractures, previous proximal femoral fracture, reverse oblique fractures, and a decision by the surgeon responsible for the patient's care not to include the patient in the study. **<u>All patients</u>** **N:** 210 **No. of dropouts:** 2 **Mean age (range):** 83.2 (42 to 99) **M/F:** 44/166 **<u>Group 1:</u>** **No. randomised:** 110 **No. of dropouts:** 0 **Mean age (range):** 83.3 (56 to 97) **M/F:** 25/85 **Other factors**: ASA score	All surgeons performing the operations had experience with the 2 implants. Following surgery, patients were mobilized bearing full weight under the supervision of a physiotherapist. Following discharge, patients were evaluated both clinically and radiographically at 3, 6 and 12 months. **<u>Group 1</u>** Sliding hip screw (Omega 2; Stryker, Newbury, UK) A four-hole, 135˚ plate was inserted. **<u>Group 2</u>** Long gamma nail (Dyax; Stryker) The femur was reamed to 1mm greater than the	**Reoperation (screw cut-out, implant failure, late fracture, and deep infection)**	**Group 1**: 2 **Group 2**: 3 **P value(s)**: 0.67 (all were screw cut out)	**Funding:** No external funding **Limitations:** Initial power calculation produced a sample requirement of 220 patients. **Outcomes not reported**: **Additional outcomes reported**: Requirement for transfusion, demographic characteristics (side of fracture, mini-mental score), tip-apex distance >25mm **Notes:**
			Mortality	**30 days** **Group 1**: 11 **Group 2**: 21 **P value(s)**: 0.13 **1 year** **Group 1**: 24 **Group 2**: 32 **P value(s)**: 0.26	
			Length of hospital stay	**Group 1**: 31 (1 to 154) **Group 2**: 32 (1 to 164) **P value(s)**: 0.17	
			Mobility (change in score – points) (1 – unaided, 2 – one cane or crutch , 3 – two canes or crutches, 4 – walker, 5 – wheelchair)	**Group 1**: 1.49 **Group 2**: 1.86 **P value(s)**: 0.26	
			Change in residence (change in score – points) (1 – own home, 2 – sheltered housing, 3 – residential home, 4 – nursing home, 5 – hospital)	**Group 1**: 1.23 **Group 2**: 1.16 **P value(s)**: 0.79	
			EuroQol 5D	**QUALY** **Group 1**: 0.46	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	1: 2, 2: 46, 3: 59, 4: 3 **<u>Group 2:</u>** **No. randomised:** 100 **No. of dropouts:** 2 died before surgery **Mean age (range):** 83.1 (42 to 99) **M/F:** 19/81 **Other factors**: ASA score 1: 0, 2: 47, 3: 49, 4: 4	diameter of the nail, and a 130˚ nail of the appropriate length was inserted; all nails were locked distally with 2 screws.		**Group 2**: 0.37	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Bridle et al., 1991[37,37] **Country of study:** UK, London **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** At least 6 months	**Patient group:** Patients with intertrochanteric fractured femur. **Inclusion criteria:** • Patients diagnosed with intertrochanteric fractured femur **Exclusion criteria:** • Not reported **<u>All patients</u>** **N:** 100 **No. lost to follow up:** 6 **<u>Group 1: Gamma nail</u>** **No. randomised:** 49 **Age:** 81.0 **M/F:** 9/40 **Other factors**: ASA score: I = 2 II = 23 III = 20 IV = 4 Fracture type: Stable: 18 Unstable: 31	**<u>Group 1</u>** The Gamma nail was inserted using a 'closed' technique under image intensifier control. The patient is positioned on the traction table, and the fracture is reduced with the leg adducted. A 6 cm incision is made just proximal to the greater trochanter, which is entered using a curved awl. The entry point is just lateral to the tip of the trochanter. A guide wire is introduced into the femoral shaft, and flexible reamers are used to the appropriate size. A nail, 1 to1.5 mm smaller than the final reamer, is selected. No attempt is made to ream the shaft to accept a large nail. The angle of the nail ranges from 125 to 140 degrees. **<u>Group 2</u>** Dynamic hip screws were inserted using the standard technique.	**Mortality**	**<u>Before discharge</u>** **Group 1:** 10 **Group 2:** 9 **<u>6 months post op</u>** **Group 1:** 15 **Group 2:** 19	**Funding:** Not reported **Limitations:** Allocation concealment unclear. **Outcomes not reported**: Length of stay in hospital, reoperation. **Additional outcomes reported**: Operative details **Notes:** Treatment was randomised at the time of anaesthesia.
			Complications	**<u>Group</u>** **1** **2** **CVA** 4 0 **Bronchopneumonia** 1 3 **Pulmonary embolism** 1 0 **Pressure score** 4 1 **Wound infection** 1 2 **Wound haematoma** 0 2	
			Accommodation Before injury	**Home** Group 1: 32 Group 2: 24 **Non-institution** Group 1: 3 Group 2: 8 **Non-hospital institution** Group 1: 9 Group 2: 13 **Hospital** Group 1: 5 Group 2: 6	
			Accommodation Latest review (at least 6 months post op)	**Home** Group 1: 24 Group 2: 18 **Non-institution** Group 1: 2 Group 2: 4	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Anaesthesia: Spinal = 6 General = 43 **<u>Group 2: Dynamic hip screw (DHS)</u>** **No. randomised:** 51 **Mean age:** 82.7 **M/F:** 7/44 **Other factors**: ASA score: I = 2 II = 22 III = 16 IV = 11 Fracture type: Stable: 23 Unstable: 28 Anaesthesia: Spinal = 7 General = 44			**Non-hospital institution** Group 1: 3 Group 2: 15 **Hospital** Group 1: 11 Group 2: 3	
			Mobility (before injury)	**Unaided** Group 1: 31 Group 2: 25 **Sticks** Group 1: 6 Group 2: 16 **Frame** Group 1: 17 Group 2: 9 **Non-walker** Group 1: 5 Group 2: 1	
			Mobility (final review)	**Unaided** Group 1: 7 Group 2: 11 **Sticks** Group 1: 24 Group 2: 9 **Frame** Group 1: 13 Group 2: 14 **Non-walker** Group 1: 13 Group 2: 3	
			Cut out	Group 1: 2 Group 2: 3	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Femoral shaft fracture	Group 1: 4 Group 2: 0	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Ekstrom et al., 2007[77,77] **Country of study:** Sweden **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** 12 months	**Patient group:** Unstable trochanteric and subtrochanteric fractures **Inclusion criteria:** Unstable intertrochanteric proximal femoral fractures and subtrochanteric fractures. **Exclusion criteria:** Stable trochanteric fractures, high energy trauma, pathological fractures, previous surgery to the proximal femur, daily steroids of more than 10mg of prednisolone, ongoing chemotherapy, irradiation treatment, presence of degenerative osteoarthritis of the injured hip. **Setting:** 2 orthopaedic hospitals, Sweden **All patients** **N:** 210 **No. of dropouts:** 25% (7 exclusions made: 5 wrong fracture and 2 wrong treatment). **Group 1: Proximal femoral nail** **No. randomised:** 105	Spinal anaesthesia was used, although 13 patients had general anaesthesia and 1 had a combination of both. **Group 1: Proximal femoral nail (Stratec)** The nail used was a 240mm long nail with a 130 degree shaft angle. The nail was inserted according to the surgical technique recommended by the manufacturer **Group 2: Medoff sliding plate (Medpac)** Both 4 hole and 2 hole were used for trochanteric fractures, whereas only the 6 hole plates were used for subtrochanteric fractures. The locking screw set was used in all subtrochanteric fractures to prevent compression along the femoral neck. No locking set screw was used in the trochanteric fractures.	**Mortality at 1 year**	**Trochanteric** **Group 1:** 14 **Group 2:** 15 **Subtrochanteric** **Group 1:** 1 **Group 2:** 3	**Funding:** Not reported **Outcomes not reported**: Length of stay in hospital **Additional outcomes reported**: Operative details, ability to climb a curb, living conditions, union, minor complications. **Notes:**
			Functional outcome- able to walk the 15m test at 6 weeks	**Trochanteric** **Group 1:** 86% **Group 2:** 72% **Subtrochanteric** **Group 1:** 94% **Group 2:** 77%	
			Functional outcome – rise from a chair without arm support (6 weeks)	**Trochanteric** **Group 1:** 25% **Group 2:** 19% **Subtrochanteric** **Group 1:** 35% **Group 2:** 31%	
			Functional outcome – rise from a chair without arm support (4 months)	**Trochanteric** **Group 1:** 46% **Group 2:** 40% **Subtrochanteric** **Group 1:** 56% **Group 2:** 23%	
			Functional outcome – rise from a chair without arm support (12 months)	**Trochanteric** **Group 1:** 50% **Group 2:** 53% **Subtrochanteric** **Group 1:** 60% **Group 2:** 50%	
			Pain while walking	**Trochanteric**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	No. of dropouts: 0 **Age (SD):** 82 (48-96) **M/F:** 24/76 **Other factors**: **Trochanteric =86** Jensen-Michaelsen (JM) JM 3: 16% JM 4: 10% JM 5: 56% **Subtrochanteric = 19** Seinsheimer (S) S3: 1% S4: 8% S5: 9% **<u>Group 2: Medoff sliding plate</u>** **No. randomised:** 98 **No. of dropouts:** 0 **Mean age (SD):** 82 (52-97) **M/F:** 25/75 **Other factors**: **Trochanteric = 85** Jensen-Michaelsen (JM) JM 3: 11% JM 4: 19% JM 5: 57% **Subtrochanteric = 13** Seinsheimer (S) S3: 5% S4: 1%	All patients received preoperative iv antibiotics with 2g of cloxacillin. Subcutaneous low molecular weight heparin was used as thromboembolic prophylaxis for 7 days.	**at 6 weeks (assesses using a visual analogue scale – VAS 0-100)**	**<u>Trochanteric</u>** **Group 1:** 30 **Group 2:** 30 **<u>Subtrochanteric</u>** **Group 1:** 30 **Group 2:** 25	
			Pain while walking at 4 months (assesses using a visual analogue scale – VAS 0-100)	**<u>Trochanteric</u>** **Group 1:** 20 **Group 2:** 20 **<u>Subtrochanteric</u>** **Group 1:** 0 **Group 2:** 20	
			Pain while walking at 12 months (assesses using a visual analogue scale – VAS 0-100)	**<u>Trochanteric</u>** **Group 1:** 0 **Group 2:** 0 **<u>Subtrochanteric</u>** **Group 1:** 0 **Group 2:** 0.5	
			Complications: Femoral fracture	**<u>Trochanteric</u>** **Group 1:** 1 **Group 2:** 0 **<u>Subtrochanteric</u>** **Group 1:** 0 **Group 2:** 0	
			Complications: cut out	**<u>Trochanteric</u>** **Group 1:** 5 **Group 2:** 1 **<u>Subtrochanteric</u>** **Group 1:** 1 **Group 2:** 1	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	S5: 7%		**Complications: femoral neck fracture**	**<u>Trochanteric</u>** **Group 1:** 0 **Group 2:** 0 **<u>Subtrochanteric</u>** **Group 1:** 1 **Group 2:** 0	
			Complications: Non union	**<u>Trochanteric</u>** **Group 1:** 0 **Group 2:** 1 **<u>Subtrochanteric</u>** **Group 1:** 0 **Group 2:** 1	
			reoperations	**<u>Trochanteric</u>** **Group 1:** 6 **Group 2:** 1 **<u>Subtrochanteric</u>** **Group 1:** 3 **Group 2:** 0	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Guyer et al., 1993A[127,128] **Country of study:** Switzerland **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** 12 weeks	**Patient group:** Pertrochanteric and intertrochanteric fractures **Exclusion criteria:** Not reported **Setting:** Orthopaedic hospital, Switzerland **<u>All patients</u>** **N:** 100 **No. of dropouts:** 0 **<u>Group 1: Gamma nail</u>** **No. randomised:** 50 **No. of dropouts:** 10 lost to follow up **Age (SD):** 79.5 **M/F:** 82% women **Other factors**: **Fracture stability:** **Pertrochanteric:** **Stable:** 23 **Unstable:** 24 **Intertrochanteric:** 3 **<u>Group 2: Dynamic hip screw</u>** **No. randomised:** 50 **No. of dropouts:** 14 lost to follow up **Mean age (SD):** 80.3 **M/F:** 88% women **Other factors**:	All patients were operated on within 24 hours where possible. **<u>Group 1: Gamma nail</u>** The greater trochanter was exposed after standard intramedullary technique and the entry point was holed with the awl. 12 mm diameter nails used in 44 cases and 14mm in 6 cases. **<u>Group 2: Dynamic hip screw</u>** 135˚ 4 to 12 hole plates were used. All patients received prophylactic cephalosporin and low dose heparin.	**Mortality (termed lethality in the study)**	**<u>30 days</u>** **Group 1:** 4 **Group 2:** 2 **<u>Late lethality (not defined)</u>** **Group 1:** 4 **Group 2:** 5	**Funding:** not reported **Limitations:** Allocation concealment unclear. **Outcomes not reported**: **Additional outcomes reported**: Operative details including blood loss and length of surgery, leg shortening, social situation
			Length of stay in hospital (excluding those who died in hospital)	**Group 1:** 30.9 **Group 2:** 30.9	
			Reoperation	**Group 1:** 5/50 **Group 2:** 6/50	
			Complications	**Cranial screw perforation (cut out)** **Group 1:** 1 **Group 2:** 3 **Intra op femoral fragmentation** **Group 1:** 1 **Group 2:** 0 **Wound haematoma** **Group 1:** 2 **Group 2:** 2 **Deep wound infection** **Group 1:** 0 **Group 2:** 1	
			Pain during walking (12 weeks)	**Group 1:** 19/28 **Group 2:** 18/32	
			Walking capacity (12 weeks)	**Full** **Group 1:** 4/28 **Group 2:** 6/32 **More than 1 hr** **Group 1:** 13/28	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Fracture stability: **Pertrochanteric:** **Stable:** 19 **Unstable:** 26 **Intertrochanteric:** 5			**Group 2:** 16/32 **Less than 1 hr** **Group 1:** 11/28 **Group 2:** 10/32	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Hardy et al., 1998[134,134] **Country of study:** Belgium, Brussels **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** At least 6 months	**Patient group:** Trochanteric proximal femoral fractures **Inclusion criteria:** **Exclusion criteria:** • Patients aged <60, pathological fractures, incorrect anatomy, history of fracture or operation involving same limb. **<u>All patients</u>** **N:** 100 **No. of dropouts:** 0 **<u>Group 1: Compression hip-screw</u>** **No. randomised:** 50 **No. of dropouts:** 0 **Age (SD):** 79.5 (±10.7) **M/F:** 15/35 **Other factors**: **Fracture stability:** Stable: 16 Unstable: 34 **ASA score:** I = 5 II = 13 III = 18	**<u>Group 1: Compression hip-screw</u>** The compression hip-screw with a plate was inserted with a standard technique by means of a straight lateral incision on the lateral aspect of the thigh, as described by Clawson*. The barrel of the plate was at a 135 degree angle in each patient. **<u>Group 2: Intramedullary hip screw</u>** A cannulated intramedullary nail with a 4 degree mediolateral bend to allow insertion through the greater trochanter. The nail is 21 cm long and available in 3 diameters (12, 14 and 16 mm). The opening for the lag-screw is available in 2 angles (130 and 135 degrees). It can be locked with one or 2 4.5 mm diameter interlocking screws. A keyed centering sleeve, which is held by a set-screw, passes through	**Mobility score (Parker and Palmer) Ability to walk indoors (SD)**	**<u>Pre op</u>** **Group 1:** 2.3 (0.8) **Group 2:** 2.4 (0.8) **<u>1 month</u>** **Group 1:** 0.9 (0.6)*** **Group 2:** 1.9 (0.7)*** **<u>6 month</u>** **Group 1:** 1.5 (1.1) **Group 2:** 1.9 (1.0) **<u>12 month</u>** **Group 1:** 1.6 (1.2) **Group 2:** 1.9 (1.0) *** p<0.01	**Funding:** Smith and Nephew Richards, Memphis, Tennesse **Limitations:** Allocation concealment unclear. **Outcomes not reported**: Reoperations, length of stay in hospital. **Additional outcomes reported**: Operative data e.g. time, blood loss. Sliding of lag screw. **Notes:** The fractures healed in all but one of the seventy patients who were still alive at 12 months. The one non-union was in a patient who had a compression hip
			Mobility score (Parker and Palmer) Ability to walk outdoors (SD)	**<u>Pre op</u>** **Group 1:** 2.1 (2.3) **Group 2:** 3.0 (2.6) **<u>1 month</u>** **Group 1:** 0.3 (0.7)** **Group 2:** 0.7 (0.9)** **<u>6 month</u>** **Group 1:** 1.7 (2.2)* **Group 2:** 2.7 (2.1)* **<u>12 month</u>** **Group 1:** 1.7 (2.2)* **Group 2:** 2.8 (2.2)* * p=0.05	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	IV = 13 V = 1 **Jenson index** **1 =** 10 **2 =** 7 **3 =** 7 **4 =** 26 Anaesthesia: Spinal: 36 General: 14 **<u>Group 2: Intramedullary hip screw</u>** **No. randomised:** 50 **No. of dropouts:** 0 **Mean age (SD): 81.7 (**±11.8) **M/F:** 8/42 **Other factors**: **Fracture stability:** Stable: 13 Unstable: 37 **ASA score:** I = 5 II = 12 III = 23 IV = 10 V = 0 **Jenson index** **1 =** 11 **2 =** 10	the intramedullary nail and over the lag-screw. The sleeve helps to prevent rotation while allowing the lag-screw to slide freely. Piritramide was administered postoperatively and paracetamol given in the recovery period. Patients were permitted to get out of bed and sit in a chair on the second day after operation and bear full weight on the fourth day.		** 0.01<p<0.05 *** p<0.01	screw.
			Perioperative complications	Bronchpneumonia: **Group 1:** 6 **Group 2:** 4 Cardiac failure **Group 1:** 5 **Group 2:** 7	
			Mortality	**3 months** **Group 1:** 12/50 **Group 2:** 13/50 **6 months** **Group 1:** 13/50 **Group 2:** 13/50 **1 year** **Group 1:** 15/50 **Group 2:** 15/50	
			Pain in hip whilst walking (4 point scale, 1 = no pain, 2 = slight pain that does not effect ability tp walk, 3 = moderate pain that that effects ability to walk, 4 – severe intractable pain even in bed)	**3 months** **Group 1:** 7/40 **Group 2:** 4/37 **1 year** **Group 1:** 2/35 **Group 2:** 2/35	
			Pain in mid portion of thigh while	**1 year** **Group 1:** 2/35	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	3 = 5 **4 =** 24 Anaesthesia: Spinal: 36 General: 14		**walking, resulting in inability to walk (4 point scale, 1 = no pain, 2 = slight pain that does not effect ability tp walk, 3 = moderate pain that that effects ability to walk, 4 – severe intractable pain even in bed)**	**Group 2:** 7/35	
			Cut-out	**Group 1:** 0 **Group 2:** 1	

*Clawson DK. Trochanteric fractures treated by the sliding screw plate fixation method. J. Trauma, 4:737-752, 1964.

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Harrington et al., 2002[137,137] **Country of study:** UK **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, UK **Inclusion criteria:** • Unstable trochanteric proximal femoral fractures **Exclusion criteria:** • Patients aged <65 years, pathological fractures, previous fractures, other fracture. • Patients with dementia who were unable to give informed consent were excluded **<u>All patients</u>** **N:** 102 **No. lost to follow up:** not reported **<u>Group 1: Compression hip screw</u>** **No. randomised:**52 **No. of dropouts:** 0 **Mean age (SD):** 82.1 (8.6) **M/F:** 11/41 **Other factors**: ASA score I: 4 II: 20	**<u>Group 1: Compression hip screw</u>** **<u>Group 2 Intramedullary hip screw</u>** The nail is 21cm long with a 4 degree valgus angulation and distal locking screws measuring 4.5mm in diameter. A 12 mm diameter nail and 2 locking screws were used for distal locking were used in all patients. **Additional non-comparative prophylaxis**: *n/a*	**Post-op stay, days (SD)**	**Group 1**: 16.3 (7.5) **Group 2**:16.5 (8.8)	**Funding:** Not reported **Limitations:** Reference made to some surgeons who had only used the IMHS on bone model sessions. **Outcomes not reported**: Reoperation, length of stay in hospital, functional status, pain. **Additional outcomes reported**: Operative details, ambulatory status **Notes:**
			Mortality in hospital	**Group 1**: 2/52 **Group 2**: 4/50	
			Ambulatory status at 1 year (retained pre injury living status)	**Group 1**: 22/33 **Group 2**: 19/30	
			Technical complications	**Group 1**: Screw cut out = 1 Barrel-plate pulled off femur = 1 **Group 2**: Screw cut out = 1 Intraoperative fracture propagation= 1 Late fracture of femoral shaft = 1	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	III: 17 IV: 11 V: 0 Anaesthesia: Spinal: 34 General: 18 **Group 2: Intramedullary hip screw** **No. randomised:** 50 **No. of dropouts:** 0 **Mean age (SD):** 83.8 (8.5) **M/F:** 10/40 **Other factors**: ASA score I: 3 II: 22 III: 16 IV: 9 V: 0 Anaesthesia: Spinal: 35 General: 15				

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Hoffman et al., 1996[147,147] **Country of study:** New Zealand **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 26 weeks	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, New Zealand **Inclusion criteria:** • Trochanteric proximal femoral fractures • Patients aged >50 years **Exclusion criteria:** • Pathological fractures excluded **<u>All patients</u>** **N:** 69 **No. lost to follow up:** none **Died before surgery:** 2 **Mean age:** 81 years **<u>Group 1: Ambi hip screw</u>** **No. randomised:**36 **Mean age (SD):** 79.0 (10.4) **M/F:** 12/24 **Other factors**: **ASA score:** II: 18 III: 15 IV: 3 V: 0	The selected device was inserted following a detailed operative protocol based on the manufacturer's guidelines. **<u>Group 1: Ambi hip screw</u>** **<u>Group 2 Gamma nail</u>** The Gamma nail was interlocked in all cases initially, as recommended, but after the first 5 cases locking was reserved for unstable fractures and in line with manufacturer's updated recommendation. No cases were locked after patient number 50. Antibiotic prophylaxis (IV	**Delay to surgery (SD)**	**Group 1**: 1.9 (± 1.4) **Group 2**: 1.6 (± 1.1)	**Funding:** Not reported **Limitations:** The manufacturer's guidelines were modified during the course of the study for the Gamma nail. **Outcomes not reported**: Reoperations, functional status. **Additional outcomes reported**: Intraoperative complications
			Total hospital stay (SD)	**Group 1**: 30.3 (±18.9) **Group 2**: 31.4 (± 19.7)	
			Postoperative stay (SD)	**Group 1**: 28.5 (±18.9) **Group 2**: 29.8 (±20.1)	
			Postoperative complications	**CVA** **Group 1**: 1 **Group 2**: 1 **Cardiac** **Group 1**: 3 **Group 2**: 2 **Pressure areas** **Group 1**: 1 **Group 2**: 0 **Pneumonia** **Group 1**: 1 **Group 2**: 1 **DVT** **Group 1**: 0 **Group 2**: 1	
			Fracture union (% united)	**6 weeks** **Group 1**: 38 **Group 2**: 32 **12 weeks** **Group 1**: 79	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Anaesthesia: Spinal: 11 General: 25 **Fracture stability:** Unstable: 12 Stable: 24 **<u>Group 2: Gamma nail</u>** **No. randomised:** 31 **Mean age (SD):** 83.2 (8.1) **M/F:** 4/27 **Other factors**: **ASA score:** II: 10 III: 15 IV: 5 V: 1 **Anaesthesia:** Spinal: 6 General: 25 **Fracture stability:** Unstable: 10 Stable: 21	cephradine – 1g) prior to induction of anaesthesia.		**Group 2**: 79 **26 weeks** **Group 1**: 96 **Group 2**: 96	
			Resolution of hip pain (% without pain)	**2 weeks** **Group 1**: 52 **Group 2**: 48 **6 weeks** **Group 1**: 55 **Group 2**: 67 **12 weeks** **Group 1**: 75 **Group 2**: 37 **26 weeks** **Group 1**: 71 **Group 2**: 60	
			intra-operative fracture	**Group 1**: 0 **Group 2**: 3	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Leung et al., 1992[191,191] **Country of study:** Hong Kong **Study design:** Randomised prospective comparison **Duration of follow-up:** 7 months	**Patient group:** Trochanteric proximal femoral fractures **Inclusion criteria:** Patients over 65 years with pertrochanteric fractures (including subtrochanteric extensions). **Exclusion criteria:** • Pure subtrochanteric fractures were excluded. **Setting:** Orthopaedic hospitals **All patients** **N:** 225 (226 fractures) **No. of dropouts:** 0 **Group 1: Gamma nail** **No. randomised:** 93 **No. of dropouts:** 0 **Age (SD):** 80.9 (±8.41) **M/F:** 25/68 **Other factors**: ASA grade 1:15 2:47 3:23 4:8 **Fracture stability:**	**Group 1: Gamma nail** 2mm Kirschner wire passed percutaneously, anterior to the femoral shaft and parallel to the femoral neck. 6 to 8cm incision made above the tip of the greater trochanter and then the medullary canal is entered. The cavity is reamed 1mm larger than the diameter of the intended nail. The nail is passed into the canal, without hammering, and the corresponding device is assembled on the nail mount and the lateral cortex of the femur is perforated by the awl and the lag screw guide wire is inserted. Distal locking is indicated for unstable fractures. **Group 2: Dynamic hip screw** Inserted using the standard technique.	**Mortality**	**4 weeks** **Group 1:** 7 **Group 2:** 5 **6 months** **Group 1:** 13 **Group 2:** 15	**Funding:** Not reported **Limitations:** Allocation concealment unclear. **Outcomes not reported**: **Additional outcomes reported**: Operative details intra-operative complications, mean sliding of lag screws, shortening, external rotation. **Notes:**
			Mean duration of hospital stay (acute hospital) in days (SD)	**Group 1 n = 93 (30 stable, 63 unstable)** **Group 2 n = 93 (20 stable, 73 unstable)** **Stable** **Group 1:** 9.2 (6.43) **Group 2:** 10.7 (6.27) **Unstable** **Group 1:** 9.5 (3.38) **Group 2:** 9.6 (4.46)	
			Mean duration of hospital stay (convalescent hospital) in days (SD)	**Stable** **Group 1:** 17.7 (11.97) **Group 2:** 15.4 (10.86) **Unstable** **Group 1:** 15.9 (8.2) **Group 2:** 19.1 (10.34)	
			mean time to full weight bearing (SD)	**Stable** **Group 1:** 1.3 (0.88) **Group 2:** 1.9 (0.89) **Unstable** **Group 1:** 1.2 (0.64) **Group 2:** 1.7 (0.76)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Stable: 30 Unstable: 63 <u>**Group 2: Dynamic hip screw**</u> **No. randomised:** 93 **No. of dropouts:** 0 **Mean age (SD):** 78.3 **(**±9.46) **M/F:** 30/63 ASA grade 1:10 2:42 3:38 4:3 **Fracture stability:** Stable: 20 Unstable: 73		**Postoperative mobility**	<u>**Stable**</u> **Independent** **Group 1:** 12 (40%) **Group 2:** 8 (40%) **Aided** **Group 1:** 11 (36.7%) **Group 2:** 11 (55%) **Chair/bed bound** **Group 1:** 7 (23.3%) **Group 2:** 1 (5%) <u>**Unstable**</u> **Independent** **Group 1:** 22 (34.9%) **Group 2:** 23 (31.5%) **Aided** **Group 1:** 36 (57.1%) **Group 2:** 42 (57.5%) **Chair/bed bound** **Group 1:** 5 (8%) **Group 2:** 8 (11%)	
			Pain in hip	**Stable** **Group 1:** 8 (26.7%) **Group 2:** 5 (25%) **Unstable** **Group 1:** 14 (22.2%) **Group 2:** 27 (40%)	
			Pain in thigh	**Stable** **Group 1:** 4 (13.4%) **Group 2:** 5 (25%) **Unstable**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				Group 1: 7 (11.1%) **Group 2:** 3 (4.1%)	
			Non union	**Stable** **Group 1:** 1 **Group 2:** 0 **Unstable** **Group 1:** 0 **Group 2:** 0	
			Postoperative complications	**Infection** **Group 1:** 1 **Group 2:** 3 **Superior cutting out** **Group 1:** 2 **Group 2:** 3 **Fracture of shaft** **Group 1:** 2 **Group 2:** 0	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Little et al., 2008[195,195] **Country of study:** England **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Inclusion criteria:** Patients presenting to the Accident and Emergency department with an extracapsular intertrochanteric fracture **Exclusion criteria:** Patients with subtrochanteric extensions of the fracture were excluded. **<u>All patients</u>** **N:** 190 **No. lost to follow up:** 0 **Mean age:** 83.4 (50 to 102) **<u>Group 1: Holland nail</u>** **No. randomised:** 92 **Mean age (range):** 82.6 (54 to 102) **M/F:** 8/84 ASA score: 1= 2 (2.2%), 2= 57 (62.0%) 3= 33 (35.8%), 4= 0 **<u>Group 2: Dynamic hip screw</u>** **No. randomised:** 98 **Mean age (range):** 84.2 (50 to 98) **M/F:** 20/78 ASA score: 1= 3 (3.1%), 2= 55 (56.1%) 3= 37 (37.7%), 4= 3 (3.1%)	A standard operative technique either recommended by manufacturer's guidelines or as detailed in previous studies was used. **<u>Group 1: Holland nail (long trochanteric-entry intramedullary mail)</u>** **<u>Group 2 Gamma nail</u>** Each patient was given a single-dose antibiotic teicoplanin and gentamicin induction.	**Mortality**	**30 day** **Group 1**: 7/92 (7.6%) **Group 2**: 6/98 (6.1%) **1 year** **Group 1**: 16/92 (17.4%) **Group 2**: 17/98 (17.3%)	**Funding:** Not reported **Limitations:** **Outcomes not reported**: Reoperation, length of stay in hospital, pain **Additional outcomes reported**: Intra-operative variables **Notes:** 2 implant failures in group II. The proximal screws migrated laterally in 4 patients in group I.
			Time to frame in days (95% CI)	**Group 1**: 3.6 (3.3 to 3.9) **Group 2**: 4.23 (3.9 to 4.8) p = 0.012	
			Patients with wound infections (%) None were reopened and all healed within 6 weeks	**Group 1**: 5 (5.4) **Group 2**: 10 (10.2) p = 0.286	
			Mobility at 1 year (95% CI)	**Group 1**: 5.9 (5.3 to 6.5) **Group 2**: 3.8 (3.3 to 4.3) p <0.001	
			Patients with mobility restored at 1year (%)	**Group 1**: 49 (64) **Group 2**: 30 (37) p <0.001	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Miedel et al., 2005[214,214] **Country of study:** Sweden **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** 12 months	**Patient group:** Unstable trochanteric and subtrochanteric proximal femoral fractures **Inclusion criteria:** • Acute unstable trochanteric (J-M type 3-5) or subtrochanteric fractures after a simple fall. **Exclusion criteria:** • Pathological fractures, rheumatoid arthritis or osteoarthritis were excluded. • Fractures extending more than 5cm distal to the lesser trochanter were excluded. **<u>All patients</u>** **N:** 217 **Lost to follow up:** 3 **<u>Group 1: Standard gamma nail</u>** **No. randomised:** 109 **No. of dropouts:** 0 **Age (SEM):** 84.6 (±0.6) **M/F:** 17/92 **Other factors**: **Fracture type:** **Trochanteric 93**	**<u>Group 1: Standard gamma nail</u>** Diameter 11mm, length 200mm, valgus bend 10˚, neck angle 125 or 130˚ (Stryker Howmedica, Malmo, Sweden). Nails were inserted by hand and not by hammering and not to use the awl before drilling for the distal locking screw. **<u>Group 2: Medoff sliding plate</u>** Neck angle 135˚, 6 hole plate (Swemac, Linkoping, Sweden). Used in the biaxial dynamisation mode, which allows sliding along both the femoral neck and shaft. All patients were given low-molecular weight heparin before and for approximately 10 to 14 days before operation and one dose of cefuroxim before operation.	**Technical failures** **Reoperation**	**<u>Trochanteric</u>** **Grp1** **Grp2** No complication 87 91 Penetration of lag screw 3 4 Redisplacement/ medialisation 0 1 intra-operative femoral fracture 3 0 Deep infection 0 1 **<u>Subtrochanteric</u>** **Grp1** **Grp2** No complication 16 10 Penetration of lag screw 0 0 Redisplacement/ medialisation 0 2 intra-operative femoral fracture 0 0 Deep infection 0 1 **Trochanteric** Group 1: 3 Group 2: 6 **Subtrochanteric** Group 1: 0 Group 2: 3	**Funding:** Grants received from the Trygg-Hansa Insurance company, the Swedish Orthopaedic Association and, in equal parts from Stryker Howmedica and Swemac. **Outcomes not reported**: Mortality, length of stay in hospital, place of residence, pain. **Additional outcomes reported**: Some outcomes grouped together (e.g. not reported separately for trochanteric and subtrochanteric) such as length of stay in hospital, HRQOL (EQ0-5D), operative data, pain **Notes:**

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	J-M 3: 12 J-M 4: 28 J-M 5: 53 **Subtrochanteric 16** S2B: 1 S2C: 11 S3A: 3 S3B: 1 S4: 0 S5: 0 **<u>Group 2: Medoff sliding plate</u>** **No. randomised:** 108 **No. of dropouts:** 0 **Mean age (SEM):** 82.7 **(**±0.6) **M/F:** 24/84 **Other factors**: **Fracture type:** **Trochanteric 96** J-M 3: 11 J-M 4: 24 J-M 5: 61 **Subtrochanteric 12** S2B: 0 S2C: 6 S3A: 2 S3B: 1 S4: 1 S5: 2				

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
O'Brien et al., 1995[244] **Country of study:** Canada **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 52 weeks	**Patient group:** Patients with hip fracture **Setting:** **Inclusion criteria:** • Patients with intertrochanteric fractures of the femur **Exclusion criteria:** • Fractures more than 1 week old • Pathological fractures • Subtrochanteric fractures. **<u>All patients</u>** **N:** 101 (102 fractures) **No. lost to follow up:** 18% **<u>Group 1: Dynamic hip screw</u>** **No. randomised:** 49 **Mean age (range):** 77 (39 to 94) **M/F:** 17/32 **Other factors**: **Fracture stability:** Unstable: 21 Stable: 28 **<u>Group 2: Gamma nail</u>** **No. randomised:** 53 **Mean age (range):** 83 (57 to 95))	The standard operative technique for fracture fixation was followed. **<u>Group 1: Dynamic hip screw</u>** The 135 degree four hole DHS was used more than 80% of the time in this group. **<u>Group 2 Gamma nail</u>** 130 or 135 degree nails were used 86% of the time. 88% of nails were distally locked. All but 4 patients received prophylactic antibiotic coverage with cefazolin intravenously.	**Length of hospital stay, range (median), days**	**Orthopaedic ward** **Group 1**: 4 – 102 (16) **Group 2**: 3 – 52 (14) **Total hospital stay** **Group 1**: 4 – 108 (18) **Group 2**: 3 – 92 (16)	**Funding:** Not reported **Limitations:** Mortality rate could be higher as the number of people lost to follow up is unclear **Outcomes not reported**: Functional status, place of residence, **Additional outcomes reported**: Blood loss and fluid replacement., length of surgery, early (in hospital) general complications **Notes:**
			Early (in hospital) local complications	**Superficial wound infection** **Group 1**: 1 **Group 2**: 0 **Wound haematoma** **Group 1**: 0 **Group 2**: 1 **Malalignment** **Group 1**: 0 **Group 2**: 1 **Early failure of fixation** **Group 1**: 0 **Group 2**: 2 **Intraoperative fracture** **Group 1**: 0 **Group 2**: 2 **Neuropraxia** **Group 1**: 2 **Group 2**: 0	
			Late local complications	**Failure of fixation** **Group 1**: 1	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	M/F: 9/43 **Other factors**: **Fracture stability:** Unstable: 23 Stable: 30			**Group 2**: 1 **Femoral shaft fracture** **Group 1**: 0 **Group 2**: 1 **Varus malunion** **Group 1**: 3 **Group 2**: 5	
			Complications requiring reoperation	**Varus collapse with pain** **Group 1**: 0 **Group 2**: 2 **Varus collapse with malunion** **Group 1**: 1 **Group 2**: 0 **Failure of fixation (cut-out)** **Group 1**: 1 **Group 2**: 2 **Femoral shaft fracture** **Group 1**: 0 **Group 2**: 1	
			Mortality (early postoperative)	**Group 1**: 1 **Group 2**: 6	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Ovesen et al., 1996[251,251] **Country of study:** Denmark **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, Odense, Denmark **Inclusion criteria:** • Patients with Intertrochanteric fractures having given informed consent. **Exclusion criteria:** • Subtrochanteric or pathological fractures • Secondary exclusions included wrong diagnosis and transfer to hospitals outside the inclusion area. **All patients** **N:** 150 (101 fractures) **No. lost to follow up:** 17% **Group 1: Dynamic hip screw** **No. randomised:** 73 **Mean age (sd):** 78.5 (±11.7) **M/F:** 21/52 **Other factors**: lost to follow up = 4	**Group 1: Dynamic hip screw (DHS)** The use of a trochanteric stabilizing plate in combination with the DHS was allowed, but only used in 2 patients. **Group 2 Gamma nail** The distal femur was reamed 13 mm and the proximal femur to 18 mm. The use of a hammer during insertion was avoided. **Additional non-comparative prophylaxis**: Prophylaxis against DVT and pulmonary embolism consisting of Enoxaparine 40 mg once daily starting at admission until mobilisation,	**Mortality**	**4 months** **Group 1**: 3/66 **Group 2**: 3/67 **12 months** **Group 1**: 3/56 **Group 2**: 3/59	**Funding:** Not reported **Limitations:** Surgeon experience may cause bias as operations were by surgical team on call – 49 surgeons participated in the trial. **Outcomes not reported**: Place of residence, pain **Additional outcomes reported**: Intraoperative details **Notes:**
			Reoperation by 12 months	**Group 1**: 6 **Group 2**: 12	
			Walking aids pre fracture	**Sticks, crutches or no walking aid** **Group 1**: 50 **Group 2**: 50 **Walking frame or wheelchair** **Group 1**: 22 **Group 2**: 22 **Missing or deceased** **Group 1**: 1 **Group 2**: 1 p = 0.41	
			Walking aids at discharge	**Sticks, crutches or no walking aid** **Group 1**: 22 **Group 2**: 13 **Walking frame or wheelchair** **Group 1**: 47 **Group 2**: 59 **Missing or deceased**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	ASA score: 1 = 19 2 = 18 3 = 26 4 = 10 **<u>Group 2: Trochanteric gamma nail</u>** **No. randomised:** 73 **Mean age (sd):** 79.9 (±10) **M/F:** 20/53 **Other factors**: lost to follow up = 11 ASA score: 1 = 20 2 = 21 3 = 25 4 = 7	discharge or for 7 days. Antibiotic prophylaxis was also given.		**Group 1**: 4 **Group 2**: 1 p = 0.03	
			Walking aids at 4 months	**Sticks, crutches or no walking aid** **Group 1**: 43 **Group 2**: 37 **Walking frame or wheelchair** **Group 1**: 23 **Group 2**: 30 **Missing or deceased** **Group 1**: 7 **Group 2**: 6 p = 0.14	
			Complications requiring reoperation	**Group 1**: Cut- out = 2 Redislocation = 3 Femoral fracture = 0 Infection = 1 Haematoma = 0 **Group 2**: Cut- out = 7 Redislocation = 0 Femoral fracture = 2 Infection = 2 Haematoma = 1	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Pajarinen et al., 2005 (Also Pajarinen 2004)[254,255] **Country of study:** Finland **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 4 months	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, Helsinki, Finland **Inclusion criteria:** • Low energy extracapsular pertrochanteric femoral fractures **Exclusion criteria:** • Pathological fractures, multiple injuries, and those unable to give informed consent were excluded. **<u>All patients</u>** **N:** 108 **No. lost to follow up:** 15 (14%) **<u>Group 1: Dynamic hip screw</u>** **No. randomised:** 54 **Mean age (sd):** 80.3 (±10.8) **M/F:** 14/40 **Other factors**: ASA score: 2 = 8 3 = 32 4 = 14 Anaesthetic: General = 2	All operations were performed within 2 days of admission, in most cases by a senior orthopaedic resident. Standard operative techniques, which are recommended by the manufacturers and have been described in detail in instruction manuals or earlier studies were used. **<u>Group 1: Dynamic hip screw (DHS)</u>** **<u>Group 2 Proximal femoral nail</u>** Intravenous antibiotic prophylaxis was given. Patients were also treated with a low-molecular weight	**Mean hospitalisation time in days (sd)**	**Group 1**: 5.4 (3) **Group 2**: 6.1 (3.3) p = 0.251	**Funding:** Not reported **Limitations:** **Outcomes not reported**: Pain **Additional outcomes reported**: Intraoperative details, radiographic findings at 4 months post-op. **Notes:**
			Discharged to (%)	Own home **Group 1**: 4 (7.4) **Group 2**: 6 (11.1) Nursing home **Group 1**: 2 (3.7) **Group 2**: 1 (1.9) Rehabilitation hospital **Group 1**: 48 (88.0) **Group 2**: 45 (83.3) Died at our hospital **Group 1**: 0 **Group 2**: 3.7 (0.495)	
			Place of residence at 4 months (%)	Own home **Group 1**: 22 (53.7) **Group 2**: 24 (57.1) p = 0.827 Nursing home **Group 1**: 6 (14.6) **Group 2**: 10 (23.8) p = 0.405 Institution **Group 1**: 13 (31.7) **Group 2**: 8 (19.0) p = 0.214	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Spinal = 52 **<u>Group 2: Proximal femoral nail</u>** **No. randomised:** 54 **Mean age (sd):** 80.9 (±9.1) **M/F:** 13/41 **Other factors**: ASA score: 2 = 6 3 = 28 4 = 20 Anaesthetic: General = 3 Spinal = 51	heparin during their stay in hospital	**Recovery of abilities to pre-op status (%)**	**Yes** **Group 1**: 32 (78) **Group 2**: 34 (81) **No** **Group 1**: 9 (22) **Group 2**: 8 (19) p = 0.791	
			Walking ability (%)	**No aids needed** **Group 1**: 12 (29.3) **Group 2**: 15 (35.7) p = 0.641 **In need of aids, but independent** **Group 1**: 22 (53.7) **Group 2**: 24 (57.1) p = 0.827 **In need of assistance** **Group 1**: 7 (17.1) **Group 2**: 3 (7.1) p = 0.194	
			Recovery of walking ability to pre-op status (%)	**Yes** **Group 1**: 22 (53.7) **Group 2**: 32 (76.2) **No** **Group 1**: 19 (46.3) **Group 2**: 10 (23.8) p = 0.040	
			Drop out patients	**Fracture redisplacement (reoperation)** **Group 1**: 2 **Group 2**: 2 p = 1.00 **Died before follow up was complete**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				Group 1: 2 **Group 2**: 4 p= 0.678 **Did not attend final review** **Group 1**: 9 **Group 2**: 6 p = 0.578	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Park et al., 1998[258,258] **Country of study:** Korea **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** University Hospital, Korea **Inclusion criteria:** Intertrochanteric fractures of the femur. Patients aged 60 and over **Exclusion criteria:** Not reported **<u>All patients</u>** **N:** 60 **No. lost to follow up:** 0 **<u>Group 1: Gamma Asia Pacific nail (GAPN)</u>** **No. randomised:** 30 **Mean age:** 73.7 **M/F:** 10/20 **Other factors**: ASA score: 1 = 3 2 = 19 3 = 8 4 = 0 Fracture pattern (Tronzo) Stable (II): 14 (47%)	**<u>Group 1: Gamma Asia Pacific nail (GAPN)</u>** These were inserted using a closed technique under image intensifier control. **<u>Group 2: Compression hip screw (CHS)</u>** CHS (135˚) were inserted using the standard technique.	**Mean time to union (weeks)**	**Systemic** **Group 1**: 14.3 **Group 2**: 15.1 p = 0.06 **Stable** **Group 1**: 14.28 **Group 2**: 14.55 p = 0.73 **Unstable** **Group 1**: 14.31 **Group 2**: 15.42 p = 0.03	**Funding:** Not reported **Limitations:** Unclear allocation concealment. **Outcomes not reported**: Pain, place of residence **Additional outcomes reported**: Operative details, decrease of neck shaft angle, length of sliding of the lag screw. **Notes:**
			Mobility assessment (Ceder et al)	**Mean** **Group 1**: 5.1 **Group 2**: 4.7 p >0.05	
			Complications	**Fracture of the shaft of the femur** **Group 1**: 0 **Group 2**: 0 **Greater trochanter fracture** **Group 1**: 1 **Group 2**: 0 **Fracture displaced by nail insertion** **Group 1**: 2 **Group 2**: 0 Cut out	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Unstable (III & IV): 16 (53%) **<u>Group 2: Compression hip screw (CHS)</u>** **No. randomised:** 30 **Mean age:** 72.2 **M/F:** 14/16 **Other factors**: ASA score: 1 = 4 2 = 16 3 = 9 4 = 1 Fracture pattern (Tronzo) Stable (II): 11 (37%) Unstable (III & IV): 19 (63%)			**Group 1**: 1 **Group 2**: 1 Deep infection **Group 1**: 1 **Group 2**: 1 Non union **Group 1**: 0 **Group 2**: 1	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Radford et al., 1993[279,279] **Country of study:** England **Study design:** Prospective randomized study **List who was masked to interventions**: Not reported. **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, UK **Inclusion criteria:** • Patients aged over 60, with a pertrochanteric femoral fracture **Exclusion criteria:** • Not reported **<u>All patients</u>** **N:** 200 **No. lost to follow up:** not stated **<u>Group 1: Dynamic hip screw</u>** **No. randomised:** 100 **Mean age:** 78 (60 to 90) **M/F:** 76/24 **Other factors**: Number with diabetes: 4 Unstable: 43% **<u>Group 2: Gamma nail</u>** **No. randomised:** 100 **Mean age:** 72.2 **M/F:** 14/16 **Other factors**:	The operations were performed using image intensification. For both implants they aimed to have a central position of the screw in the femoral head on both anteroposterior and lateral views, with its tip 5 to 10 mm from the subchondral bone. **<u>Group 1: Dynamic hip screw</u>** 4 hole 135˚ plate with a screw of appropriate length **<u>Group 2: Gamma nail</u>** A preoperative radiograph was taken of the other hip to compare with the implant template to decide the angle of the chosen nail.	**Mortality**	**3 months** **Group 1**: 10 **Group 2**: 12	**Funding:** Not reported **Limitations:** Includes diabetic patients. Unclear allocation concealment. **Outcomes not reported**: Pain, place of residence **Additional outcomes reported**: Prefracture mobility and housing score, femoral shaft fracture details of patients treated with gamma nails, preoperative blood loss. **Notes:** Only surgeons of registrar grade and above took part in the trial and were already experienced
			Delayed wound healing or persistent discharge leading to another course of antibiotics to be given	**Group 1**: 8 **Group 2**: 3	
			Infection (bacteriologically proven)	**3 months** **Group 1**: 4 **Group 2**: 0	
			Thromboembolism during hospital stay	**Group 1**: 6 **Group 2**: 8	
			Fixation failure requiring surgical revision	**Group 1**: 3 **Group 2**: 2	
			Fracture of the femoral shaft	**Group 1**: 1 **Group 2**: 11	
			Fracture of the femoral shaft – requiring surgical revision	**Group 1**: 1 **Group 2**: 3	
			Reoperation	**Group 1**: 3 **Group 2**: 6	
			Cut-out	**Group 1**: 3 **Group 2**: 2	
			Non-union	**Group 1**: 0 **Group 2**: 0	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Number with diabetes: 6 Unstable: 38%	Distal locking of the nail in the femoral shaft was performed only when indicated for longitudinal instability.			in the use of the DHS. The first 2 Gamma nail operations performed by each surgeon were not included in the trial. Perioperative fractures were caused by too forceful insertion of the nail into the femoral shaft – often by hammer

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Rahme et al., 2007[281,281] **Country of study:** Australia **Study design:** Randomised prospective comparison **List who was masked to interventions**: Not reported. **Duration of follow-up:** 9 months	**Patient group:** Subtrochanteric femoral fractures **Inclusion criteria:** All skeletally mature patients presenting with acute subtrochanteric fractures **Exclusion criteria:** Ipsilateral femoral shaft or neck fractures. **<u>All patients</u>** **N:** 58 **No. of dropouts:** 0 **<u>Group 1: Blade plate</u>** **No. randomised:** 29 **No. of dropouts:** 0 **Mean age :** 67 **M/F:** 12/17 **Seinsheimer classification:** Type 1: 0, Type 2: 8 Type 3: 8, Type 4: 4 Type 5: 9 **<u>Group 2: Proximal femoral nail</u>** **No. randomised:** 29 **No. of dropouts:** 0 **Mean age:** 73 **M/F:** 13/16 **Seinsheimer classification:** Type 1: 1, Type 2: 7 Type 3: 10, Type 4: 1 Type 5: 10	**<u>Group 1: Proximal femoral nail</u>** Treated with closed reduction using a traction table and percutaneous insertion of the nail (Synthes AG, Chur, Switzerland) without anatomic reduction. **<u>Group 2: Intramedullary hip screw</u>** Treated with open anatomic reduction, Internal fixation was achieved using a 95˚ angled blade plate (Synthes AG, Chur, Switzerland).	**Length of stay in hospital**	**Group 1:** 22 **Group 2:** 25 p=0.7	**Funding:** not reported **Limitations:** Allocation concealment unclear. Underpowered. **Outcomes not reported**: Pain, mobility, functional status **Additional outcomes reported**: mean operating time, blood transfusion, infection (all, including whether an organism was confirmed as present or not) **Notes:** Intention to treat analysis performed
			Non-union (absence of bridging callus on 2 radiographic views 9 months after injury)	**Group 1:** 8 **Group 2:** 1 p=0.025	
			Revision	**Group 1:** 8 **Group 2:** 0 p=0.005	
			Mortality	**Group 1:** 2 **Group 2:** 6 p=0.25	
			Infection	**Group 1:** 1 **Group 2:** 3 p=0.6	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Sadowski et al., 2002[294,294] **Country of study:** Switzerland **Study design:** Prospective randomized study **Duration of follow-up:** 12 months	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, Geneva, Switzerland. **Inclusion criteria:** • Patients aged over 55, with AO/OTA 31-A3 fractures (trochanteric proximal femoral fractures) • Low energy fractures **Exclusion criteria:** • Patients with pathological fractures, fractures associated with polytrauma, fractures associated with polytrauma, a preexisting femoral deformity preventing hip screw osteosynthesis or intramedullary nailing, previous surgery on the ipsilateral hip or femur, and a fractures extending 5cm distal to the inferior border of the lesser trochanter. **All patients** **N:** 39	All procedures were performed by staff surgeons. **Group 1: Dynamic hip screw** Operative technique described by Blatter and Janssen **Group 2: Gamma nail** Operative technique as described in Simmermacher et al. The fracture was not exposed for nailing unless it could not be reduced with closed techniques. A 10 or 11mm diameter nail was used I 8/20 patients and the lag screw measured 100 or 105mm in 10/20 patients. The proximal fragment was reamed in all	**Residence - Preoperative (chi square with Yates correction)**	**Home** **Group 1**: 15 **Group 2**: 13 **Nursing home** **Group 1**: 4 **Group 2**: 7 p = 0.54	**Funding:** Not reported **Limitations:** Includes diabetic patients **Additional outcomes reported**: Operative time, blood transfusion, difficulty of operation, type of reduction, conversion from static to dynamic construct, consolidation time. **Notes:**
			Postoperative data – complications (chi square)	Pneumonia **Group 1**: 3 **Group 2**: 2 Cardiac failure or infarction **Group 1**: 1 **Group 2**: 1 Cerebrovascular accident **Group 1**: 0 **Group 2**: 1 p = 0.83	
			Wound complications (chi square with Yates correction)	**Group 1**: 2 **Group 2**: 3 p = 0.95	
			Hospital stay (days) (student t test)	**Group 1**: 18 ± 7 **Group 2**: 13 ± 4 p = 0.01	
			Discharge to: (chi square)	**Home** **Group 1**: 15 **Group 2**: 13	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	No. lost to follow up: 1 **<u>Group 1: Dynamic condylar screw</u>** **No. randomised:** 19 **Mean age:** 77 (±14) **M/F:** 5/14 **Other factors**: ASA score: 1 = 1 2 = 9 3 = 9 4 = 0 Anaesthesia: General = 10 Regional = 9 **<u>Group 2: Proximal femoral nail</u>** **No. randomised:** 20 **Mean age:** 80 (±13) **M/F:** 7/13 **Other factors**: ASA score: 1 = 0 2 = 6 3 = 11 4 = 3 Anaesthesia: General = 11 Regional = 9	20 patients, but distal reaming was only performed on1 patient. All of the nails were interlocked distally with 2 screws. All patients were given one dose of prophylactic intravenous antibiotic. In addition all patients were treated with low-molecular weight heparin		**Nursing home** **Group 1**: 4 **Group 2**: 7 **Home** **Group 1**: 15 **Group 2**: 13 **Nursing home** **Group 1**: 4 **Group 2**: 7 p = 0.26	
			Status of patient at 1 year (chi square)	**Mortality** **Group 1**: 1 **Group 2**: 2 **Lost to follow-up** **Group 1**: 1 **Group 2**: 0 **Available for review** **Group 1**: 17 **Group 2**: 18	
			Orthopaedic complications at 1 year (chi square)	**Implant failure** **Group 1**: 6 **Group 2**: 0 **Non-union** **Group 1**: 1 **Group 2**: 1 **Infection** **Group 1**: 1	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				Group 2: 0 p = 0.007 **cut-out** **Group 1**: 5 **Group 2**: 0	
			Major reoperations at 1 year **(chi square)**	**Group 1**: 6 * **Group 2**: 0 *(1 hip prosthesis, 1 change of implant, 4 change of implant and bone graft) p = 0.008	
			Hip/thigh pain score at 1 year (student t test)	**Group 1**: 1.77 ±0.73 **Group 2**: 1.44 ±0.86 **p = 0.2**	
			Jenson social-function score at 1 year **(student t test)**	**Group 1**: 2.5 ±1.3 **Group 2**: 2.6 ±1.0 **p = 0.9**	
			Parker-and-palmer score at 1 year **(student t test)**	**Group 1**: 6.0 ±3.5 **Group 2**: 5.0 ±2.6 **p = 0.39**	
			Residence at 1 year **(chi square)**	**Home** **Group 1**: 15 **Group 2**: 13 **Nursing home** **Group 1**: 4 **Group 2**: 7	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Saudan et al., 2002[300,300] **Country of study:** Switzerland **Study design:** Prospective randomized study **Duration of follow-up:** 12 months	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, Geneva, Switzerland. **Inclusion criteria:** All fractures of the trochanteric region (in persons over the age of 55 years) caused by a low energy injury. Included classifications were AO/OTA Type 31-A1 or A2. **Exclusion criteria:** Pathologic fractures, fractures associated with polytrauma, a patient with previous ipsilateral hip or femur surgery, or any fractures with extension 5 cm distal to the inferior border of the lesser trochanter. **All patients** **N:** 206 **No. lost to follow up:** 4% **Group 1: Dynamic hip screw** **No. randomised:** 106 **Mean age:** 83.7 (±10.1) **M/F:** 22/84 **Other factors**: ASA score:	**Group 1: Dynamic hip screw** In 50% of patients the length of the screw was 90 or 95mm, and in almost all cases the side plate was 135˚ with 4 holes **Group 2: Proximal femoral nail** Operative technique as described by Simmermacher. All patients were given one dose of antibiotic prophylaxis preoperatively, and treated with a low-molecular weight heparin followed by Coumadin as prophylactic anticoagulation, begun after surgery and continued for 6 weeks.	**Postoperative data – complications (chi square)**	Respiratory **Group 1**: 7 **Group 2**: 7 Cardiovascular **Group 1**: 9 **Group 2**: 5 Pulmonary embolism **Group 1**: 1 **Group 2**: 1 Deep vein thrombosis **Group 1**: 1 **Group 2**: 1 Gastrointestinal **Group 1**: 2 **Group 2**: 1 Neurologic **Group 1**: 1 **Group 2**: 2 p = 0.24	**Funding:** Not reported **Limitations:** **Additional outcomes reported**: Intraoperative data. **Notes:**
			Wound complications	**Group 1**: 10 **Group 2**: 11 p = 0.71	
			Hospital stay (days)	**Group 1**: 14 ±10 **Group 2**: 13 ±4 p = 0.71	
			Discharge to:	**Home**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	1 = 3 2 = 30 3 = 66 4 = 7 Anaesthesia: General = 37 Regional = 69 **<u>Group 2: Proximal femoral nail</u>** **No. randomised:** 100 **Mean age:** 83 (±9.7) **M/F:** 24/76 **Other factors**: ASA score: 1 = 1 2 = 30 3 = 63 4 = 6 Anaesthesia: General = 38 Regional = 62			**Group 1**: 24 **Group 2**: 22 **Nursing home/rehabilitation hospital** **Group 1**: 78 **Group 2**: 74 **Died in hospital** **Group 1**: 4 **Group 2**: 4 p = 0.99	
			Status of patient at 1 year	**Died** **Group 1**: 13 **Group 2**: 16 **Lost to follow up** **Group 1**: 4 **Group 2**: 5 **Available for review** **Group 1**: 89 **Group 2**: 79	
			Complications at 1 year	**Fixation failure (cut-out_** **Group 1**: 1 **Group 2**: 3 **Non-union** **Group 1**: 0 **Group 2**: 0 **Infection** **Group 1**: 1 **Group 2**: 3	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
				p = 0.15	
			Reoperation at 1 year	**Hip prosthesis** **Group 1**: 1 **Group 2**: 3 **Removal of implant and/or debridement** **Group 1**: 1 **Group 2**: 3 p = 0.15	
			Habitation	**Home** **Group 1**: 50 **Group 2**: 37 **Nursing home** **Group 1**: 39 **Group 2**: 42 p = 0.22	
			Pain (score)	**Group 1**: 1.31 ±0.63 **Group 2**: 1.36 ±0.63 **p = 0.59**	
			Social function – Jensen (mean)	**Group 1**: 2.65 ±1.14 **Group 2**: 2.88 ±1.16 **p = 0.2**	
			Mobility score – Palmer/Parker (mean)	**Group 1**: 5.07 ±2.97 **Group 2**: 4.94 ±3.33 **p = 0.8**	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Utrilla et al., 2005[337,337] **Country of study:** Spain **Study design:** Prospective randomized study **Duration of follow-up:** 12 months	**Patient group:** Patients with hip fracture **Setting:** Orthopaedic hospital, Alicante, Spain **Inclusion criteria:** Patients aged over 65 years who sustained a trochanteric fracture of the femur. **Exclusion criteria:** Patients with subtrochanteric fractures or subtrochanteric fracture extension, pathologic fractures, history of a previous injury involving the lower limbs, and patients who had a severe concomitant medical condition (grade V ASA score). **<u>All patients</u>** **N:** 210 **No. lost to follow up:** 7 (3.3%) **<u>Group 1: Trochanteric Gamma Nail (TGN)</u>** **No. randomised:** 106 **Mean age:** 80.6 (±7.5) **M/F:** 38/66 **Other factors**: ASA score: 1 = 13	Fracture fixation was performed within 4 days. 4 surgeons experienced in the standard gamma nail did all the operations, but the first 3 TGN operations performed by each surgeon were not included in the study. Spinal anaesthesia was performed in all but 3 patients. **<u>Group 1: Trochanteric Gamma Nail (TGN)</u>** This was a modification of the standard implant: shorter in length (180mm), with a lower mediolateral curvature (4˚) and available only in	**Mortality**	**0 – 30 days** **Group 1**: 7 **Group 2**: 10 31 – 90 days **Group 1**: 1 **Group 2**: 5 91 – 180 days **Group 1**: 3 **Group 2**: 0 181 – 365 days **Group 1**: 8 **Group 2**: 6	**Funding:** Not reported **Limitations:** **Outcomes not reported**: *List the outcomes in which we are interested that are not reported here* **Additional outcomes reported**: Perioperative data, leg shortening **Notes:**
			Walking ability (Parker/Palmer score) at 12 months	**Total** **Group 1**: 6.4 ±2.8 n= 82 **Group 2**: 6.2 ±2.8 n= 81 p = 0.74 **Stable** **Group 1**: 7.6 ±2.2 **Group 2**: 7.3 ±2.4 p = 0.92 **Unstable** **Group 1**: 7.0 ±2.1 **Group 2**: 5.8 ±2.7 p = 0.017	
			Hip flexion (˚)	**Group 1**: 97.9 ±10.3 **Group 2**: 95.6 ± 9.5 p = 0.15	
			Hip pain (no.)	**Group 1**: 41	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	2 = 39 3 = 41 4 = 11 **<u>Group 2: Compression hip screw</u>** **No. randomised:** 106 **Mean age:** 79.8 (±7.3) **M/F:** 28/78 **Other factors**: ASA score: 1 = 14 2 = 35 3 = 54 4 = 3	proximal and distal diameters of 17 and 11 mm. The neck shaft angle was 130˚ and was inserted by a percutaneous technique. Distal locking with 1 screw only was performed on those fractures with rotational instability of the diaphyseal fragment. **<u>Group 2: Compression hip screw (CHS)</u>** The CHS was inserted using the standard technique, the implant was a 135˚ plate with 4 holes. All patients received antibiotic and thromboembolic prophylaxis.		**Group 2**: 44 p = 0.75	
		Thigh pain (no.)	**Group 1**: 50 **Group 2**: 45 p = 0.52		
		Postoperative complications	**Grp 1** **Grp2** n 82 81 DVT 4 3 Local wound 6 7 Deep infection 0 1 Trochanter fracture 4 2 Fixation failure 5 6 Cut out 1 2 Reoperation 1 4	

Evidence tables – extracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Zou et al., 2009[364,364] **Country of study:** China **Study design:** RCT **Duration of follow-up:** 1 year	**Patient group:** Consecutive patients with low-energy trochanteric femoral fractures **Setting:** Dept orthopaedic surgery, The first affiliated hospital of Soochow University, Suzhou, Jiangsu, China **Inclusion criteria:** Patients with 31-A1 stable trochanteric or 31-A2/31-A3 unstable trochanteric fractures. **Exclusion criteria:** Patients with a pathological fracture or multiple injuries were excluded. **<u>All patients</u>** **N:** 121 **<u>Group 1</u>** **No. randomised:** 63 **Stable:** 52 **Unstable:** 11 **Age (mean <u>+</u>SD):** 65 (34-89) **M/F:** 24%/76% **Operative time:** 93 +/- 13 mins **<u>Group 2</u>** **No. randomised:** 58 **Stable:** 42 **Unstable:** 16 **Age (mean <u>+</u>SD):** 65 (37-91) **M/F:** 21%/79%	Surgery was performed with the patient in the supine position on a fracture table, with the injured extremity slight adducted to facilitate insertion of the implant. After surgery the patients were mobilised and given standard rehabilitation instructions by a physiotherapist. **<u>Group 1</u>** Dynamic hip screw **<u>Group 2</u>** Proximal femoral nail antirotation	**Femoral shaft fracture**	**Group 1**: 0 **Group 2**: 0 **P value(s)**: not significant	**Funding:** Not stated **Limitations:** **Outcomes not reported**: *The Salvati and Wilson scoring system for hip function* **Additional outcomes reported**: list additional outcomes reported in the study that we are not interested in **Notes:**
			Cut-out	**Group 1**: 0 **Group 2**: 0 **P value(s)**: not significant	
			Non-union	**Group 1**: 1 (unstable) **Group 2**: 0	
			Breakage of implant	**Group 1**: 0 **Group 2**: 2 (1 unstable, 1 stable, of which 1 required reoperation) **P value(s)**: not significant	
			Wound infection	**Group 1**: 1 (stable) **Group 2**: 1 (unstable) **P value(s)**: not significant	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Operative time: 52 +/- 10 mins				

17.9 Evidence Table 9: Surgical approach to hemiarthroplasty

Study details	Patients	Exposure	Outcome measures	Effect size	Comments
Enocson et al., 2008[85,85] **Country of study:** Sweden **Study design:** Historical cohort **List who was masked to interventions**: Not applicable **Duration of follow-up:** Median 2.3 (0-10) years	**Patient group:** Consecutive patients who had a hemiarthroplasty for non-pathological displaced femoral neck fracture **Setting:** Orthopaedics department **Inclusion criteria:** • Not reported **Exclusion criteria:** • None reported **All patients** **N:** 739 hips in 720 patients **No. of dropouts:** not reported **Age (mean ±SD):** women: 84 (54-103) , men 82 (55-97) years **M/F:** 147/592	Surgical approach Group 1 431 operations performed by an **anterolateral** approach. Group 2 176 operations performed by a **posterolateral approach with posterior repair**. Group 3 129 operations performed by a **posterolateral approach without posterior repair**.	**Number of dislocations**	**Group 1:** 13/431 (3%) **Group 2:** 15/176 (9%) **Group 2:** 17/129 (13%)	**Funding:** None reported **Limitations:** Not stated how patients allocated to a surgeon. Surgical approach based on surgeon's own preference **Outcomes not reported**: Mortality, length of stay in secondary care, requirement for surgical revision, wound infection. Operations performed by registrars or post-registrars.
			Dislocation for **posterior lateral approach with posterior repair** compared to anterolateral approach.	Logistic regression **univariate analysis** Odds ratio: 3.0 (1.4, 6.4) P=0.005 Logistic regression **multivariate analysis** adjusted for age, sex, indication for surgery, surgeon seniority and femoral head size Odds ratio: 3.9 (1.6, 9.8) P=0.003	
			Dislocation for **posterior lateral approach without posterior repair** compared to anterolateral approach.	Logistic regression **univariate analysis** Odds ratio: 4.9 (2.3, 10) P<0.001 Logistic regression **multivariate analysis** adjusted for age, sex, indication for surgery, surgeon seniority and femoral head size Odds ratio: 6.9 (2.6, 19) P<0.001	

Evidence tables – surgical approach to hemiarthroplasty

Study details	Patients	Exposure	Outcome measures	Effect size	Comments
Parker et al., year[269] **Country of study:** UK **Study design:** Systematic review including 1 RCT **Duration of follow-up:** 2 years	**Patient group:** Patients with displaced intracapsular hip fracture **Setting:** Hospital **All patients** **N:** 114 patients **No. of dropouts:** not reported	Surgical approach Group 1 57 cemented Thompson hemi-arthroplasties by an **anterolateral** approach. Group 2 57 cemented Thompson hemi-arthroplasties by **posterior** approach	**Outcomes extracted** Results reported in forest plots for: -Number of dislocations -Pain at 1 month -Impairment of mobility at 6 months		**Funding:** None reported **Limitations:** Most operations were performed by trainees with different levels of experience. No blinding of anyone reported. Unclear allocation concealment. **Outcomes not reported**: Mortality (only presented in graphs), length of stay in secondary care, reoperations (unable to work out numbers), quality of life.

17.10 Evidence Table 10: Mobilisation strategies

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Hauer et al., 2002 [139,140] **Country of study:** Germany **Study design:** *RCT* **Duration of follow-up:** 3 month	**Patient group:** Patients with hip fracture **Setting:** **Inclusion criteria:** • Hip surgery, recent history of injurious falls, age over 75 years, female, consent of orthopaedic surgeon, patient willingness to participate in the study. **Exclusion criteria:** • Acute neurological impairment, severe cardio-vascular disease, unstable chronic or terminal illness, major depression, severe cognitive impairment or severe musculo-skeletal impairment. **All patients** **N:** 28 **No. of dropouts:** **Age (mean ±SD):** 81 (±3.9) **M/F:** All female **Group 1** **No. randomised:** 15	**Group 1** High intensity progressive resistance training of functionally relevant muscle groups and a progressive functional training for 3 days a week for 12 weeks. Intensity of strength training was adjusted to 70-90% of the individual maximal workload. Basic functions such as walking, stepping or balancing were trained progressively with increasing complexity. **Group 2** Patients in the control group met 3 times a week for 1 hour for motor placebo activities. Typical activities, which were not supposed to be relevant for the study purpose, were calisthenics, games and memory tasks whilst seated	**Barthel/Mahoney activities of daily living (ADL)**	**Group 1**: 93.0 (8.2) **Group 2**: 96.1 (8.2) p = 0.636	**Funding:** A grant received from the Ministerium fur Wissenschaft, Forschung und Kunst Baden-Wuerttemberg and the University of Heidelberg. **Limitations:** Small study size **Additional outcomes reported**: Further baseline characteristics. Balance score, functional reach, total activity, 'sports' activity. Household activities, emotional state **Notes:**
			Lawton/Brody Instrumental activities of daily living index	**Group 1**: 7.3 (1.4) **Group 2**: 6.9 (1.3) p = 0.416	
			Maximal dynamic and isometric muscle strength, at 3 months mean, (±SD)	**Leg-press, fractured side 1RM (kg)** **Group 1**: 71 (35) **Group 2**: 50 (21) p = 0.021 **Leg-press, non-affected side1RM (kg)** **Group 1**: 88 (39) **Group 2**:67 (17) p = 0.018 **Leg-extensor, fractured side, Newton** **Group 1**: 68 (13) **Group 2**: 51 (22) p = 0.011 **Leg-extensor, non affected side, Newton** **Group 1**: 80 (11) **Group 2**: 60 (20) p = 0.006 **Leg flexor, fractured side, Newton** **Group 1**: 37 (7) **Group 2**: 34 (13) p = 0.036	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	No. of dropouts: **Age (mean ±SD):** 81.7 (±7.6) **M/F:** All female **Group adherence:** 93.1 (±13.5%) **Group 2** **No. randomised:** 13 **No. of dropouts:** **Age (mean ±SD):** 80.8 (±7.0) **M/F:** All female **Group adherence:** 96.7 (±6.1%)	Both groups received identical physiotherapy two times a week for 25 mins. Strength and balance training were excluded during physiotherapy and control group sessions. Physiotherapy consisted of massage, stretching and application of heat or ice.		**Leg flexor, non affected side, Newton** **Group 1**: 39 (11) **Group 2**: 37 (13) p = 0.113 **Ankle plantar flexion, fractured side, Newton** **Group 1**: 88 (30) **Group 2**: 65 (33) p = 0.944 **Ankle plantar flexion, non affected side, Newton** **Group 1**: 98 (32) **Group 2**: 78 (32) p = 0.968	
			Handgrip strength, both hands, Kilopascal	**Group 1**: 121 (29) **Group 2**: 108 (28) p = 0.270	
			Maximal gait speed, m/sec	**Group 1**: 0.72 (0.28) **Group 2**: 0.49 (0.15) p = 0.121	
			Timed up and go, (sec)	**Group 1**: 26.1 (17.8) **Group 2**: 26.9 (9.8) p = 0.731	
			Tinetti's performance oriented mobility assessment (POMA)	**Overall** **Group 1**: 23.5 (4.5) **Group 2**: 20.5 (4) p = 0.505 **Part 1** **Group 1**: 12.7 (2.2) **Group 2**: 11.4 (2.4) p = 0.747 **Part 2** **Group 1**: 10.8 (2.5) **Group 2**: 9.1 (2.1) p = 0.249	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Box step, cm	**Fractured leg** **Group 1**: 34.5 (6.4) **Group 2**: 30.6 (9.8) p = 0.482 **Unaffected leg** **Group 1**: 38.5 (7.8) **Group 2**: 34.4 (5.8) p = 0.420	

Evidence tables – mobilisation strategies

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Karumo et al., 1977[171,171] **Country of study:** Finland **Study design:** RCT **List who was masked to interventions**: Not reported **Duration of follow-up:** 3 months	**Patient group:** Patients with hip fracture **Inclusion criteria:** Consecutive patients aged over 50 with dislocated fractures of the femoral neck. **Exclusion criteria:** Inadequate follow up examination. **All patients** **N:** 100 **Lost to follow up:** 13 **Group 1** **No. randomised:** 23 treated with prosthesis 26 with internal fixation **No. of dropouts:** **Age (mean ±SD):** **M/F:** 13/26 **Subgroup category numbers**: **Other factors**: **Group 2** **No. randomised:** 16 treated with prosthesis 22 with internal fixation **No. of dropouts:** **Age (mean ±SD):** **M/F:** 9/29	**Group 1 – usual care** Average of 30mins physiotherapy per day. **Group 2 – Intensive** Physiotherapy performed twice daily – average of 1 hour. Physiotherapy shame: Walking on crutches on first postoperative day with almost all allowed full weight bearing from the beginning. From first post op day training in sitting in a chair with the hip and knee joint in 90˚ flexion. In second postoperative week training in walking up and down stairs. Patients urged to perform extension-flexion movements of the knee joint.	**Length of hospital stay**	**Prosthesis** **Group 1**: 33.9 (±20.1) **Group 2**: 31.8 (±19.6) **Internal fixation** **Group 1**: 36.0 (±23.2) **Group 2**: 32.5 (±23.6) Cochrane report: Group 1: 35.01 (21.8) Group 2: 32.21 (22.03)	**Funding:** Not stated **Limitations:** Most data presented for overall trial population or split by surgical treatment rather than rehab type. **Additional outcomes reported**: Ability to move/sit up/stand/walking ability/social management – all split by surgical treatment. No difference reported. **Notes:**
			Strength of the adductor muscle (9 weeks post op) – operated leg	**Prosthesis** **Group 1**: 5.6 (3.3) **Group 2**: 6.3 (5.7) **Internal fixation** **Group 1**: 6.4 (4.0) **Group 2**: 4.5 (2.3) Cochrane report: Group 1: 5.26 (4.08) Group 2: 6.02 (3.69)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments

Evidence tables – mobilisation strategies

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Moseley et al., 2009[216,216] **Country of study:** Australia **Study design:** *RCT* **List who was masked to interventions**: Assessor-blinded **Duration of follow-up:** 16 weeks	**Patient group:** Patients with hip fracture **Setting:** Inpatient rehab units of 3 teaching hospitals in Sydney **Inclusion criteria:** • Patients with surgical fixation for hip fracture admitted to inpatient rehab units who had approval to weight bear or partial weight bear; able to tolerate the exercise programmes; able to take 4 plus steps with a forearm support walking frame and the assistance of one person; no medical contraindications that would limit ability to exercise; living at home or low care residential facility prior to the hip fracture, with the plan to return to this accommodation at discharge. • Subjects with cognitive impairment were included if a carer who was able to supervise the exercise programme was available. • Middle band of people with hip	**<u>Group 1</u>** High group. Weight bearing exercise twice daily for a total of 60 minutes per day for 16 weeks. 5 weight bearing exercises were prescribed in addition to walking on a tread mill with partial body weight support using a harness (for inpatients) or a walking programme (after hospital discharge). The 5 weight bearing exercises used for both legs included stepping in different directions, standing up and sitting down, tapping the foot and stepping onto and off a block. Hand support could be used if necessary. The exercises were progressed by reducing support from the hands, increasing block height, decreasing chair height and increasing the number of repetitions. This started	**Knee extensor strength (isometric knee extensor strength at 90˚ measured using a spring balance.)kg, mean (SD)**	**4 week** **Group 1**: 7.8 (3.9) **Group 2**: 7.7 (4.0) **16 week** **Group 1**: 10.3 (5.0) **Group 2**: 9.3 (4.4)	**Funding:** Project grant from the National Health and Medical Research Council , Australia. **Limitations:** **Additional outcomes reported**: Fear of falling, balance, step test, body sway, stability test, falls efficiency scale. Further participant characteristics. **Notes:**
			Walking speed (measured over a 6 m distance using a stop watch) m/sec. Mean (SD)	**4 week** **Group 1**:0.53 (0.25) **Group 2**: 0.48 (0.22) **16 week** **Group 1**: 0.63 (0.32) **Group 2**: 0.60 (0.31)	
			Pain (7 item ordinal scale) – some. Moderate or severe.	**4 week** **Group 1**:44 **Group 2**: 41 **16 week** **Group 1**: 30 **Group 2**: 29	
			Quality of life (EQ 5D and expressed as a utility score)	**4 weeks** **Group 1**: 0.53 (0.27) **Group 2**: 0.53 (0.27) **16 week** **Group 1**: 0.62 (0.30) **Group 2**: 0.62 (0.26)	
			Length of stay in hospital	**16 week** **Group 1**: 28 (15) **Group 2**: 25 (14)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	fracture **Exclusion criteria:** • High functioning patients who are discharged directly to home and low functioning patients who are discharged to a residential aged care facility from the acute orthopaedic ward were excluded. **<u>All patients</u>** **N:** 160 **No. of dropouts:** **<u>Group 1</u>** **No. randomised:** 80 **No. of dropouts:** 2 withdrew by 16 weeks **Age (mean ±SD):** 84 (8) **M/F:** 15:65 **Subgroup category numbers**: **Other factors**: **<u>Group 2</u>** **No. randomised:** 80 **No. of dropouts:** 1 withdrew at 16 weeks **Age (mean ±SD):** 84 (7) **M/F:** 15:65	as an inpatient programme, followed by home visits and a structured home exercise programme. **<u>Group 2</u>** Low group. Patients undertook 5 exercises in sitting or lying plus a small amount of walking using parallel bars or walking aids for a total of 30 mins each day for 4 weeks. The exercises were progressed by increasing the repetitions and resistance. This type of exercise programme is regarded as usual care. All patients received usual post-op mobilisation, and the rehab programme usually provided by other health professionals and any gait aids were progressed as per usual protocols. No physiotherapy treatments were administered during the trial.	**Total exercise time with a physiotherapist or physiotherapy assistant as an inpatient, (min) mean (IQR)**	**Group 1**: 545 (463) **Group 2**: 363 (318) **P value(s)**: 0.001	
			sit-to-stand (stand-ups per sec) mean (SD)	**4 week** **Group 1**: 0.24 (0.15) **Group 2**: 0.19 (0.09) **16 week** **Group 1**: 0.26 (0.14) **Group 2**: 0.22 (0.11)	
			Barthel index	**4 week** **Group 1**: 93 (85-100) **Group 2**: 90 (85-95) **16 week** **Group 1**: 95 (90-100) **Group 2**: 95 (85-100)	

Evidence tables – mobilisation strategies

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Oldmeadow et al., 2006[247,247] **Country of study:** Australia **Study design:** RCT **Duration of follow-up:** 1 week post surgery	**Patient group:** Patients with hip fracture **Setting:** The Alfred Hospital, Victoria, Australia **Inclusion criteria:** Consecutive patients admitted through the emergency department for surgical fixation of an acute neck of femur fracture (by sliding screw, gamma nail or a hemiarthoplasty) were considered for inclusion in the study. **Exclusion criteria:** Pathological fractures, if postoperative orders were for non-weight bearing on the operated hip, the patient admitted from a nursing home or the patient was non-ambulant premorbidly. **<u>All patients</u>** **N:** 60 Mean age: 79.4 years (53-95) M/F: 68% women **<u>Group 1</u>** **No. randomised:** 29 **No. of dropouts:** 10 patients failed to achieve their first walk within the 48h. **Age (mean ±SD):** 78.8 (2.14)	**<u>Group 1</u>** Early ambulation (within 48 h/postoperative day) with a physiotherapist during standard working hours. **<u>Group 2</u>** delayed (longer than 48 h/postoperative day 3 or 4) All patients received routine postoperative medical and nursing clinical care, as currently practiced at The Alfred. The physiotherapy ambulation re-education program was implemented once per day over 7 days. This program was the same for all and included	**Function – Assistance required to transfer from supine to sit, sit to stand**	**independent** **Group 1**: 16 **Group 2**: 4 **assistance** **Group 1**: 10 **Group 2**: 21 **P value(s)**: 0.009	**Funding:** Not stated **Limitations:** **Additional outcomes reported**: Further baseline characteristics, Troponin, subgroup analysis of true early ambulation and failed early ambulation. **Notes:**
			Function – Mean walking metres	**Group 1**: 58.63 (0.05 – 400) **Group 2**: 29.71 (0 – 150) **P value(s)**: 0.03	
			Assistance required to negotiate one step on day 7 post-surgery.	**Independent** **Group 1**: 10 **Group 2**: 23 **Failed/unable** **Group 1**: 13 **Group 2**: 1 **P value(s)**: 0.32	
			Discharge destination	**Group 1**: Home: 5 Fast stream rehab: 8 Slow stream rehab: 14 Nursing home: 1 Death: 1 **Group 2**: Home: 1 Fast stream rehab: 14	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	M/F: 8/21 **Group 2** **No. randomised:** 31 **Age (mean ±SD):** 80.0 (2.08) **M/F:** 11/20	walking re-education, bed exercises and chest physiotherapy as indicated. Only the time to first walk differed between groups		Slow stream rehab: 16 Nursing home: 0 Death: 0 **P value(s)**: 0.19	
			Length of stay, mean (range)	**Group 1**: 9.27 (4-33) – outlier removed n =18. 17.90 (5-33) – failed early ambulation n = 10 **Group 2**: 11.39 (5-24) **P value(s)**: 0.59	

17.11 Evidence Table 11: Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Cameron 1993[42,44] **Country of study:** Australia **Study design:** RCT **Duration of follow-up:** 4 months	**Patient group:** Patients with proximal femoral hip fracture **Setting:** General hospital serving an outer urban area of Sydney, Australia. **Inclusion criteria:** Patients aged over 50 with an uncomplicated proximal femoral fracture (non-pathological, no additional fractures), surgical intervention within 7 days of injury and residence in the district. **Exclusion criteria:** Fractures sustained whilst in hospital or who were transferred to another hospital for surgical treatment. **<u>All patients</u>** **N:** 252 **Lost to follow up:**	**<u>Group 1</u>** A nursing care plan starts immediately post-op that supports early mobility and self-care. A physician sees the patient the same day or the next day of the operation to identify and treat concurrent illness, review previous level of disability and assess social support needs. The Physician also liaises with the orthopaedic surgeon regarding likely complications or precautions (e.g. limitations of weight bearing). The physician leads on planning the rehab according to the patient's pre fracture condition. Patients from nursing homes are returned there as soon as feasible to undergo supervised mobilization and physiotherapy. Patients not from nursing homes are discharged once they can walk (with an aid) and go to the toilet independently. The patient received	**Median length of hospital stay, days (interquartile range)** **Mortality (obtained from the Cochrane review- Handoll 2009) 12 months** **Mean Barthel index**	**Group 1**: 13 (7-25) **Group 2:** 15 (8-44) p=0.034 **Group 1**: 32 **Group 2:** 38 **2 weeks after injury** **Group 1**: 32 **Group 2:** 38 **1 month after injury** **Group 1**: 32 **Group 2:** 38	**Funding:** Australian Department of Health, Housing and Community Services. **Limitations:** Mean age significantly lower in accelerated rehab group (p = 0.0042) No assessor blinding **Outcomes not reported**: **Additional outcomes reported**: Additional baseline characteristics such as pre-injury situation, injury details. **Notes:**

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (mean ±SD): 84 **M/F:** 17% male Cognitively impaired: 122 **Group 1 Accelerated rehab** **No.:** 127 **No. of dropouts:** **Age (mean):** Nursing home: 84.2 (n = 48) Non nursing home+moderate to severe disability: 87.2 (n = 21) Non-nursing home+limited disability: 79.2 (n = 58) **M/F:** **Group 2 Usual care** **No. :** 125 **No. of dropouts:** **Age (mean):** Nursing home: 88.5 (n=46) Non nursing home+moderate to severe disability: 89.3 (n = 22) Non-nursing home+limited disability: 81.4 (n = 57) **M/F:** **Other factors**: **Living alone**	physiotherapy on each weekday (ideally 2 sessions per day). The orthopaedic surgeon and rehab physician review the patient 3 or 4 times weekly. After discharge the patient's rehab continues either at home (physiotherapist home visit) or at a day hospital until they reach their pre-fracture level of function or plateau at a lower level. **Group 2** Conventional care			Patients stratified into 3 groups: Nursing home, non nursing home + moderate to severe disability and non-nursing home + limited disability. Key difference in accelerated rehab was concentrated input of an experienced physician with training in geriatric and rehab medicine.

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Crotty 2002[58,60] **Country of study:** Australia **Study design:** RCT **Duration of follow-up:** 12 months	**Patient group:** Patients with hip fracture **Setting:** 2 Australian teaching hospitals in Adelaide (Flinders Medical centre, Repatriation General Hospital) **Inclusion criteria:** Aged 65 or over, medically stable, needed a formal rehabilitation program, had adequate physical and mental capacity to participate in rehabilitation, were expected to return home after discharge from the hospital, and had a home environment suitable for rehabilitation. **Exclusion criteria:** If patients had inadequate social support in the community, no telephone at home, or did not live in Adelaide's southern metropolitan region. **<u>All patients</u>** **N:** 66	Randomisation was undertaken by the hospital pharmacy department (computer generated allocation sequence in sealed opaque envelopes). **<u>Group 1</u>** Patients were discharged within 48 hours of randomisation and were visited by physiotherapists, occupational therapists, speech pathologists, social workers, and therapy aides, who negotiated a set of realistic, short-term, and measureable treatment goals with both participants and their care-givers. Standard therapy services podiatry, nursing care, and assistance with light domestic tasks, were provided as required. **<u>Group 2</u>** Conventional care in routine hospital interdisciplinary rehabilitation.	**Mortality at 12 months**	**Group 1**: 3 **Group 2:** 4	**Funding:** Supported by the South Australian Department of Human Services **Limitations:** Baseline data not given for male/female ration or mean age in each arm. **Outcomes not reported**: **Additional outcomes reported**: **Notes:**
			Moved to higher level of care	**Group 1**: 1 **Group 2:** 2	
			Unable to walk	**Group 1**: 0 **Group 2:** 2	
			SF-36 physical component score at one year, mean (95% CI)	**Group 1**: 38 (34.0-41.9) **Group 2:** 33.3 (27.6-39.1)	
			SF-36 mental component score at one year, mean (95% CI)	**Group 1**: 53.8 (49.2-58.3) **Group 2:** 52.3 (47.3-57.3)	
			Length of hospital stay, mean (SD) – from Cochrane review, Handoll 2009	**Group 1**: 7.8 (9.3) **Group 2:** 14.3 (10.6)	
			Length of rehab, mean (SD) – from Cochrane review, Handoll 2009	**Group 1**: 28.3 (14.5) **Group 2:** 14.3 (10.6)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Lost to follow up: 3 **Age (mean +SD):** 82.5 **M/F:** 33% male **Group 1 Early discharge + home rehab** **No.:** 34 **Age (mean):** not stated **M/F:** not stated **Group 2 Usual care** **No. :** 32 **Age (mean):** not stated **M/F:** not stated		**Hospital readmissions during 4 month follow up – from Cochrane review, Handoll et al., 2009**[132,133]	**Group 1**: 8 **Group 2:** 7	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Galvard 1995[107,107] **Country of study:** Sweden **Study design:** RCT **List who was masked to interventions**: **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Vaernhem Hospital, Malmo, Sweden **Inclusion criteria:** Independently living hip fracture patients in the municipality of Malmo **Exclusion criteria:** People resident in nursing homes or waiting for a nursing bed, or already in hospital **<u>All patients</u>** **N:** 371 **Age (mean + range):** 79 (52-102) **M/F:** 26% male **<u>Group 1 Geriatric (MDR)</u>** **No.:** 179 **Age (mean ±SD):** men: 79.1 (8.6) women: 80.9 (9.2) **M/F:** 50/129 **<u>Group 2 Usual care</u>** **No. :** 192 **Age (mean ±SD):** men: 73.6 (10) women: 79.6 (8.2) **M/F:** 45/147	All patients were treated at the orthopaedic department and then randomization took place immediately after the operation, using a random number generator. **<u>Group 1</u>** Patients were transferred on the second postoperative day, and once weekly a visiting orthopaedic surgeon would decide on further treatment of the fracture **<u>Group 2</u>** Usual care – stayed on the orthopaedic ward.	**length of stay in hospital, days (mean, SD)** **Mortality at 1 year** **Total no. of patients readmitted to hospital**	**Group 1**: 53.3 (47.7) **Group 2:** 28 (24.2) **Median** **Group 1**: 40 **Group 2:** 21 **Group 1**: 45 **Group 2:** 40 **Group 1**: 36 **Group 2:** 57	**Funding:** Not stated **Limitations:** Higher number of subtrochanteric fractures and higher mean age of men in the geriatric MDR group. Unclear allocation concealment. **Outcomes not reported**: **Additional outcomes reported**: Baseline data – distribution of fracture types. Destination at discharge from hospital. Causes for hospital readmissions. Hip pain and walking ability one year postoperatively. Indoor walking speed. **Notes:** Study states that longer length of hospital stay in geriatric MDR group may relate to lack of experience in geriatric department at the time and that the orthopaedic (usual care) group had over 25 years of experience with these patients.

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Gilchrist et al., 1988[113,113] **Country of study:** Glasgow, UK **Study design:** RCT **Duration of follow-up:** 6 months	**Patient group:** Patients with femoral neck fractures **Setting:** Orthopaedic unit, Western Infirmary **Inclusion criteria:** Women aged over65 **Exclusion criteria:** Patients referred from nearby hospitals, patients who made a rapid recovery and were sent directly home. **<u>All patients</u>** **N:** 222 **Age (mean ±SD):** **<u>Group 1 Orthopaedic geriatric unit</u>** **No.:** 97 **Age (mean):** 82 **Length of stay before transfer (days): 10.2** **<u>Group 2 Usual care (orthopaedic ward)</u>** **No. :** 125 **Age (mean):** 80.6 **Length of stay before transfer (days):** 9.8	Patients were admitted to the orthopaedic unit and had standard preoperative medical assessment. After surgery were transferred to orthopaedic wards at Gartnavel General Hospital for rehab. Randomisation occurred at time of transfer. **<u>Group 1</u>** Patients were under overall care of the orthopaedic surgical staff. A weekly combined ward round was performed by a geriatrician (consultant or senior registrar), an orthopaedic senior registrar, and the senior ward nurse. A physiotherapist, occupational therapist, and a social worker participated in the case conference that followed. Advice was given on medical problems that arose between ward rounds by consultation with the geriatrician. Patients were seen on average, 4 times by a geriatrician. **<u>Group 2</u>** Similar nursing cover and paramedical services as group 1, but no case conference. Referral for any medical problem to the geriatric service was made by letter, and patients were seen by a different geriatrician than in group 1.	**Mortality**	**Inpatient** **Group 1**: 4 **Group 2:** 13 **3 month** **Group 1**: 10 **Group 2:** 18 **6 month** **Group 1**: 14 **Group 2:** 23	**Funding:** Not stated **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: Type of fracture, placement of patients admitted from home, conditions in patients at discharge **Notes:**
			Length of stay in hospital (mean, SE)	**Group 1**: 44 (5.7) **Group 2:** 47.7 (7.7)	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Huusko et al., 2002[157,158] (Huusko et al., 2000[157,157] gives subgroup data for patients with dementia) **Country of study:** Finland **Study design:** RCT **List who was masked to interventions**: No assessor blinding **Duration of follow-up:** 12 months	**Patient group:** Patients with proximal femoral fracture **Setting:** Specialist district hospital in Jyvaskyla, Finland **Inclusion criteria:** • Community-dwelling patients with acute hip fractures over 64 years of age. **Exclusion criteria:** • Pathological fracture, multiple fractures, terminally ill, serious early complication, receiving calcitonin, unable to communicate **<u>All patients</u>** **N:** 243 **Lost to follow up:** **Age (mean and range):** 80 (66-97 **M/F:** 28% male **<u>Group 1 Geriatric rehab</u>** **No.:** 84 **Age (mean + range):** 80 (67-92) **M/F:** 36/84 **Living alone:** 62 Dementia: 32	**<u>Group 1</u>** Intensive geriatric rehab within hospital: multidisciplinary geriatric team (geriatrician, specialist GP and nurses, occupational therapist, physiotherapist, social worker, neuropsychiatrist). Twice daily physiotherapy; ADL practice; daily schedule; counselling; information; discharge plan; home visits, treatment at home after discharge based in geriatric ward in same hospital as surgery. **<u>Group 2</u>** Discharge to local community hospitals, treatment by GP with physiotherapists usually available. Transfer 2 to 5 days after surgery.	**Mortality at 12 months**	**Group 1**: 18 **Group 2:** 20	**Funding:** Study was supported by grants from Central Finland Health Care District, Kuopio University Hospital, Emil Aaltonen Foundation, Uulo Arthio Foundation and Novartis Finland Ltd **Limitations:** Imbalance of baseline characteristics. Intervention group had a greater number with Dementia 32/120 vs. 20/123); fewer were functionally independent in ADL before hip fracture (41 vs. 66) **Outcomes not reported**: **Additional outcomes reported**: IADL and ADL change
			Mortality at discharge	**Group 1**: 5 **Group 2**: 5	
			Total days in hospital (during 1 year)	**Group 1**: 80 **Group 2:** 80	
			Length of hospital stay (median + range) – severe dementia (mini mental state examination score 0-11)	**Group 1**: 85 (13-365) N = 19 **Group 2:** 67 (15-365) N = 9 P=0.902	
			Length of hospital stay (median + range) – moderate dementia (mini mental state examination score 12-17)	**Group 1**: 47 (10-365) N = 24 **Group 2:** 147 (18-365) N = 12	
			Place of residence and mortality – severe dementia (mini mental state examination score 0-11)	**<u>1 year</u>** Independent living **Group 1**: 7 **Group 2**: 3 Nursing home **Group 1**: 5 **Group 2**: 0 Hospital **Group 1**: 2 **Group 2**: 3	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	<u>Group 2 Usual care</u> **No. :** 90 **Age (mean + range):** 80 (66-97 **M/F:** 33/90 **Living alone:** 70 Dementia: 20			Dead **Group 1**: 5 **Group 2**: 3 **Group 1**: n = 19 **Group 2**: n = 9	from baseline. **Notes:** Patients were mobilised on the first postoperative day.
			Place of residence and mortality – moderate dementia (mini mental state examination score 12-17)	**<u>1 year</u>** Independent living **Group 1**: 15 **Group 2**: 4 Nursing home **Group 1**: 1 **Group 2**: 2 Hospital **Group 1**: 4 **Group 2**: 4 Dead **Group 1**: 4 **Group 2**: 2 **Group 1**: n = 24 **Group 2**: n = 12	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Kennie et al., 1988[176,176] **Country of study:** Stirling, UK **Study design:** RCT **Duration of follow-up:** 1 year	**Patient group:** Women with proximal femoral fracture **Setting:** Orthopaedic ward and geriatric rehab ward, Stirling **Inclusion criteria:** Women aged over 65 **Exclusion criteria:** Mortality prior to randomisation, pathological fractures, those likely to be discharged within 7 days of entering the trial, those remaining unfit for transfer by ambulance to a peripheral hospital. **<u>All patients</u>** **N:** 108 **Lost to follow up:** **Age (mean +SD):** **M/F:** All female **<u>Group 1 Geriatric rehab</u>** **No.:** 54 **Age (median + range):** 79 (65-94) **M/F:** All female **<u>Group 2 Usual care</u>** **No. :** 54	Patients were randomised to geriatric rehab or usual care once the orthopaedic surgeon judged them fit to be moved to a rehab ward. Both treatment and control groups received physiotherapy, occupational therapy, and orthotic and other services. **<u>Group 1</u>** Transferred by ambulance 5km to orthopaedic beds in a peripheral hospital. The median delay between entry into the study and transfer was one day (range 0-7). A GP provided day-to-day medical attention, and a consultant physician in geriatric medicine attended 2 ward round and 1 conference of the multidisciplinary team each week. Orthopaedic advice was available on demand.	**Length of hospital stay**	**Mean +/- SD(from Cochrane review, Handoll 2009)** **Group 1**: 37 (33) **Group 2:** 56 (54) **Median** **Group 1**: 24 (8-197) **Group 2:** 41 (9-365)	**Funding:** Forth Valley Health Board **Limitations:** No blinding of staff or patients. **Outcomes not reported**: **Additional outcomes reported**: Additional baseline data including residence, independence and mental state before admission, details of fracture. **Notes:** Similar baseline characteristics across groups, apart from age and difference in mental state, with more moderate and severe impairment in
			More dependent based on Katz score at 1 year (from Cochrane review, Handoll 2009)	**Group 1**: 22/43 **Group 2:** 28/35	
			Type of residence after discharge	**NHS or private nursing home** **Group 1**: 5 **Group 2:** 16 **Own home** **Group 1**: 31 **Group 2:** 19	
			Mortality (taken from Reid 1989)	**At discharge** **Group 1**: 5 **Group 2:** 4 **At 1 year** **Group 1**: 10 **Group 2:** 18	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (median + range): 84 (66-94) **M/F:** All female	**Group 2** The control group remained in the orthopaedic admission ward. A few of these patients were moved into other short stay wards at the discretion of the consultant orthopaedic surgeon.			the control group (p=0.06)

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Naglie et al., 2002[222,222] **Country of study:** Toronto, Canada **Study design:** RCT **List who was masked to interventions**: Assessors **Duration of follow-up:** 6 months	**Patient group:** Patients with hip fracture **Setting:** Teaching hospital in Toronto **Inclusion criteria:** • Patients aged over 70 from the community and from nursing homes **Exclusion criteria:** • Fractures occurring in an acute care hospital, pathologic fractures, multiple traumas, previous surgery on the fractured hip, expected survival less than 6 months, residence in a nursing home and dependence and at least one person for ambulation before the fracture, or residence outside metropolitan Toronto.	Within 48h of randomisation the research coordinator reviewed each case for compliance with the inclusion criteria and a panel then reviewed eligibility. Separate staff provided care in each group to prevent containment bias. **<u>Group 1</u>** Protocols and standardized orders were used, early mobilisation, early participation in self care and individualised discharge planning. All nursing staff on the ward received specialised education about the care of elderly with hip fracture. A physiotherapist, occupational therapist or a clinical nurse specialist and	**Mortality**	**At discharge** **Group 1**: 7 (5%) **Group 2:** 13 (9.4%) **3 months** **Group 1**: 10 (7.1%) **Group 2:** 12 (8.7%) **6 months** **Group 1**:17 (12.1%) **Group 2**: 21 (15.2%)	**Funding:** Supported by a grant from Ontario Ministry of Health and the Research Institute of the Queen Elizabeth Hospital, Toronto. **Limitations:** Anticipated that the intervention would increase length of hospital stay. **Outcomes not reported**: **Additional outcomes reported**: Baseline characteristics such as: Functional and cognitive scores,
			Decline in ambulation- data missing for 3 patients in group 1 and 8 patients in group 2 at 3 months.	**3 months** **Group 1**: 73 (57%) **Group 2:** 72 (61%) **6 months** **Group 1**:59 (47.6%) **Group 2**: 56 (47.9%)	
			Decline in transfers- data missing for 3 patients in group 1 and 8 patients in group 2 at 3 months.	**3 months** **Group 1**: 57 (44.5%) **Group 2:** 48 (40.7%) **6 months** **Group 1**: 45 (36.3%) **Group 2**: 44 (37.6%)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Patients were excluded postoperatively if the surgery failed for technical reasons, if they required care in an intensive care unit or of there was no bed available on the interdisciplinary care ward. **<u>All patients</u>** **N:** **Lost to follow up:** **Age (mean <u>+</u>SD):** **M/F:** **<u>Group 1 interdisciplinary care</u>** **No.:** 141 **No. of dropouts:** 0 **Age (mean):** 83.8 (6.9) **M/F:** 32/109 **Other factors**: **Living alone**: 23.4% **Mean time to surgery:** 1.3 days Subcapital fractures: 46.8% **<u>Group 2 Usual care</u>** **No. :** 138 **Withdrawal:** 1 **Age (mean):** 84.6 (7.3) **M/F:** 24/114 **Other factors**: **Living alone:** 23.2% **Mean time to surgery:** 1.4 days Subcapital fractures: 39.1%	social worker assigned to the ward routinely assessed all study patients within 72 hours. Daily medical care from a senior internal medicine resident supervised by an internist-geriatrician. **<u>Group 2</u>** Patients had access to allied health professionals if a consultation was requested, but had limited access to an occupational therapist or a clinical nurse specialist.	**Change in residence**	**3 months** **Group 1**: 31 (23.7%) **Group 2:** 32 (25.4%) **6 months** **Group 1**: 22 (17.7%) **Group 2**: 23 (19.7%)	medical indicators, surgical procedure. Care by allied health professional. Place of residence at discharge, **Notes:** Intervention group received more physiotherapy hours than the control p<0.001 A subgroup analysis in the paper shows a trend towards benefit in patients with mild to moderate cognitive impairment. NB Intensive intervention during hospital stay.
			Length of stay in hospital, days (SD)	**Group 1**: 29.2 (22.6) **Group 2**: 20.9 (18.8)	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Marcantonio et al., 2001[203,203] **Country of study:** USA **Study design:** RCT **Duration of follow-up:**	**Patient group:** Patients with proximal hip fracture **Inclusion criteria:** All patients aged 65 and older admitted to an academic tertiary medical center for primary surgical repair of hip fracture. **Exclusion criteria:** Presence of metastatic cancer or other comorbid comorbid illnesses likely to reduce life expectancy to less than 6 months, or inability to obtain informed consent within 24h of surgery or 48h of admission **All patients** **N:** 126 **Lost to follow up:** **Age (mean ±SD):** **M/F:** **Group 1 Geriatric consultation** **No.:** 62 **No. of dropouts:** **Age (mean):** 78±8 **M/F:** 79% female **Other factors:** **Pre fracture dementia:** (Blessed score ≥4) :21 **Prefracture ADL impairment (Katz ADL score <5:** 11	**Group 1: Intervention** Geriatric consultation preoperatively or within 24h postoperatively. A geriatrician performed daily visits for the duration of hospitalisation and made targeted recommendations based on a structured protocol. The protocol included 10 modules each containing 2 to 5 specific recommendations. Detailed fully in the paper, includes adequate CNS oxygen delivery, fluid/electrolyte balance, treatment of severe pain, elimination of unnecessary medications, regulation of bowel/bladder function, adequate nutritional intake, early mobilization and rehab, management of postop complications, appropriate environmental stimuli, treatment of agitated delirium. **Group 2:** usual care Management by orthopaedic team, including internal medicine or geriatric consults	**Delirium: Total cumulative incidence during acute hospitalisation**	**Group 1**: 20 **Group 2:** 32	**Funding:** Part funded by a pilot project grant from the Older Americans Independence Centre and a grant from the Charles Farnsworth Trust. **Limitations:** Not MDR rehab, focus on impact of geriatric consultation. **Notes:** Recommendations made, and adherence to them varied. Full data given in paper.
			Severe delirium: cumulative incidence during acute hospitalisation	**Group 1**: 7 **Group 2:** 18	
			Hospital days of delirium per episode (mean ±SD)	**Group 1**: 2.9±2 **Group 2:** 3.1±2.3	
			Hospital length of stay (median +IQR)	**Group 1**: 5±2 **Group 2:** 5±2	
			Discharged to institutional setting (nursing home, rehab hospital)	**Group 1**: 92% **Group 2:** 88%	
			Delirium at hospital discharge	**Group 1**: 8 **Group 2:** 12	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Group 2 Usual care **No. :** 64 **No. of dropouts:** **Age (mean):** 80±8 **M/F:** 78% female **Other factors**: **Pre fracture dementia:** (Blessed score ≥4) :29 **Prefracture ADL impairment (Katz ADL score <5:** 18	on a reactive rather than proactive basis.			

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Shyu et al., 2008[305,306] **Country of study:** Taiwan **Study design:** RCT **Duration of follow-up:** 1 year	**Patient group:** Patients with hip fracture **Setting:** Teaching hospital in Taiwan **Inclusion criteria:** Aged 60 or over, admitted to hospital for an accidental single-side hip fracture, receiving hip arthroplasty or internal fixation, able to perform full range of motion against gravity and against some or full resistance and had a prefracture Chinese Barthel Index score >70, and living in northern Taiwan **Exclusion criteria:** Severely cognitively impaired, making them unable to follow orders or terminally ill. **All patients** **N:** 162 **Age (mean ±SD):** 78 **M/F:** 31.5% male **Group 1 Intervention** **No.:** 80 **Age (mean):** 77.36 (8.19) **M/F:** 25/55	Patients recruited from the emergency room by research assistants. **Group 1** Interdisciplinary programme of geriatric consultation, continuous rehabilitation and discharge planning. Geriatrician and geriatric nurses provided geriatric assessment/consultation; physiotherapist, geriatric nurses and rehab physician were responsible for rehab programme, Early mobilisation, home visit and follow-up services provided.4x 30min physical therapy sessions per patient, 2 assessments from a physical therapist and one visit from rehab physician. 4 home visits during first month and 4 during second and third month from a geriatric nurse. **Group 2** On trauma or orthopaedic ward. Occasional consultation with other disciplines depending on patient's	**Length of hospital stay, mean days (SD)** **Recovery of walking ability** **Mortality** **Non-recovery/decline in walking ability – long-term at 12 months** (additional info from Cochrane review Handoll 2009)	**Group 1**: 10.1 (3.7) **Group 2:** 9.72 (4.96) **at 6 months** **Group 1**: 62 **Group 2:** 44 **at 12 months** **Group 1**: 61 **Group 2:** 49 **at 6 months** **Group 1**: 6 **Group 2:** 8 **at 12 months** **Group 1**: 13 **Group 2:** 15 **Group 1**: 59 **Group 2:** 56	**Funding:** Supported by grants from the National Health Research Institute, Taiwan. **Limitations:** **Outcomes not reported**: **Additional outcomes reported**: Marital status, educational background. Occurrence of falls, self-care ability, depressive symptoms **Notes:** Includes early mobilisation and intensive rehab. Intervention resembles a geriatric hip fracture rehab

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Independent walking ability: 68 **<u>Group 2 Usual care</u>** **No. :** 82 **Age (mean):** 78.94 (7.28) **M/F:** 26/56 **Independent walking ability:** 69	condition. Exercises taught by nurses in first 2 to 3 days. Physical therapy sessions varied according to insurance policy.			programme and early supportive discharge.

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Stenvall et al., 2007[320,320] **Country of study:** Sweden **Study design:** RCT **List who was masked to interventions**: **Duration of follow-up:** 12 month	**Patient group:** Patients with femoral neck fracture **Setting:** Umea University Hospital, Sweden **Inclusion criteria:** • Patients aged 70 years or older **Exclusion criteria:** • Patients with severe rheumatoid arthritis, severe hip osteoarthritis or a pathological fracture, or severe renal failure. Patients who were bed bound prior to the fracture. **All patients** **N:** 199 **Lost to follow up:** **Age (mean ±SD):** **M/F:** 26% male **Group 1 Intervention** **No.:** 102 **No. of dropouts:** **Age (mean):** 82.3 (6.6) **M/F:** 28/74 **Other factors**:	**Group 1** Geriatric unit specializing in geriatric orthopaedic patients. Active prevention, detection and treatment of post op complications implemented daily. Early mobilisation, with daily training was provided by physiotherapists, occupational therapists and care staff during hospital stay. Assessment at 4 months by geriatric team. **Group 2** Specialist orthopaedic unit following conventional postoperative routines. A geriatric unit was used for those needing longer rehab n = 40, but this was not the	**Living independently**	**At 4 months** **Group 1**: 54 **Group 2:** 46 **At 12 months** **Group 1**: 47 **Group 2:** 36	**Funding:** Supported by the Vardal Foundation, the Joint Committee of the Northern Health Region of Sweden, the JC Kempe Memorial Foundation, the Dementia Fund, and the Foundation of the Medical Faculty, the Borgerskapet of Ulmea Research Foundation, the Erik and Anne-Marie Detlof's Foundation, University of Ulmea and the County Council of Vasterbotten and the Swedish Research Council. **Limitations:** Not blinded, but independent assessors. Intensity and quality of outpatient rehab is unknown.
			Independent walking ability	**At 4 months** **Group 1**: 59 **Group 2:** 52 **At 12 months** **Group 1**: 55 **Group 2:** 45	
			Independent walking without walking aid indoors	**At 4 months** **Group 1**: 31 **Group 2:** 19 **At 12 months** **Group 1**: 35 **Group 2:** 22	
			Independent in P-ADL (poorer personal activities of daily living)	**At 4 months** **Group 1**: 35 **Group 2:** 23 **At 12 months** **Group 1**: 33 **Group 2:** 17	
			Length of stay in hospital	**At 12 months** **Group 1**: 30 (18.1) **Group 2:** 40 (40.6)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Living alone: **<u>Group 2 Usual care</u>** **No. :** 97 **No. of dropouts:** **Age (mean):** 82 (5.9) **M/F:** 23/74 **Other factors**: **Living alone**	same ward as the intervention.		p=0.028	**Outcomes not reported**: Baseline data such as health and medical problems, functional performance prior to fracture. **Additional outcomes reported**: **Notes:** Paper contains a detailed description of the intervention and control group.
			Mortality	**At discharge** **Group 1**: 6 **Group 2:** 7 **At 12 months** **Group 1**: 16 **Group 2:** 18	
			Hospital readmissions	**At 12 months** **Group 1**: 38 **Group 2:** 30	
			More dependent based on Katz index at 1 year	**Group 1**: 35 **Group 2:** 49	
			Non recovery in ADL at 1 year	**Group 1**: 51 **Group 2:** 59	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Swanson et al., 1998[325,325] **Country of study:** Australia **Study design:** RCT **Duration of follow-up:** 12months	**Patient group:** Patients with femoral fractures. **Setting:** Royal Brisbane Hospital, teaching hospital. **Inclusion criteria:** Patients aged 55 or over; non-pathological fractures; residing at home or in a hostel; independently mobile (with or without a walking aid); able to give informed consent; accessible for follow up (i.e., residing in the Brisbane area); and public patients. **Exclusion criteria:** Patients with dementia, with inadequate English to give informed consent or residing in a nursing home. **All patients** **N:** 71	Patients were identified by the trial coordinator in the Accident and Emergency Department **Group 1** Multidisciplinary team: full time physiotherapist, occupational therapist, clinical nurse consultant, half time social worker, geriatrician, orthopaedic surgeon. Early mobilisation (1st day after surgery if possible), twice daily intense sessions by physiotherapist, daily assessment, treatment or counselling by the occupational therapist and social worker. Review by geriatrician	**Length of stay (**discharge criteria used e.g. when medically stable and able to transfer and walk independently with or without aids)	**Mean** **Group 1**: 21 (17.2-24.4) **Group 2:** 32.5 (24.2-41.1) p<0.01 **Median** **Group 1**: 17 **Group 2:** 24 p<0.01	**Funding:** Medicare Incentives Hospital Access Program. **Limitations:** Underpowered – initial power analysis determined that 120 patients (60 in each arm) would have the power to detect a reduction in mean length of stay of 7 days at 0.05 level of significance. However the difference in length of stay was larger than anticipated. No assessor blinding **Outcomes not reported**:
			Mortality	**In hospital** **Group 1**:2 **Group 2:** 2 **12 months** **Group 1**:5 **Group 2:** 6	
			Modified Barthel Index at discharge (95% CI)	**6 months** **Group 1**: 92.8 (90.0-95.6) **Group 2:** 85.6 (81.3-89.8) **12 months** **Group 1**: 95.3 (SD 9.8) **Group 2:** 89 (SD 15.8)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Lost to follow up: 0 **Age (mean +SD):** **M/F:** 22% male **Group 1 Early intervention** **No.:** 38 **Age (mean):** 78.5 (75.3-81.7) **M/F:** 11/27 **Living at home:** 35 (92.1%) **Group 2 Usual care** **No. :** 33 **No. of dropouts:** **Age (mean):** 77.8 (74.0-81.6) **M/F:** 5/28 **Living at home:** 29 (87.9%)	on next working day after surgery, 2 additional ward rounds attended by all staff, weekly case conference attended by all staff, coordination of care by trial coordinator, home assessment visit before discharge. **Group 2** Standard orthopaedic management including daily visits from a physiotherapist, and social worker or occupational therapist visits as requested by hospital staff. Weekly discharge planning, home visits as requested by social worker.	**Complications (additional from Cochrane review)**	**Chest infection, cardiac problem bedsore** **Group 1**: 6 **Group 2:** 13 **Stroke emboli** **Group 1**: 4 **Group 2:** 1	**Additional outcomes reported**: **Notes:** Surgery was carried out within 48 hours of admission for 90% of intervention and 80% of standard care. 12 month data from Day 2001.

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Vidan et al., 2005[344,344] **Country of study:** Spain **Study design:** RCT **Duration of follow-up:** 12 months	**Patient group:** Patients with hip fracture **Setting:** Hospital General Universitario "Gregorio Maranon". **Inclusion criteria:** • Consecutive patients aged 65 and older between February 1 and December 15, 1997 for acute hip fracture surgery. **Exclusion criteria:** • Inability to walk before the fracture and dependency in all basic activities of daily living; pathological hip fracture; known terminal illnesses, defined as those associated with a life expectancy of less than 12 months. **All patients** **N:** 319 **Lost to follow up:** **Age (mean ±SD):** **M/F:** 18.5% male **Group 1 Usual care** **No.:** 164 **No. of dropouts:** not stated	All patients had an orthopaedic surgeon and a nurse assigned when they were admitted to hospital. The intervention and control group shared the same orthopaedic wards and used the same hospital-wide support services, including physical therapy and social work. The orthopaedic surgeon made the decision of discharge moment in both groups. **Group 1** The surgeon and orthopaedic nurses managed patients, with counselling from different specialists as needed. **Group 2** A geriatrician visited the patients daily and was responsible for medical care. After initial	**Median total length of hospital stay (25th to 75th percentile)**	**Group 1**: 18 (13 – 24) **Group 2:** 16 (13 – 19) p = 0.06	**Funding:** Not stated **Limitations:** Usual care group have a higher percentage of coexisting conditions **Outcomes not reported**: **Additional outcomes reported**: Additional baseline data: coexisting conditions, type of fracture, type of surgery. Also medical complications: heart failure, DVT, myocardial infarction, arrhythmia. **Notes:** ADL = activities of daily living. (Bathing, dressing, using the toilet, getting from bed to chair, and continence) FAC = Functional
			In hospital mortality	**Group 1**: 9 (5.5%) **Group 2:** 1 (0.6%) p = 0.03	
			Mortality – end of scheduled follow up (from Cochrane review)	**Group 1**: 39 **Group 2:** 28	
			Major medical complications	**Confusion** **Group 1**: 67 (44.1%) **Group 2:** 53 (34.2%) p = 0.07 **Pressure sores** **Group 1**: 27 (16.9%) **Group 2:** 8 (5.2%) p = 0.001 **Pneumonia** **Group 1**: 6 (3.7%) **Group 2:** 6 (3.9%) p = 0.95 **Heart failure** **Group 1**: 5 **Group 2:** 12	
			Time from surgery to rehabilitation, days, mean (SD)	**Group 1**: 10.2 (6) **Group 2:** 8.3 (3.9) p = 0.007	
			Recovery of ADL or FAC	**Group 1**: 3 (2%)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (mean): 82.6 (±7.4) **M/F:** 35/129 **Living at home before admission:** 134 (82%) **Type of surgery:** **Internal fixation:** 101 (61.6%) **Prosthetic replacement:** 53 (32.3%) **Others:** 10 (6.1%) **Mean time to surgery, hours (SD):** 78.5 ±53.2 **<u>Group 2 Intervention</u>** **No. :** 155 **No. of dropouts:** not stated **Age (mean):** 81.1 (±7.8) **M/F:** 24/131 **Living at home before admission:** 135 (87%) **Internal fixation:** 91 (58.7%) **Prosthetic replacement:** 58 (37.4%) **Others:** 6 (3.9%) **Mean time to surgery, hours (SD):** 75.8 ±43.2	assessment and within 72 hours after admission, there was an interdisciplinary meeting, including the orthopaedic and geriatric teams, to discuss the patient's medical, functional, and social problems and to elaborate a comprehensive therapeutic plan. The meeting was repeated weekly.	**at time of hospital discharge**	**Group 2:** 5 (3%)	Ambulation Classification. This consists of 6 different functional levels.
			Recovery of ADL or FAC at time of 3 months	**Group 1**: 59/134 (44%) **Group 2:** 82/144 (57%) p = 0.03	
			Incomplete recovery of ADL and mobility at 1 year (from Cochrane review)	**Group 1**: 75 **Group 2:** 67	

Evidence tables – multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Ziden et al., 2008 and Ziden et al., 2010[360,361] **Country of study:** Sweden **Study design:** RCT **Duration of follow-up:** 1 year	**Patient group:** Community-dwelling patients with hip fracture **Setting:** Patients admitted to the emergency unit at the Sahlgrenska University Hospital **Inclusion criteria:** Acute hip fracture surgery, medically approved by the responsible geriatric doctor as being in need of geriatric care and rehab, aged 65 or over and able to speak and understand Swedish. **Exclusion criteria:** Severe mental illness with expected survival of less than one year, severe drug or alcohol abuse, mental illness or documented severe cognitive impairment. **<u>All patients</u>** **N:** 102 Total of 212 randomised: Excluded: 99	A geriatric nurse who performed the randomisation using sealed envelopes. Patients with hip fracture were referred from the emergency unit to a geriatric ward with home rehab (group 1) or with conventional care. Both groups performed early mobilization, preferably within 48 h. When needed an occupational therapist or physiotherapist made a home visit with the patient to assess if they could manage and what aids they needed. **<u>Group 1</u>** Conventional care and rehab as in group 2, plus supported discharge. An initial meeting with the patient aimed to establish individual goals. Close contact with social home services and relatives to plan discharge and cooperation during 1st few	**Balance confidence – Swedish version of the Falls Efficacy Scale – 1 month (SD) .** 0-10 scale where 0 indicates very confident, no fear of falling, 10 is not confident, very afraid of falling. Swedish. Includes 13 items covering activities of daily living. **Activities of daily living and leisure activities – degree of independence assessed by Functional Independent Measure (FIM) motor scale (mean, SD).** 13 items with a 7 point grading scale (0 = totally dependent and 7 = totally independent) max score 91 points	**1 month** **Group 1**: 117.4 (12.0) **Group 2:** 85.5 (30.5) p<0.0001 **1 month** **Self-care** **Group 1**: 38.4 (2.9) **Group 2**: 33.5 (7.2) **Mobility** **Group 1**: 18.3 (1.5) **Group 2**: 16.3 (3.3) **Locomotion** **Group 1**: 10.4 (2.5) **Group 2**: 7.6 (3.6) **6 months – median with range** **Self-care** **Group 1**: 40 (33-42) **Group 2**: 37 (6-42) **Locomotion** **Group 1**: 31 (15-34) **Group 2**: 30 (5-35)	**Funding:** Supported by the Vardal Institute, the Hjalmar Svensson's Foundation and the Geriatric Section of the Swedish Association of Registered Physiotherapists. **Limitations:** No length of hospital stay or total length of rehab in control group. **Outcomes not reported**: **Additional outcomes reported**: Other baseline characteristics such as walking ability, number of medical diagnosis, functional independence and instrumental activity.

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Declined to participate: 11 **Lost to follow up:** **Age (mean +SD):** 81.9 (6.8) **M/F:** **Group 1 Home rehab** **No.:** 48 **No. of dropouts:** **Age (mean):** 81.2 (5.9) **M/F:** 19/29 **Other factors**: **Living alone:** 26 **Group 2 Usual care** **No. :** 54 **No. of dropouts:** **Age (mean):** 82.5 (7.6) **M/F:** 12/42 **Other factors**: **Living alone** 39	weeks at home. Home rehab consisted of a 3 week intervention period. **Group 2** Participation in standard rehab including daily training in basic activities: transfer techniques, technical aids, indoor and stair walking. Also physiotherapy and occupational therapy group sessions. Prior to discharge the home service officer and patient's next of kin was contacted to make plans for the future. All rehab measures were adapted to the patient's individual medical and functional status and personal goals.		**1 year – median with range** **Self-care** **Group 1**: 40 (23-42) **Group 2**: 38 (12-42) **Locomotion** **Group 1**: 32 (11-35) **Group 2**: 29 (9-35)	Subsequent falls, frequency of activities, balance confidence. **Notes:**
			Basic physical mobility – timed "up and go" test. Assess total time for standing up from a chair, walking 3 m, turning 180^{o} returning and sitting down **(**performed twice, one trial and one timed)	**1 month** **Group 1**: 24.9 (15.4) **Group 2**: 30.8 (16.0)	
			Functional lower extremity muscle strength. Ability to rise from a chair was measured by sit-to-stand. Best of 3 trials was recorded. Made in participant's home with ordinary chairs, preferable with armrests, and ordinary walking aids were used, if needed (secs)	**1 month** **Group 1**: 1.8 (0.8) **Group 2**: 3.3 (3.6)	
			Length of hospital stay (mean +/- SD)	**Group 1**: 18.4 (8.4) **Group 2**: 20.0 (6.8)	

17.12 Evidence Table 12: Patient views

Study	Archibald 2003[8]. Country: UK. Setting: community hospital in Bradford
Aim	To explore experiences of individuals who had suffered a hip fracture. Not to produce generalisable findings but to generate "rich description" of the experience of incurring and recovering from hip fracture to inform nursing practice.
Population	**5 patients** with hip fracture Age >65; 4 women and 1 man; all were cognitively intact
Method of gaining views	In depth audio-recorded interviews with open ended questions, ranging between 25 and 50 minutes duration were conducted during stay in the hospital.
Data analysis	"Colaizzi's analysis framework. 6 step methodological interpretation • Interviews transcribed verbatim and read to get a feel for responses • Significant statements and phrases extracted • Meanings formulated from significant statements • Organised into clusters of themes • Themes used to provide full description of experience • Researcher returns description to participants for confirmation of validity
Findings	4 main themes: injury experience, pain experience, recovery experience, disability experience. **Injury** – relates to falling and breaking their hip **Pain** - Most participants described the pain they had. One mentioned being in a lot of pain in orthopaedic unit despite pain killers. Another mentioned they thought the pain went with rest after a while, but not completely. Only 1 person was still having pain at time of interview. One said "…I have not suffered, not what I call real pain, at all", **Recovery - operation**: varied comments - some did not remember anything or much, one had a "horrendous" recollection of operating theatre: "The operation was pretty horrendous. I had the injection in the spinal cord, [an] epidural… There was no pain, but the noises [laughs] – it was like being in an engineering shop or something. The noise was terrible. I thought 'What are they doing me?' Anyway, it came to an en (it took quite a long time)..and before I knew it I was back on the ward." **Recovery - beginning struggle**: 3 patients discussed this, 1: not being able to do anything, 2: struggling to get to toilet & into the chair, 3: hated using bed pan. **Recovery - regaining independence**: Motivation found to be key factor in recovery, all comments in study positive comments about regaining independence during their rehabilitation. **Disability**: comments about reduced functional status, dependence on others, being house bound.
Comments	Not stated how patients were selected for the study. No baseline data provided about patients. The role of the researcher is not described.

Evidence tables – patient views

Study	Borkan 1991 & 1992[28,29]. Country: USA. Setting: 4 hospitals (no more detail)
Aim	Two research questions addressed: • What are the meanings present in the narratives of elderly hip fracture patients? • What is the importance of narrative elements as prognostic indicators or 'risk factors' for predicting rehabilitation outcomes?
Population	**80 patients** with hip fracture (from a pool of 174) "functionally hardy elderly, intact mental status, independent or lightly-supervised residence outside long-term care facilities, full pre-fracture ambulation; >65 years; 65 women and 15 men; diagnosed within 48 hours of fracture; treated surgically within 1 week. Excluded open pathological or multiple fractures.
Method of gaining views	**Interviewed during first week after hip fracture**, generally 1 or 2 days after surgery, in participant's hospital room. In depth initial interviews included demographics, open ended questions and standardised scales. Combination of open-ended and multiple choice questions. Interview content validated through pretesting with 10 subjects, and reviewed by a panel of experts. Inconsistencies and ambiguities revised or deleted from study. Follow up interviews at 3 and 6 months post-fracture generally conducted in participants' current residence, except where movement to distant states or particular patient preferences precluded face to face contact. These attempted to match some of the patient's perceptions to what actually happened. In addition, observations carried out on main orthopaedic floors over the course of 2 years in order to familiarise research team with the treatment and rehabilitation as well as to confirm information drawn from interviews and uncover unexpected associations.
Data analysis	Quantitative analysis & qualitative narrative. Names coded and interview transcripts sent to independent expert panel to identify emergent or recurrent themes. 13 dimensions identified and grouped into 3 composite. Subjects' narrative accounts rated on a 7 point bipolar scale.
Findings	Gives themes around the patient perception of hip fracture, how it happened, how they perceive their injury, what the future holds, their subsequent level of ability and their future. Categories derived from narratives are rated on a bipolar scale and presented in 3 groups. The remaining percentage not given for each category relates to patients either not giving a view or indicating an equal rating for both polar elements. 1. **Explanation of fracture:** described as disease (1%) or fracture (49%); fall as secondary (4%) or primary (82%); etiology, internal degeneration – primary (6%) or secondary (11%); broke and fell (10%) or fell and broke (64%); course of rehabilitation described as chronic (19%) or acute (49%); functional severity – total impairment (14%) or complete recovery (70%); range of severity – whole body (11%) or affected leg or hip (15%). 2. **Perception of disability:** vulnerable (41%) or not vulnerable (34%); dependency increased (21%) or not increased (30%); sense of alienation from the world – alienated (20%) or integrated (29%); objectification of body part – alienation (4%) or wholeness (7%). 3. **Futurity:** hopefulness (54%) or hopelessness (19%). **Expectations of recovery** during initial hospitalisation**:** 43 (53.7%) expected full recovery; 14 (17.5%) partial recovery; the rest did not know or did not give an answer. Narrative responses varied "from stubborn optimism to despair". **Expectations of living situation**: 61% predicted going home, 15% predicted going into a nursing home (none came from nursing home), 9% going to children's house, 15% did not know or did not respond. **Actual figures**: 34 (43%) discharged to long-term care institutions, 13 (38%) of these remained in institution at 1 year, 18 (53%) returned home, 3 (9%) died.
Comments	The role of the researcher is not well described.

Evidence tables – patient views

Study	Bowman 1997[33]. Country: Canada. Setting: hospital
Aim	To describe sleep satisfaction, pain perceptions & psychological concerns of patients undergoing planned & emergency hip operations. Two additional questions on perceptions of how they would manage.
Population	43 out of 50 consecutively admitted patients: **17 with hip fracture** & 26 undergoing elective hip replacement. Gender for overall study 29 women and 14 men. Characteristics of hip fracture patients: mean age 80 (+7.5); 8/17 had delirium; 11/17 patients claimed to be active or very active prior to fracture
Method of gaining views	Pain assessment was conducted using a visual analogue scale. Sleep satisfaction was conducted using a 'Likert' scale. Not much detail on methods for qualitative part of study**. Interviewed on day of admission**. Two structured questions but no details on how or by whom they were delivered. 1. What are your biggest concerns at this time as a result of this injury and your upcoming surgery? 2. Do you have any concerns about your ability to recover fully and quickly?
Data analysis	Numerical analysis of responses to two questions.
Findings	6/17 feared being unable to walk again; additional 3/17 concerned about recovery and managing on their own; 5/17 put their trust in God.
Comments	Little detail about methods used for the qualitative part of this review. Little baseline data provided about patients. The role of the researcher is not described.

Evidence tables – patient views

Study	Furstenberg 1986[105]. Country: USA. Setting: Large urban teaching hospital
Aim	2 parts to study: 1. community residents without hip fracture, 2. hospitalised patients with hip fracture. "The purpose of hospital study was to construct a natural history of the hip fracture, from the events surrounding the fracture through the hospitalisation period.
Population	**11 patients** hospitalised for hip fracture. Patient characteristics: age 59 to 85 years; 4 men & 7 women; cognitively intact, fracture that had not resulted from malignancy or its treatment.
Method of gaining views	**Interviewed at one or more points during their hospital stay**. "Ethnographic interviews" recorded and transcribed in full. Interviews took place in physical therapy hospital rooms or in rehabilitation centre for 3 who were transferred. During interview informants requested to talk about the fracture, their reactions to it, their pre-fracture functioning, their experiences during hospitalisation and the process for planning for discharge.
Data analysis	"Analysis consisted of identifying salient and recurrent issues and themes and grouping the portions of the interviews dealing with each theme. The variations on each theme were described, and correlates of these variations were identified".
Findings	Split into two main sets: (1) immediate expectations about recovery explicitly or implicitly expressed by patients; (2) contextual factors to the evolving expectations about recovery. 1. **Immediate or early expectations of recovery - most expressions of despair and discouragement**. Only 1 patient feared "it was over". First reactions "varied from shock to a focus on immediate problems, and for some, immediate concern about the consequences of their way of life. As the situation progressed, patients' concerns focused more exclusively on limitations on their functioning and the implications these would have". Most expressed worry about the degree to which they would recover, and when. Several talked repeatedly about the slowness of the process of recovery of physical function. Some worried about being burdens on their caretakers, some worried about further falls. Those who went temporarily to a home of an adult child worried about being able to return to independent living. Summary - hip fracture was going to result in extended period of slow recovery of function, with attendant dependency, postponement or relinquishment of cherished plans and changed living situation with the threat of permanent loss of independent living. Also suffered uncertainty about timing & completeness of return to full recovery. 2. Contextual factors **- as time progressed. Only positive points, not negative ones**, came out in this section. Patients observing their own progress sometime after surgery commented that although progress slow they could see improvement. Participants also took encouragement from others progress. The study notes that while patients could focus on positive and negative points, the informants only focused on encouraging examples. 3. Contextual factors - **health professionals influence on patients' perceptions**. Healthcare professionals' cues, encouragement and feedback guided the informants' perceptions about their own progress. Quotes of the healthcare professionals were scattered throughout participants' responses. Some patients "referred to the elusiveness of the doctors and their own unanswered questions." 4. Contextual factors - other health issues. Also reports a few comments by patients on other health issues.
Comments	Little baseline data provided about patients. The role of the researcher is not described.

Evidence tables – patient views

Study	Olsson 2007[249]. Country: Sweden. Setting: geriatric/orthopaedic ward
Aim	To describe patients' own perceptions of their situation and views of their responsibility in the rehabilitation process.
Population	**13 hip fracture patients** from a geriatric/orthopaedic ward, non-institutional residence pre-fracture, median age 81 (range 71 to 93) years, 2 men & 11 women. Excluded patients with severe illness, cognitive impairment, dementia or pathological fracture.
Method of gaining views	30-45 minute **interviews** conducted in informant's room or in a secluded area of the ward as **soon after the operation** as the informants felt strong enough. Semi-structured questions were used "such that the main questions, related to the informant's perception of the transitional properties, were included in all interviews." Deliberate efforts were made to encourage informants to reveal and comment freely on their personal experiences of and reflections on their situation, without imposing the interviewer's own values on what was being said. The interviewees all talked freely and appeared to be grateful for the attention and for having someone to listen to their reflections. All interviews were recorded and transcribed.
Data analysis	Transcripts read several times. 5 transitional properties & 542 meaning units identified & pooled. A "saturation" was observed when 9 interviews had been conducted "...meaning units describing qualitatively similar conceptions were grouped together and the nature of this similarity was articulated." Categories were labelled and exemplified with representative quotations from interviews. To test the reliability of the categories the second author evaluated the categories in relation to the interviews.
Findings	Participant's responses were categorised into **different conceptions**: • **autonomous** – appeared confident and accustomed to managing for themselves and being in control of their lives. Willing to listen to staff, but made their own decisions. Even if they appeared strong they felt just as vulnerable as the other groups. However, they were aware of the importance of information, personal support and their own responsibility. One informant commented that **more information given preoperatively could have made a great difference**: ○ "Of course, **if someone had come and sat down for a little while** and talked. If they had said something like, this is what it will be like and so on and after a while you will be able to walk and maybe manage on your own again. That would have been reassuring, it really would. Because I really must say, at moments like that, you get a feeling of being small and insignificant." • **modest** – gave the impression of being vulnerable and dependent on others and they expressed themselves cautiously. Instead of demanding community aftercare like the Autonomous, they were willing to go along with what was offered. These informants appreciated information offered to them but for some reason they did not request more, even though they seemed to want to. They worried more about their future ability to walk and maintain their former lifestyles than the other two groups. They feared being discharged, saw only problems and appeared unaware of the progress they had made. They were reluctant to talk about their hopes for the future and did not see their responsibility as clearly as the autonomous. • **heedless** – "appeared to view their situation with some detachment, almost as if it did not concern them. The Heedless did not doubt they would recover and they were confident that people around them would care for them." "The Heedless were characterized predominantly by a reluctance to reflect on their own situation, by a refusal to accept responsibility and by their need for information. ….They did not appear to have reached a stage where planning for the future was relevant." Also identifies some **common traits**: • **[lack of] awareness** - most lacked adequate awareness about their condition, what to do and how to act and needed more information. Only

	1 patient knew someone who had undergone rehabilitation for hip fracture. • **shocking event** - although several suspected they had a fracture all were distressed by the diagnosis. Period before surgery was mostly blurred and filled with fear and pain. They worried about how they would function postoperatively; • **zest for life** - all expressed a strong desire to recuperate. While confined to bed they were worried remembering the pain and inability to move their leg. The suffering experienced in anticipation and preparation for the operation led them to believe they might not be able to walk.
Comments	Not stated how patients were 'strategically selected' for the study. Little baseline data provided about patients. The role of the researcher is not described.

Evidence tables – patient views

Study	Pownall 2004[274]. Country: UK. Setting: trauma and orthopaedic ward
Aim	Critical appraisal of an individual patient narrative of their experience with hip fracture. Undertaken in an effort to understand further the nature of personal experience. Narrative was acquired as part of a routine nursing evaluation and helped to illuminate nursing care issues through they eyes of the patient.
Population	**A 60 year old woman** with an intracapsular fracture in Nottingham hospital. She stated she was fully independent prior to fracture.
Method of gaining views	**Interviewed prior to discharge** from acute trauma and orthopaedic ward, exact time point unclear. A list of structured questions were devised but not rigidly adhered to: • What did you feel about requiring hospitalisation? • What were the good aspects of your hospitalisation? • What were the bad aspects of your hospitalisation? • What do you feel could be improved?
Data analysis	Narrative assessment of patient's views
Findings	A few areas for potential improvement for the hospital/department were identified: • communication skills • time management for staff so time spent with patient is used effectively • pain management Ann's comments that were included in the study: • I could not understand why I had to wait so long in A & E, they had done the X-ray, it was broken the X-ray person told me that. So why did I have to wait? • The pain was unbearable; I didn't care what happened or what was said I just wanted to get rid of the pain. • The staff were so kind, they could not do enough for me. • Initially, I could not understand why they (the staff) wanted to keep checking my bottom, I was comfortable why keep moving me? • It was terrible to be kept nil by mouth the first day, I didn't feel like eating but I really wanted a drink. • It was such a disappointment to be told my operation was cancelled; I just wanted to be fixed. • When I came back from theatre I really needed a drink, but I could not reach my glass. I didn't want to bother the staff they looked so busy. • It was a relief to come back from theatre and be able to press a button and get pain relief, but it was taken away the next day when the physiotherapist came. So I had to keep asking for pain killers. • The staff are so busy no one has time to sit and explain things to you. • I could hear the nurse explaining the operation to my son, but what about me I needed to know. • It was frightening to wake up from the operation and see that I was having a blood transfusion, no-one said that I might need a blood transfusion. It makes you feel something has gone terribly wrong. • I couldn't believe it when they wanted to mobilise me the day after the operation, even my son was shocked to see me out of bed.

Comments	Almost no methodology described so results could be unreliable. It is unclear how this patient was chosen. The role of the researcher is not described.

Evidence tables – patient views

Study	Slauenwhite 1998[314]. Country: Canada. Setting: interviewed at home after discharge from hospital
Aim	Purpose of this study was to investigate the impact of **enhanced early discharge** on families experiencing repaired hip fracture in an older adult.
Population	Convenience sample of **23 caregivers for 23** patients who had experienced **hip fracture**. Patient characteristics: age 75.9 (range 56-97) years; 19 women 4 men. Care giver characteristics: 16 women, 7 men.
Method of gaining views	**Interviewed 4 to 6 weeks after discharge** with questions adapted from Canadian Patient Centered Hospital Care Survey, a "validated tool". The developers of the tool determined the adaptations would not affect the validity or reliability of the questionnaire. Questionnaires mailed to caregiver 1 week before interview (questions reported in study). "Data were considered qualitative if the interviewee elaborated on an answer, expressing strong beliefs about a topic. At the end of the interview, specific questions were asked to elicit how the patient and family experienced the illness episode." One interviewer was used. Interviews were taped then transcribed.
Data analysis	2 investigators separately analysed the transcripts and developed themes that emerged from the data. Themes were then compared, contrasted and collapsed until only main themes remained.
Findings	• **Length of stay not a major issue** for 15/23 families, care-recipient thought too long while patient-carer thought too short for 3 families, 4 families said people heal better in own homes. • 20/23 families stated **pain management not a problem** in hospital or at home • several families thought **transition from house to home a problem** as took several hours to days for all info to be relayed to home care system. This went hand in hand for those with comorbidities. • **"Instrumental functioning"** not a concern when patients were allowed to manipulate their own resources in their own home. • Older people and men more capable of **role flexibility** while younger people and women talked more about **role strain**. • Many caregivers had stories of dissatisfaction which was suggested to be related to health care system and **mismatched care**. Mismatched care not well defined.
Comments	No description of 'early supported discharge'. No baseline description of patients and no indication of how patients were selected.

Evidence tables – patient views

Study	Williams 1994[354]. Country: USA. Setting: At home after discharge from 4 hospitals
Aim	Aim to gain information on: (1) the recovery pattern in functional status & mood in first 14 weeks after hospital discharge; (2) factors most associated with the extent of assistance required in specific mobility activities & patient assessment of their problems; (3) problems patients identified as most important; (4) **advice those patients would give to others**.
Population	**120 consecutive patients meeting inclusion criteria with hip fracture**. Older patients who were relatively healthy & home dwelling before fracture. Mean 79.9 (+9.7) range 60 to 100). Included intracapsular (68), extracapsular (52), internal fixation (76), femoral head replacement (44). Sample included only white women as a result of low number in region of study.
Method of gaining views	**Interviewed** before hospital discharge and followed up at 2, 8 and 14 weeks. **At 14 weeks** participants asked what advice they would give to other persons who fractured their hip. Also assessed functional status, perceived return to normal mobility, mood states, and other factors including urinary problems according to scales.
Data analysis	Coding of responses to advice to give to other hip fracture patients done by the two "co-principal investigators" with recategorisation occurring until 100% agreement was reached.
Findings	**Advice to patients** with newly fractured hips from women with a personal experience of hip fracture Number of comments by category: • 94 **importance of mental attitude** - maintain hope & look to the future • 76 **follow experts advice** • 34 **mobility** – keep mobile, rest before getting up to walk, use walker to help get up • 15 maintain **healthy lifestyle** • 7 use **caution** & be careful not to fall • 3 limit stay in institution and get help to be at home if possible; • 6 gave no specific advice as they commented that everyone is different.
Comments	

Evidence tables – patient views

Study	Wykes 2009[355]. Country: Australia. Setting: rehabilitation hospital
Aim	Pilot study to explore "the impact of fractured neck of femur on the lives of previously independent women and identifies their concerns when participating in inpatient rehabilitation".
Population	**5 patients undergoing inpatient rehabilitation for hip fracture** at 2 rehabilitation hospitals, aged 60-85 years, living alone and independently before fracture, cognitively intact and able to converse fluently in English
Method of gaining views	**Interviewed** in a private room **during stay in rehabilitation hospital**. Interviews were shared by two researchers previously unknown to the patients. Interviews taped and transcribed verbatim. Each woman invited to tell her story with as few interruptions as possible. Main questions were "Can you tell me how you came to be here in this rehabilitation ward?" and "What do you think about while you are in hospital?" To ensure in depth coverage patients were frequently asked "Could you please tell me more about that?"
Data analysis	Thematic analysis using stages set out by Burnard 1991. Two researchers independently made notes of themes apparent in the data as a whole. Transcript lines were coded. Similar codes combined into higher order categories. Same two researchers carried out the analysis. Researchers engaged in "reflexive self-awareness". This included a conscious awareness of previous experiences of and with patients who had fractured a neck of the femur.
Findings	Two major findings: 1. **Impact of fracture** for previously independent women was an issue for all. Primarily, others had to assume responsibility for things they had done previously. 2. **Concerns** following fracture listed in 4 sections: a. behaviour of others (22 instances identified) - these included: **what others do** - **things staff said or did** (1 women upset when she overheard staff talking about the possibility of limb shortening if they stayed in a wheelchair too long, 1 women upset about being put on a ward with people "completely of the planet" as a result of dementia; 1 patient commented that staff don't understand because they encouraged her to walk when she felt she could not because of Parkinson's Disease interfering with her mobility), **friends & family doing things without consulting her** **what others do not do** -; family not told by staff when patient moved hospital; not enough information about complications **what others expect** – 1 women concerned by staff expecting her daughter to look after her before rehabilitation started; family and friends expectations upset participants. b. what was happening to them - possible **accommodation changes after discharge**; possible **loss of independence**; money issues c. impact of their injury on others - **inconveniencing and upsetting others** d. other health issues – 2 women had pre-existing conditions that overshadowed their concerns about hip fracture and had adverse effects on their rehabilitation outcomes. – 1 severely disabled with Parkinson's Disease; 1 had recent cardiac surgery and a long-standing vertebral disc prolapse.
Comments	Study notes: only 5 patients included so it only reveals some of the concerns of older women with hip fractures; not enough data to explore the differences between hospitals; analysis only at 1 point in time.

Evidence tables – patient views

Study	Young 2009[358], Country: USA. Setting: rehabilitation programme
Aim	To explore the perceptions of older adults regarding their functional recovery 1 year after hip fracture.
Population	62 hip fracture patients ('convenience sample' from a longitudinal study of rehabilitation and functional recovery after hip fracture involving 280 patients). Age 65 or older (average: 78, range 65-91), 47 women, 15 men, cognitively intact, community dwelling, admitted to one of the five predetermined rehabilitation sites with a primary diagnosis of acute hip fracture, receiving a surgical procedure, non pathological fracture, no evidence of metastatic cancer.
Method of gaining views	Participants invited and completed an exit **interview** immediately after the **12-month post hip fracture follow up** data collection. The exit interview was a thematic survey with open-ended questions that explored areas of functional recovery and participants' willingness to engage in rehabilitation activities. Questions: 1. Have you been satisfied with your functional recovery since your hip fracture surgery? – YES, NO a. If "YES" what do you think has helped the most with regards to your recovery process? b. If "NO" what do you think has hindered your recovery process most? c. If "NO" what things would you have liked to see differently regarding you recovery process? 2. What do you think needs to be done to help improve the functional recovery process for future hip fracture patients? 3. What one piece of advice would you give a hip fracture patient to help them with their recovery? Responses were transcribed verbatim by a physical therapist and a physician assistant, both of whom were familiar with hip fracture care and received three sessions of interview training at the Center on Aging and Health at John Hopkins University in Baltimore.
Data analysis	**Data analysis** conducted using basic content analysis. "Although the interview guide used in this study contained specific themes and directed participants to address things that facilitated their recovery process, response analysis was conducted using participants' own words to capture their particular responses and ideas about thematic areas." A list including a definition of each code was developed and continually revised as new codes were added. **"** **"Confirmability"** Data were initially coded by first reviewer, a geriatric nurse practitioner, and researcher familiar with the hip fracture trajectory. The coded data were then given to a second researcher, an epidemiologist and gerontologist who had studied patients post-hip fracture across the entire recovery period. The second interviewer independently coded the transcripts, compared her coding to the coding of the first reviewer, and then discussed the findings with the first reviewer. As the discrepancies were identified, the reviewers went back to the data to clarify their interpretations. This process repeated until consensus was reached. Codes were then grouped based on similarities and differences. **Data credibility** was addressed by presenting the findings to an interdisciplinary group of clinicians and researchers (one physician, four epidemiologists, three exercise trainers, one physical therapist, and one occupational therapist) familiar with the hip fracture trajectory to establish if the findings made sense and were consistent with the current understanding of the recovery process post hip-fracture. The findings were presented in a small group and one on one in the clinical setting. Participants were asked to verbally confirm or refute the findings.
Findings	53 participants were satisfied with their functional recovery, 9 were not satisfied. 25 codes were identified and collapsed into four main themes. 1. **Facilitators of recovery** (identified by 53 participants satisfied with their recovery): • **professionals** (40) – comments covered being buoyed by seeing physician frequently, having good doctors or surgeons, getting "correct" or "professional" care. "They evaluated professionals as a team and did not single out one provider over another in terms

	of help and support received". Communication and a positive attitude by professionals also important; • **social support** (13) – from family and friends essential to their recovery. Specifically mentioned verbal encouragement helped them maintain a positive attitude • **determination** (12) – own determination to exercise and be involved • **lifestyle factors** (4) & **environment** (1) – eating healthy food, taking appropriate medications and vitamins, and engaging in physical activity. "an environment that encouraged healthy behaviors (i.e. facilitated physical activity) was important to promote exercise" • **individualised care** – verbal encouragement (4); • **spirituality** (4) – spirituality and belief in a supreme being helped them maintain their optimism throughout the process • identifying **goals** (3) – returning home, regaining independence and being able to walk like they could prefracture 2. **Factors that hinder recovery** (identified by 9 participants dissatisfied with their recovery): • medical complications/comorbidities (4) • **unpleasant sensations** (3) – pain reported as a limiting factor • age (1) 3. **System recommendations to facilitate recovery**: • **more care** (26) – more direct physical & occupational therapy and more education about the recovery process and ways to optimise physical function • **better care** (9) – follow up and care in the home setting after discharge from rehabilitation • **spirituality** (3), **social support** (2) – some participants said they would have like exposure to spiritual support options throughout the course of their rehabilitation programme. Some participants also felt that additional social and spiritual supports were needed from family and friends. • additional information (8) • elimination of unpleasant sensations (4) • policy (1) 4. **Peer advice to facilitate recovery**: • **participate** (48) **& listen to providers** (19) – listen to healthcare instructions and participate as much as possible in rehabilitation activities. Comments included "listen to the advice from medical staff such as doctors, therapists, and nurses" and "Do a lot of physical and occupational therapy even if it's painful • **positive attitude** (20) & **determination** (13) – participants strongly recommended that older adults who sustain hip fractures maintain a positive attitude, avoid worry and remain determined throughout the recovery experience • **be careful** (8) – avoid subsequent trauma, prevent anything that would impede recovery, prevent falls • **push through pain** (6), relieve pain – "do your physical therapy even though it may hurt" & "use all offered medications that could alleviate pain and relax muscles" • don't worry (4). Numbers in brackets relate to the number of times noted

Comments	Paper reports the study used to as the basis to recruit participants for this paper had stringent eligibility criteria because it was designed to evaluate rehabilitation. Therefore, the findings of this study may only be applicable to a similar patient group. Although the findings were found to be credible with rehabilitation clinicians and researchers they were not verified with patients who had sustained hip fracture. Themes were determined by the interview guide.

Evidence tables – patient views

Study	Ziden 2008 & Ziden 2010[362,363]. Country: Sweden. Setting: hospital
Aim	Aim to explore & describe the experienced consequences of an acute hip fracture among home dwelling elderly people shortly after discharge. "The ambition was to let the subjects concretize their experiences, for instance by describing in as great details as possible their ordinary daily activities before and after the fracture."
Population	Patients selected from a larger sample of 102 participants (ZIDEN2008 RCT) with acute hip fracture, >65 years old, living in own home, no cognitive impairment, and able to understand Swedish. Participants asked if they were willing to participate a few days after surgery. **At 1 month**: 18 participants, 16 women and 2 men **At 1 year**: 15 participants, 13 women and 2 men
Method of gaining views	Semi-structured **interviews** using the phenomenographic method. Interviews held in patients own homes **1 month & 1 year after hospital discharge**. Interviews conducted in a conversational manner that allowed interviewees to speak freely and to express their own experiences of the consequences of the hip fracture. As an introduction, the subject was asked to narrate what had happened when he or she broke their hip. Follow up questions and prompts were used, such as "Tell me more about it", What does this mean to you?" and "Can you clarify?" Interviews were taped and were transcribed verbatim.
Data analysis	Phenomenographic method described by Dahlgren & Fallsberg: interviews read through repeatedly to obtain a total concurrent **overview**; **statements extracted** that dealt with consequences of hip fracture to achieve a concentrated and representative version of entire dialogues; **quotes** from previous step were **compared** in order to uncover sources of variation or agreement; **similar quotes were grouped** together, an attempt was made to "describe the essence of similarity within each group" (stage called articulating); these **groups were then labelled/categorised** and compared to ensure categories did not overlap. The grouping and describing stages were revised several times before the analysis was judged to be satisfactory. Sequence of steps in the analysis made separately by authors before joint discussions leading finally to consensus.
Findings	**<u>At 1 month</u>** 8 categories in 3 focused areas were identified: **In relation to your body and yourself:** • You are limited to move and have lost confidence in your body (18 people) • You become humble and grateful (7 people) • You respect yourself and your own needs (2 people) **In relation to others:** • You become more dependent on others (12 people) • You gain more human contact and are treated in a friendly way by others (2 people) **In relation to the life situation:** • You are secluded and trapped at home (4 people) • You are old, closer to death and have lost your zest for life (4 people) • You take one day at a time and are uncertain about the future (7 people) **<u>At 1 year</u>** 6 categories in 2 focused areas were identified: **Experienced consequences of a hip fracture 1 year after discharge**

	• Isolated life with more restricted activity and fewer social contacts a. more insecure and afraid (11 patients) b. more limited ability to move (12 patients) • Disappointed and sad that identity and life have changed (8 patients) • Satisfied with the situation or feeling even better than before fracture (5 patients) **Conceptions of what influences hip fracture recovery** • Own mind and actions influence recovery (10 patients) • Treatment and actions from others influences recovery (4 patients) • You cannot influence recovery (6 patients)
Comments	

18 Appendix F: Evidence tables - Economic studies

Abbreviations

CI	Confidence interval
IQR	Interquartile range
ITT	Intention to treat analysis
Int	Intervention
LOS	Length Of Stay
LR+	Positive likelihood ratio
LR-	Negative likelihood ratio
M/F	Male/female
N	Total number of patients randomised
NA	Not Applicable
NPV	Negative predictive value
NR	Not reported
PPV	Positive predictive value
QALY	Quality-Adjusted Life Years
QoL	Quality of life
RCT	Randomised controlled trial
RR	Relative risk
SA	Sensitivity analysis
SD	Standard Deviation
SE	Standard Error
Sig	Statistically significant at 5%

18.1 Evidence Table 13: General versus regional anaesthesia

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Chakladar 2010 UK **Economic analysis:** Cost analysis **Study design** Survey **Duration of follow-up:** NA **Perspective:** UK NHS **Discount rates:** Costs: NA Effects: NA	**Patient group:** Hypothetical patients undergoing uncomplicated anaesthetic for hip fracture repair.	**Group 1:** Spinal anaesthesia **Group 2:** General anaesthesia	Mean (SD) anaesthetic time (minutes)	**Group 1:** 31 (15) **Group 2:** 27 (16) **p value:** p<0.0001	**Funding/conflict of interest:** The authors declared there were no competing interests or external funding. **Limitations:** Partial economic evaluation. Survey on hypothetical patients, not on real cohorts. Spinal anaesthesia after failure of regional was not included in the analysis. Anaesthetists from one hospital only were interviewed. **Overall quality and applicability** Potentially serious limitations and partial applicability. **Data sources:** Anaesthetic time from Brighton Hip Fracture Database. **Notes:** * 20 anaesthetic consultants
			Mean (SD) cost of anaesthesia equipment per patient (2010 GBP)	**Group 1:** £66.73 (30.05) **Group 2:** £108.15 (38.53) **p value:** NR	
			Mean (SD) cost of airway equipment per patient (2010 GBP)	**Group 1:** £1.81 (0) **Group 2:** £25.68 (2.28) **p value:** NR	
			Mean (SD) cost of personnel per patient (2010 GBP)	**Group 1:** £105.90 (0) **Group 2:** £106.76 (0) **p value:** NR	
			Mean (SD) cost of drugs per patient (2010 GBP)	**Group 1:** £19.03 (11.00) **Group 2:** £25.17 (11.04) **p value:** NR	
			Mean (SD) cost of gases/inhalational agents per patient (2010 GBP)	**Group 1:** £0.43 (0.13) **Group 2:** £6.26 (3.94) **p value:** NR	
			Mean total cost per patient (SD) 2010 GBP, sum of previous categories of costs.	**Group 1:** £193.81 (37.49) **Group 2: £**270.58 (44.68) **p value:** p<0.0001	
			Cost-effectiveness	NR	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Sensitivity analysis	NR	

Abbreviations: NR=not reported, NA=not applicable

18.2 Evidence Table 14: Displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Johansson2006[163] Sweden **Economic analysis:** cost-consequences analysis **Study design** RCT **Duration of follow-up:** 2 years **Perspective:** Hospital **Discount rates:** Costs: NR Effects: NA	**Patient group:** Patients 75 years or older who were admitted to the Linkoping University Hospital with displaced femoral neck fractures with walking ability prior to the trauma, no contraindications to major surgery, no rheumatic joint disease. **<u>All patients</u>** **N:** 143* **Mean age (range):** 84 (75–101) **M/F:** 34/109 **Drop outs:** 16 patients **<u>Group 1</u>** **N:** 78* **Age (mean):** **M/F**: **Drop outs:** 9 patients **<u>Group 2</u>** **N:** 68* **Age (mean):** **M/F**: **Drop outs:** 7 patients	**Group 1:** Internal fixation performed with two parallel and percutaneously inserted screws after closed reduction. **Group 2:** Total hip replacement performed with a cemented prosthesis using a poster-lateral approach. All patients had postoperative physiotherapy.	Number of hips that required reoperation (%)	**Group 1:** 34 (44%) **Group 2:** 11 (16%) **p value:** NR	**Funding/conflict of interest:** NR **Limitations:** Costs derived only from one hospital. **Overall quality and applicability** Potentially serious limitations and partial applicability. **Additional outcomes:** There was no difference in the change of average cost of community services/place of residency between the two groups. Pain was significantly higher in Group 1. **Notes:** *143 patients were followed up but two patients in Group 1 and one patient in Group 2 were randomised twice in the same group because they had bilateral fractures. ** Data for 7 patients in Group 1 and 4 in Group 2 were missing at 1 year, and data for 9 patients in Group 1 and 7 in Group 2 were missing at 2 years. *** Once a patient scored as poor due to a failure they remained in this group despite reoperation.
			Number of patients with a Harris hip score excellent or good/fair or poor at 1 year**	**Group 1:** 6/48*** **Group 2:** 24/24 **p value:** <0.0001	
			Number of patients with a Harris hip score excellent or good/fair or poor at 2 years**	**Group 1:** 6/42*** **Group 2:** 20/21 **p value:** <0.001	
			Mean cost per patient 2000 Euros, cost of surgical procedures, hospital stay, radiographic examination, home rehabilitation, emergency and outpatient visits, hospital overheads, complications and reoperations.	**Group 1:** 13,100 (£11,575) **Group 2:** 12,800 (£11,310) **p value:** NR	
			Cost-effectiveness	NR	
			Sensitivity analysis	NR	

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table: displaced intracapsular fractures

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Keating 2005 [173] UK **Economic analysis:** Cost-utility analysis **Study design** RCT **Duration of follow-up:** 2 years **Perspective:** NHS **Discount rates:** Costs: 0%* Effects: 0%	**Patient group:** previously fit patients of 60 years or older with displaced subcapital hip fractures. **<u>All patients</u>** **N:** 298 **Age (range):** 60 - 93 **M/F:** 65/233 **Drop outs:** **<u>Group 1</u>** **N:** 118 **Age (mean):** 74.9 **M/F**: 29/89 **Drop outs:** 19 (18/19 died) **<u>Group 2</u>** **N:** 111 **Age (mean):** 75.4 **M/F**: 19/92 **Drop outs:** 20 (19/20 died) **<u>Group 3</u>** **N:** 69 **Age (mean):** 75.2 **M/F**: 17/52 **Drop outs:** 7 (7/7 died)	**Group 1:** Internal fixation **Group 2:** Bipolar hemiarthroplasty **Group 3:** Total hip replacement	Number of deaths within 4 months of operation (%)	**Group 1:** 3 (3%) **Group 2:** 6 (5%) **Group 3:** 2 (4%) **p value:** Not sig	**Funding/conflict of interest:** grant from the National Health Service Health Technology Assessment programme. **Limitations:** Small number of patients. **Overall quality and applicability** Minor limitations and partial applicability. **Additional outcomes:** Place of discharge, adverse events **Notes:** * Costs were not discounted because most of the costs were incurred within 1 year of injury. ** Group1 vs 3 was sig after adjusting for age and gender
			Number of patients with further surgery within 4 months of first operation (%)	**Group 1:** 26 (22%) **Group 2:** 6 (5%) **Group 3:** 5 (7%) **p value:** NR	
			Number of deaths within 12 months of operation (%)	**Group 1:** 10 (8%) **Group 2:** 11 (10%) **Group 3:** 4 (6%) **p value:** Not sig	
			Number of patients with further surgery within 12 months of first operation (%)	**Group 1:** 37 (31%) **Group 2:** 6 (5%) **Group 3:** 6 (9%) **p value:** NR	
			Number of deaths within 24 months of operation (%)	**Group 1:** 18 (15%) **Group 2:** 18 (16%) **Group 3:** 6 (9%) **p value:** Not sig	
			Number of patients with further surgery within 24 months of first operation (%)	**Group 1:** 46 (39%) **Group 2:** 6 (5%) **Group 3:** 6 (9%) **p value:** <0.001 (Group 1 vs 2 and 3) Not sig (Group 2 vs 3)	
			EQ-5D utility scores at 4 months – mean (SD)	**Group 1:** 0.56 (0.29) **Group 2:** 0.61 (0.29) **Group 3:** 0.68 (0.24) **p value:** Not sig**	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			EQ-5D utility scores at 12 months – mean (SD)	**Group 1:** 0.58 (0.34) **Group 2:** 0.64 (0.33) **Group 3:** 0.70 (0.29) **p value:** 0.04 (Group 1 vs 3) Other groups not sig	
			EQ-5D utility scores at 24 months – mean (SD)	**Group 1:** 0.55 (0.38) **Group 2:** 0.53 (0.35) **Group 3:** 0.69 (0.32) **p value:** 0.008 (Group 2 vs 3) Other groups not sig	
			Mean cost per patient over 2 years (95% CI) 2001 GBP, cost of hospital admission (inpatient and day case), theatre costs, prosthesis and profile of hardware, excluding non-hip-related admissions.	**Group 1:** 12,623 (10,768 – 14,478) **Group 2:** 9,897 (8,062 – 11,732) **Group 3:** 9,399 (8,265 – 10,532) **p value:** Sig (Group 1 vs 3) Other groups not sig	
			Cost-effectiveness Cost per utility gained	Total Hip Replacement is dominant.	
			Sensitivity analysis Two-way SA	Results did not change when cost of prostheses and cost of readmission were varied over a range from -50% to +100% around the baseline values.	

Abbreviations: NR=not reported, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, SA=sensitivity analysis

18.3 Evidence Table 15: Cemented arthroplasties

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Santini 2005[298] Italy **Economic analysis:** Cost-consequences analysis **Study design** RCT* **Duration of follow-up:** One year **Perspective:** Provider **Discount rates:** Costs: NA Effects: NA	**Patient group:** at least 65 years old, with life expectancy of at least 3 months, low-energy trauma. **<u>All patients</u>** **N:** 106 **Age (mean):** NR **M/F:** 24/82 **Drop outs:** 0 **<u>Group 1</u>** **N:** 53 **Age (mean):** 82 **M/F**: 13/40 **Drop outs:** 0 **<u>Group 2</u>** **N:** 53 **Age (mean):** 80 **M/F**: 11/42 **Drop outs:** 0	**Group 1:** Cemented bipolar hemiarthroplasty **Group 2:** Uncemented bipolar hemiarthroplasty	VELCA functional score	**Group 1:** 9.13 **Group 2:** 8.95 **p value:** Not sig	**Funding:** The authors declared no conflict of interest. **Limitations:** Surgical time not included in cost calculation although it was significantly different (group 2 had shorter operating time). The only difference considered was the cost of prostheses. **Overall quality and applicability:** Potentially serious limitations and partial applicability. **Additional outcomes:** Social environment at 1 year was similar in the two groups. **Notes:** * included in our clinical review **only cost of prostheses was different between the two groups.
			Peri-operative mortality – number of patients (%)	**Group 1:** 3 (24.5%) **Group 2:** 2 (26.4%) **p value:** Not sig	
			Mortality at 1year – number of patients (%)	**Group 1:** 13 (24.5%) **Group 2:** 14 (26.4%) **p value:** Not sig	
			Number of patients with complications	**Group 1:** 21 **Group 2:** 21 **p value:** NR	
			Mean cost per patient** 2001 Euros, cost of medical and nursing staff, drugs, diagnostic procedures, prostheses, blood transfusion and hospital stay.	**Group 1:** 3,093 (£2,400) **Group 2:** 4,008 (£3,110) **p value:** NR	
			Cost-effectiveness	NR	
			Sensitivity analysis	NR	

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, N=total number of patients randomised, VELCA=Verona Elderly Care, Sig=statistically significant at 5%

18.4 Evidence Table 16: Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Cameron 1994[45] Country: Australia **Economic analysis:** CEA **Study design** RCT **Duration of follow-up** 4 months **Perspective:** Health care provider **Discount rates** NA	**Patient group:** Patients with proximal femoral hip fracture **<u>All patients</u>** **N:** 252 **Age (mean):** 84 **M/F:** 14/70 **Drop outs:** 0 **<u>Group 1: Accelerated Rehab</u>** **N:** 127 **Age (mean):** Nursing home: 84.2 (n=48) Non-nursing home + moderate to severe disability: 87.2 (n=21) Non-nursing home +limited disability: 79.2 (n=58) **M/F**: NR **<u>Group 2</u>** **N:** 125 **Age (mean):** Nursing home: 88.5 (n=46) Non-nursing home +moderate to severe disability: 89.3 (n=22) Non-nursing home +limited	**Group 1: Accelerated rehab** (involving: early mobilization after surgery, comprehensive rehabilitation program, early discharge from hospital, community-based rehabilitation). **Group 2: Conventional care**	Median length of stay, days (interquartile range)	**Group 1:** 13 (7-25) **Group 2:** 15 (8-44) p value = 0.034	**Funding** Australian Department of Health, Housing, and Community Services. **Conflict of interest:** NR **Limitations** A longer follow up could have better reflected differences in costs and outcomes. Health-related QoL were not calculated. **Overall quality and applicability** The study has potentially serious limitations and partial applicability. **Notes:** (1)Calculated using the Power Purchasing Parity (PPP) of 1990
			Mean Barthel index: No. of patients recovered at 4 months from surgery	**Group 1:** 63 (49.6%) **Group 2:** 52 (41.6%) 95% CI (-3% to 21%) p value = Not significant	
			Mean Barthel index: No. of patients worse at 4 months from surgery	**Group 1:** 31 (24%) **Group 2:** 39 (31%) p value= NR	
			Mean Barthel index: No. of patients death at 4 months from surgery	**Group 1:** 19 **Group 2:** 20 p value = NR	
			Mean cost per patient Year: 1990 Currency: Australian dollars Cost components: inpatient hospital (surgical, post	**Group 1:** A$ 10,620 (£ 4678.9 – 1990 PPP)(1) **Group 2:** A$ 12,790 (£ 5635.01 – 1990 PPP)(1)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	disability: 81.4 (n=57) **M/F:** NR		surgical), readmissions, community support services, institutional care.	**p value** = 0.186	
			Cost-effectiveness Incremental cost per additional recovered patient	The accelerated rehab program is the dominant strategy (more effective, less costly)	
			Sensitivity analysis Threshold sensitivity analysis	Accelerated rehab is more costly than usual care when: (1) The difference in LOS between the 2 strategies is less than 1.5 – 2 days (2) Cost of treatment is more than 40% per bed day compared to conventional care. These results were not sensitive to the % of patients recovering nor to the definition of recovery.	

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Farnworth 1994 [91] Australia **Economic analysis:** CCA **Study design** Case study with historical control **Duration of follow-up** 6 months **Perspective:** Health care provider **Discount rates** NA	**Patient group:** Patients with hip fracture **<u>All patients</u>** **N:** 138 **Age (mean):** NR **M/F:** 23/115 **Drop outs:** 0 **<u>Group 1</u>** **N:** 67 **Age (mean), (SD):** 78.4 (8.8) **M/F** 10/57 **<u>Group 2</u>** **N: 71** **Age (mean**): 79.8 (10.7**)** **M/F** 13/58	**Group 1:** Fractured Hip Management Program (FHMP) comprising: orthopaedic surgeon, geriatric physician, nurses, occupational therapist, physiotherapist. Rehabilitation took place in the patient's normal environment. **Group 2:** Usual care	In-hospital mortality at 1 year	**Group 1:** 16 (24%) **Group 2:** 19 (27%) **p value =** NR	**Funding/conflict of interest:** NR **Limitations:** The year at which cost data refer is not clear. The duration of follow up is not clear. No sensitivity analysis was conducted. Health related QoL outcomes were not calculated. No incremental analysis was conducted. **Overall quality and applicability** The study has potentially serious limitations and partial applicability **Additional outcomes:** Changes in living arrangements at discharge from hospital and 1 year after hip fracture. **Notes:**
			Length of Stay – days (nursing home patients)	**Group 1:** 7.3 **Group 2:** 10.2 **p value =** NR	
			Length of Stay – days (non-nursing home patient)	**Group 1:** 21.5 **Group 2:** 28.2 **p value =** NR	
			Readmission within 1 year	**Group 1: 4 (6%)** **Group 2: 6 (8%)** **p value = NR**	
			Mean cost per patient Year: 1990 Currency: $Aus Cost components: -Hospital costs - FHMP costs (staff time, use of medical goods, office space and travel time for home visits).	**Group 1:** $Aus11 060 (£4872) (1) **Group 2:** $Aus 9280 (£4088) (1) **p value =** NR	
			Cost-effectiveness	NR	
			Sensitivity analysis	NR	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
					(1) The costs were expressed in GBP using the Power Purchasing Parity for 1990.

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Galvard 1995[107] Sweden **Economic analysis:** CCA **Study design** RCT **Duration of follow-up:** 1 year **Perspective:** NHS and PPS **Discount rates** NA	**Patient group:** Patients with hip fracture **<u>All patients</u>** **N: 371** **Age (mean): NR** **M/F:** 95/276 **Drop outs: 0** **<u>Group 1</u>** **N: 192** **Age (mean) - female:** 79.6 years (SD 8.2) **Age (mean) - male:** 73.6 years (SD 10.0) **M/F** 45/147 **Drop outs: 0** **<u>Group 2</u>** **N: 179** **Age (mean) - male:** 79.1 (SD 8.6) **Age (mean) - female:** 80.9 (SD 9.2) **M/F** 50/129 **Drop outs:** 0	**Group 1:** Rehabilitation in geriatric department (Patients transferred on second postoperative day. Orthopaedic surgeon would visit them once weekly) **Group 2:** Usual care (rehabilitation in orthopaedic department**)**	Readmissions to hospital	**Group 1:** 36 **Group 2:** 57 **p value =** NR	**Funding/ Conflict of interest:** NS **Limitations:** No sensitivity analysis was performed. Health related QoL outcomes are not calculated. No incremental analysis was conducted. The source used to estimate the unit cost of resources was unclear. **Overall quality and applicability** The study has potentially serious limitations and partial applicability **Additional outcomes:** Destination at discharge: 72.4% of patients from group 1 and 72.0% of patients in group 2 returned to their previous living arrangements (NS). **Notes:** (1) Values in GBP obtained using the Power Purchasing Parity (PPP) for
			Mortality at 1 year	**Group 1:** 45 **Group 2:** 40 **p value =** NR	
			Mean length of stay in hospital, days (SD)	**Group 1:** 53.3 (47.7) **Group 2:** 28 (24.2) **p value =** NR	
			Mean cost per patient **Y**ear: 1989 Currency: Swedish Krona (SEK) Cost components: Technical aids, home adjustment costs, stay at convalescent home, new hospital admission, daily costs at orthopaedic and geriatric department.	**Group 1:** SEK 94,026.05 (£6590.82) (1) **Group 2:** SEK 84,536.81 (£5925.67) (1) **p value =** NR	
			Cost-effectiveness	NR	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Sensitivity analysis	NR	1989.

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Hollingworth 1993[148] UK **Economic analysis:** Cost analysis **Study design** Case series **Duration of follow-up:** Until discharge (1) **Perspective:** NHS **Discount rates** NR	**Patient group:** Hip fracture patients. **<u>All patients</u>** **N:** 1080 **Age (mean):** NR **M/F:** 198/882 **Drop outs:** NA **<u>Group 1</u>** **N**=779 (2) **Age (mean):** 78.7 (SD 11.2) **M/F**: 143/636 **Drop outs:** NA **<u>Group 2</u>** **N:** 301 **Age (mean):** 79.8 (SD 10.9) **M/F**: 55/246 **Drop outs:** NA	**Group 1:** Community rehabilitation - Hospital at home (HAH) scheme. The scheme provides care from trained nurses, nursing auxiliaries, physiotherapists, and occupational therapists in the patient's home for up to 24 hours a day under the medical supervision of the general practitioner. The scheme lasts for up to two weeks – after then, other community services take over. **Group 2:** Usual care	LOS (mean inpatients days)	**Group 1:** 32.5 **Group 2:** 41.7 **p value:** <0.001	**Funding/conflict of interest:** NR **Limitations:** Unclear follow up time Parameters' uncertainty has not been subjected to appropriate probabilistic sensitivity analysis. No incremental analysis was conducted. Health-related QoL were not determined. Information on costs obtained from the hospital finance department, not from official statistics. **Overall quality and applicability** The study has potentially serious limitations and partial applicability **Notes:** (1) The duration of follow up was unclear from the paper (2) These were patients with access to the HAH scheme. Of these 779 patients, 292 patients were actually
			Readmission rates at 1 year (for patients with access to HAH scheme and for usual care patients)	**Group 1:** 53 (6.8%) **Group 2:** 8 (2.7%) **p value =**0.008	
			Mean cost per patient Year: 1992 Currency: UK sterling Cost components: Ward, Hospital at home, hotel, overheads, medical, theatre, other treatment.	**Group 1:** £4884 **Group 2:** £5606 **p value =** 0.048	
			Cost-effectiveness	NR	
			Sensitivity analysis One-way deterministic sensitivity analysis.	The costs in the HAH scheme would still be lower than in the usual care case even if inpatients costs were 50% lower than predicted and the HAH costs were 50% higher.	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
					discharged to the scheme.

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Huusko 2002[158] Finland **Economic analysis:** CCA **Study design** RCT **Duration of follow-up:** One year **Perspective:** NHS **Discount rates:** Costs: NA Effects: NA	**Patient group:** Patients with acute hip fracture **<u>All patients</u>** **N: 243** **Age (mean): 80** **M: 69** **F: 174** **Drop outs:** **<u>Group 1</u>** **N:** 120 **Age (mean, range):** 80 (66-97) **M:** 36 **F**: 84 **Drop outs:** **<u>Group 2</u>** **N: 123** **Age (mean, range):** 80 (67-92) **M:** 33 **F**: 90 **Drop outs:**	**Group 1:** 2 weeks intensive rehabilitation on the geriatric ward **Group 2:** Standard care in a local hospital	Length of stay, days	**Group 1:** 34 (95% CI 28-38) **Group 2:** 42 (95% CI 35-48) **p value:** 0.05	**Funding/conflict of interest:** Study was supported by grants from Central Finland Health Care District, Kuopio University Hospital, Emil Aaltonen Foundation, Uulo Arthio Foundation and Novartis Finland Ltd **Limitations:** No sensitivity analysis No HRQoL **Overall quality and applicability** The study has limited applicability and potentially serious limitations **Additional outcomes:** Pre-fracture instrumental activities of daily living – IADL (median) – baseline to 3 months and baseline to
			Mortality (at discharge)	**Group 1:** 5 (4%) **Group 2:** 5 (4%)	
			Mortality (at 1 year)	**Group 1:** 18 (15%) **Group 2:** 20 (16%)	
			Patients regaining their independency in ADL – median, baseline to 3 months	**Group 1:** 5 **Group 2:** 6 **p value:** 0.004	
			Patients regaining their independency in ADL – median, baseline to 1 year	**Group 1:** 5 **Group 2:** 6 **p value:** 0.008	
			Mean cost per patient (includes hospital care, nursing home care, and outpatient services) PPP = 0.667223 (of 2002)	**Group 1:** € 17,900 (**£**11,723) **Group 2:** € 15,900 (£10,414) **p value:** NR	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
			Cost-effectiveness	NR	1 year **Data sources:**
			Sensitivity analysis	NR	**Notes:**

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
O'Cathain 1994 [245] UK **Economic analysis:** CCA **Study design** Non randomised trial with concurrent controls **Duration of follow-up:** 3 months **Perspective:** NHS **Discount rates** NA	**Patient group:** Patients with fracture neck of femur **All patients** **N:** 110 **Age (mean):** NR **M/F:** 16/94 **Drop outs:** 14 **Group 1** **N:** 76 **Age (mean):** 76.4 (SD 10.0) **M/F**: 11/65 **Drop outs:** 8 **Group 2** **N: 34** **Age (mean):** 77.6 (SD 9.7) **M/F**: 5/29 **Drop outs:** 6	**Group 1: Hospital at home scheme** (patients discharged to their own homes and cared for by a community HAH team under the clinical responsibility of the GP for a maximum of 12 days. The HAH team consisted of district nurses, community physiotherapists, occupational therapists and generic workers.) **Group 2:** Usual care	Health-related QoL: Emotional reaction at discharge (from the Nottingham Health Profile questionnaire)(1)	**Group 1:** 14 **Group 2:** 24 **p value** <0.05	**Funding:** The study was funded by Trent Regional Health Authority, Southern Derbyshire Community Health Services and Southern Derbyshire Department of Public Health. **Conflict of interest:** NR **Limitations:** The length of period during which costs are calculated is unclear. A longer follow up would have better reflected differences in costs and outcomes. No sensitivity analysis was conducted. No incremental analysis was conducted. **Overall quality and applicability** The study has potentially serious limitations and limited applicability **Notes:** (1) The other dimensions of the NHP (Physical mobility, pain, sleep, energy and social isolation) were not statistically significant.
			Mortality	**Group 1:** 5.3% **Group 2:** 5.9% **p value:** NR	
			Readmission rate (at three months)	**Group 1:** 15.8% **Group 2:** 8.8% **p value:** 0.187 (NS)	
			Hospital LOS, median number of days (interquartile range)	**Group 1:** 10 **Group 2:** 17 **p value:** <0.001	
			Mean cost per patient Year: 1992 Currency: UK sterling Cost components: staff costs, orthopaedic bed cost.	**Group 1:** £1500 **Group 2:** £1870 **p value:** NR	
			Cost-effectiveness	NR	
			Sensitivity analysis	NR	

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

Evidence table - Multidisciplinary rehabilitation

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Parker 1991[270] **Economic analysis:** CCA **Study design** Prospective observational study **Duration of follow-up:** 3 years **Perspective:** NHS **Discount rates:** Costs: NR Effects: NR	**Patient group:** Patients with acute hip fracture **<u>All patients</u>** **N:** 410 **Age (mean):** 77 **F: 80%** **Drop outs:** **<u>Group 1</u>** **N: 284** **Age (mean, range):** 77 **F**: 79% **Drop outs: 113** **<u>Group 2</u>** **N: 126** **Age (mean, range):** 77 **F**: 83% **Drop outs: NA**	**Group 1:** early supported discharge scheme – hospital at home scheme **Group 2:** usual inpatient rehabilitation	LOS (mean, days) Mortality (at 90 days) **Mean cost per patient** **Cost-effectiveness** **Sensitivity analysis**	**Group 1:** 29 **Group 2:** 38 **p value:** 0.035 **Group 1: 40 (14%)** **Group 2: 14 (11%)** **Group 1: £1165.30** **Group 2:** £365.50* **p value:** NR NR NR	**Funding/conflict of interest:** **Limitations:** No sensitivity analysis Costs were not discounted **Overall quality and applicability** The study has limited applicability and potentially serious limitations **Additional outcomes:** **Data sources:** Hospital records **Notes:** ***HAH cost saving (-£799.80). Only 171 patients (60% of 284) were discharged using the HAH scheme, and the mean cost of the scheme refers to this group only.**

Abbreviations: NR=not reported, NA=not applicable, M/F=male/female, Sig=statistically significant at 5%, N=total number of patients randomised, Int=intervention, SA=sensitivity analysis

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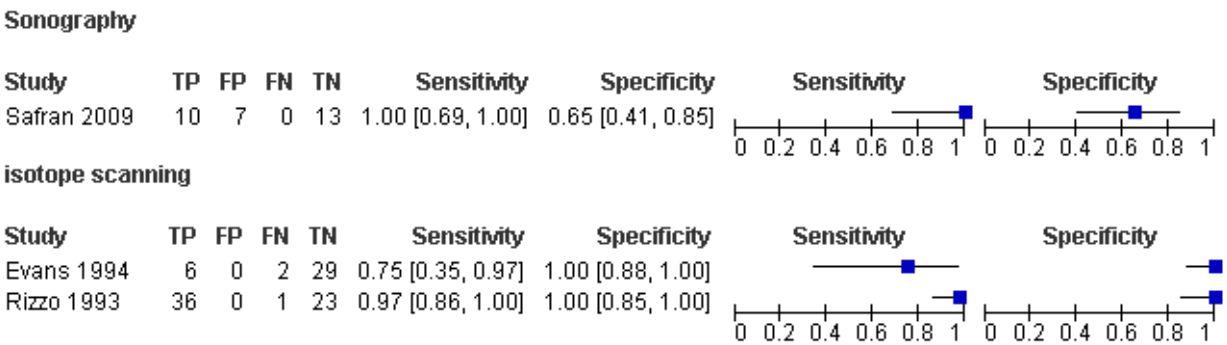
19.1 Radiology

Figure G-2. Sensitivity and specificity: Sonography and isotope scanning (reference standard: MRI)



19.2 Timing of surgery

Figure G-3. Mortality: Early (≤24 hours) vs. late surgery

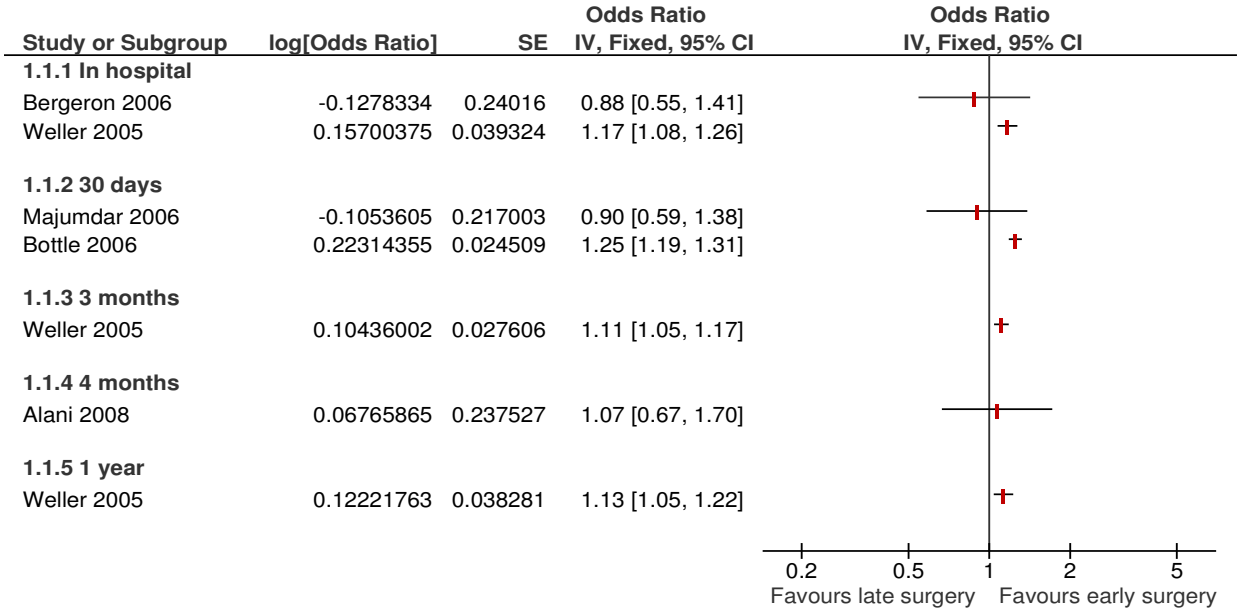


Figure G-4. Return to independent living: late (>24 hours) vs. early surgery

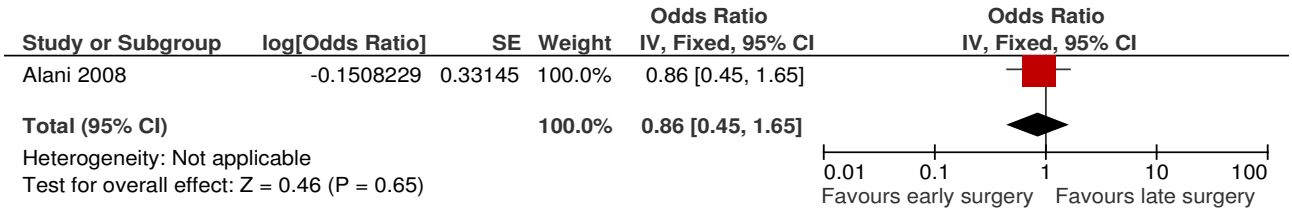


Figure G-5. Pressure ulcers: late (>24 hours) vs. early surgery

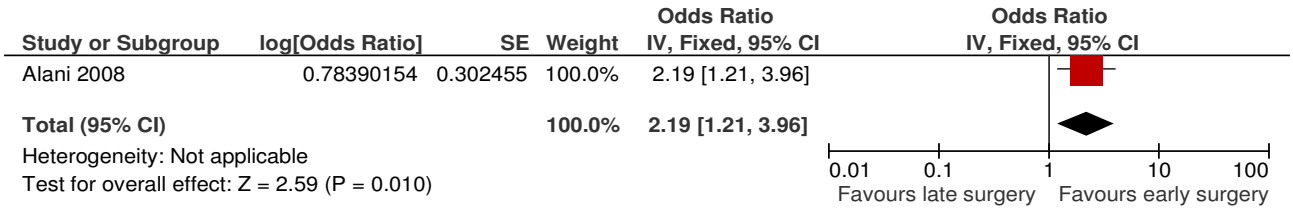


Figure G-6. Major complications: late (>24 hours) vs. early surgery

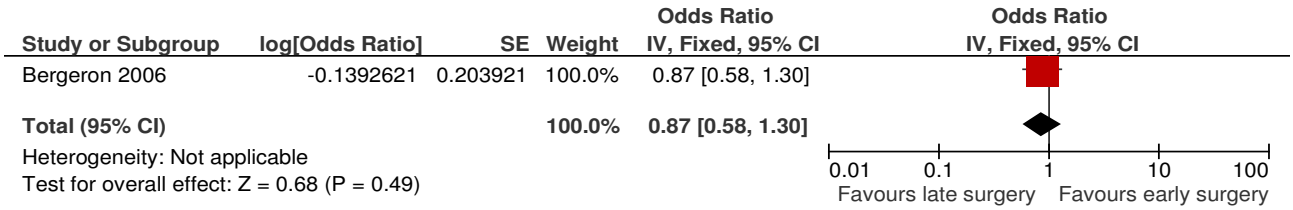


Figure G-7. Mortality – in hospital: late (24-48 hours) vs. early surgery

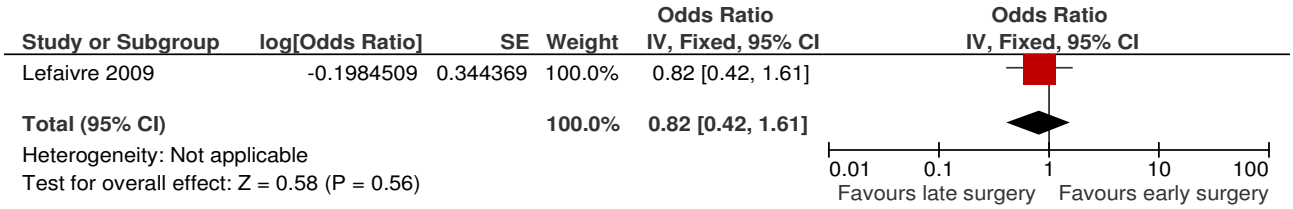


Figure G-8. Complications: late (24-48 hours) vs. early surgery

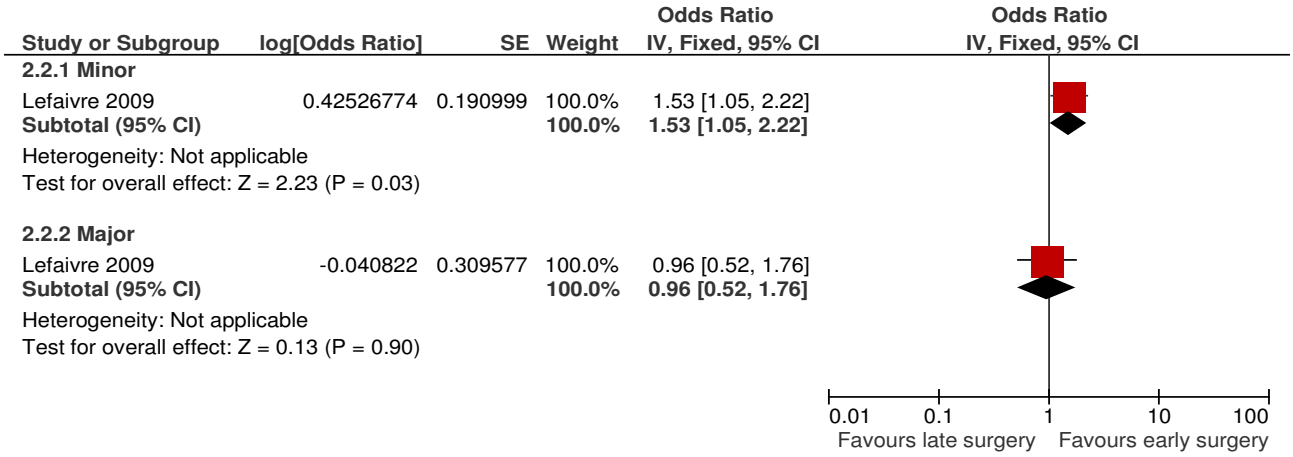


Figure G-9. Pressure ulcers: late (24-48 hours) vs. early surgery

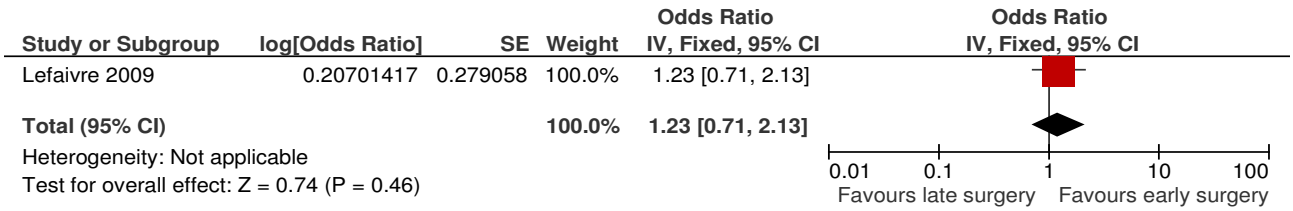


Figure G-10. Mortality – at 4 months: late (>36 hours) vs. early surgery

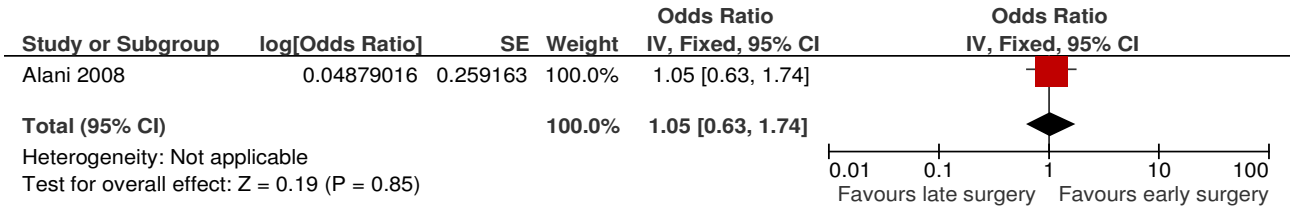


Figure G-11. Pressure ulcers: late (>36 hours) vs. early surgery

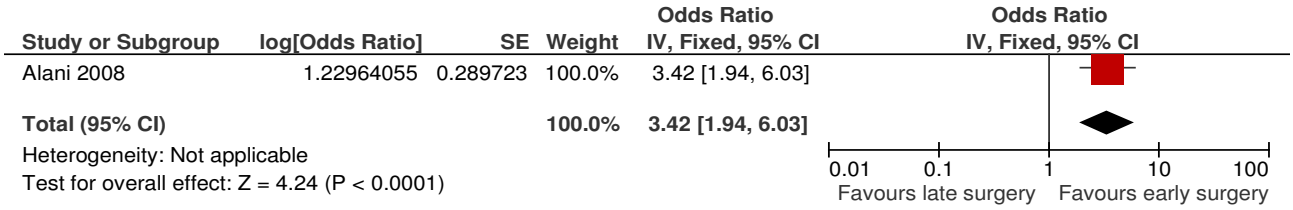


Figure G-12. Return to independent living: late (>36 hours) vs. early surgery

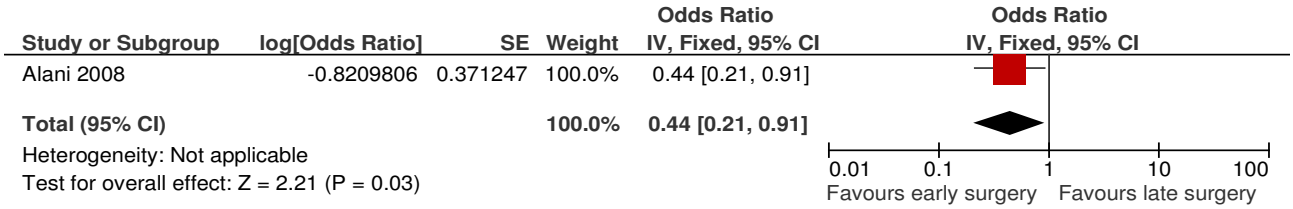


Figure G-13. Mortality: late (>48 hours) vs. early surgery

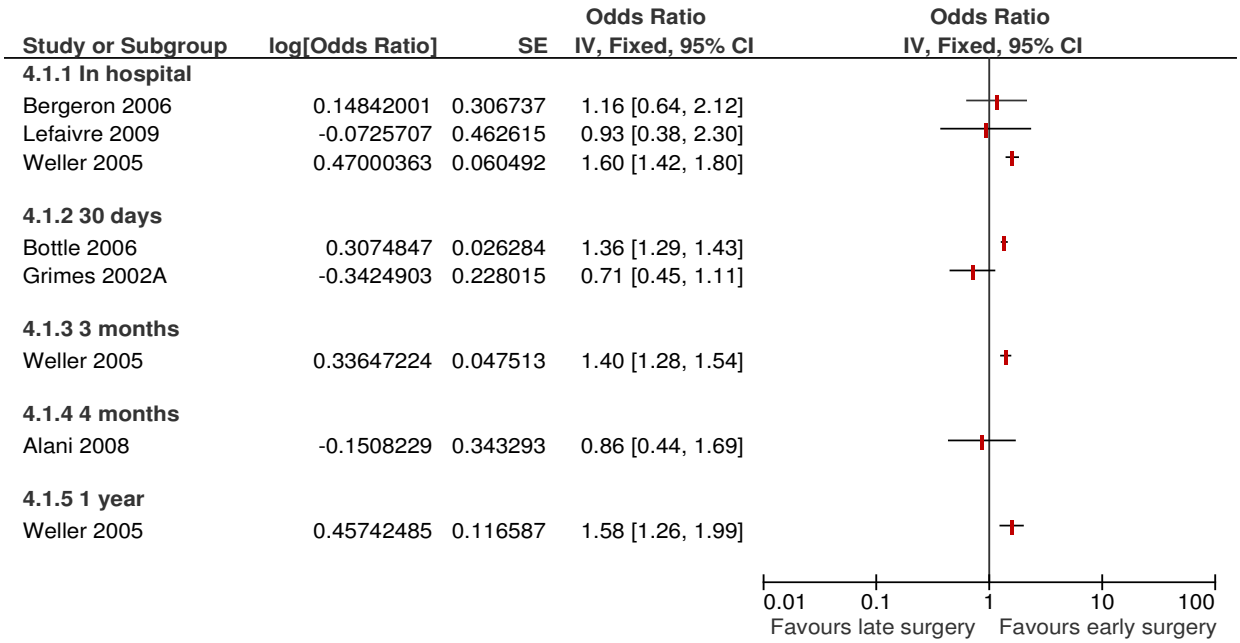


Figure G-14. Return to independent living: late (>48 hours) vs. early surgery

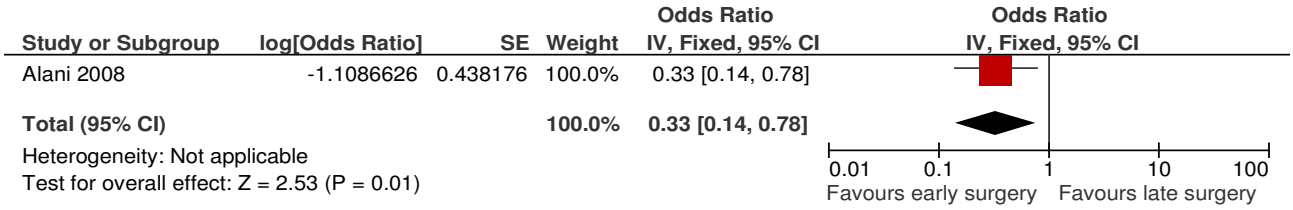


Figure G-15. Pressure ulcers: late (>48 hours) vs. early surgery

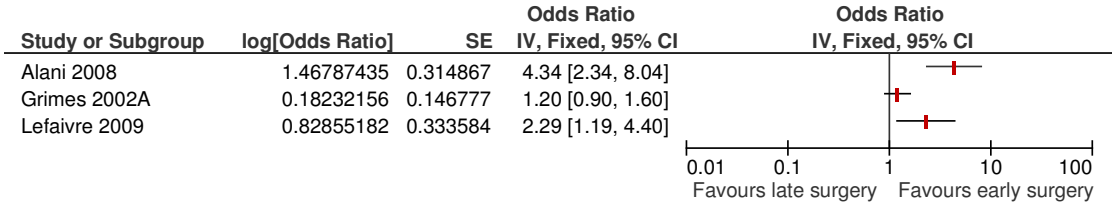


Figure G-16. Major complications: late (>48 hours) vs. early surgery

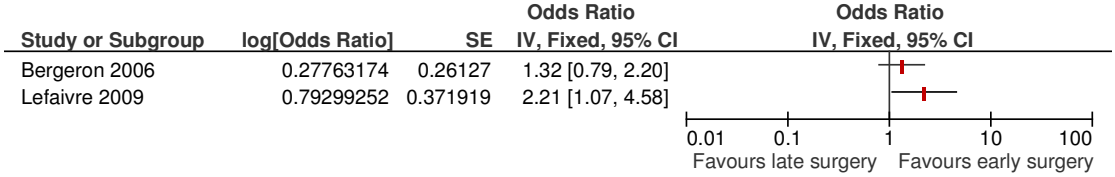


Figure G-17. Minor complications: late (>48 hours) vs. early surgery

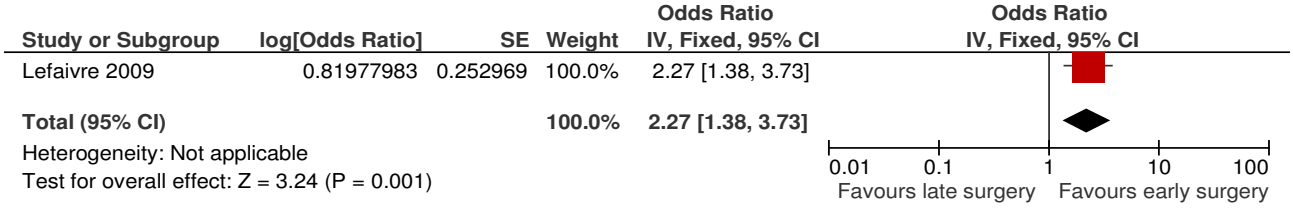


Figure G-18. Mortality – 30 days: late (>24 hours) vs. early surgery with the exclusion of patients unfit for surgery

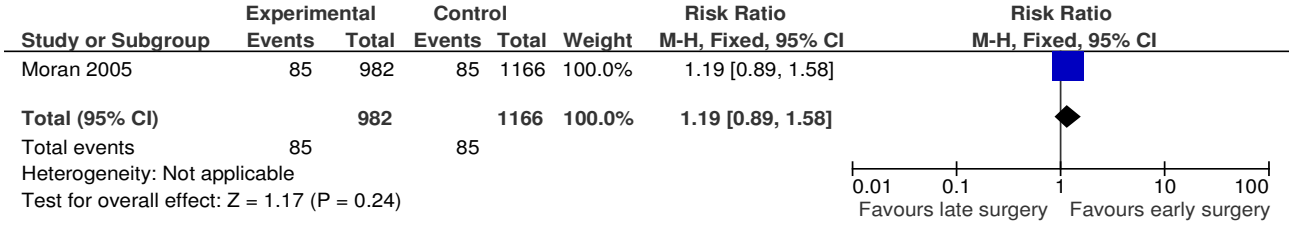


Figure G-19. Combined mortality and needing total assistance in locomotion at 6 months: late (>24 hours) vs. early surgery with the exclusion of patients unfit for surgery

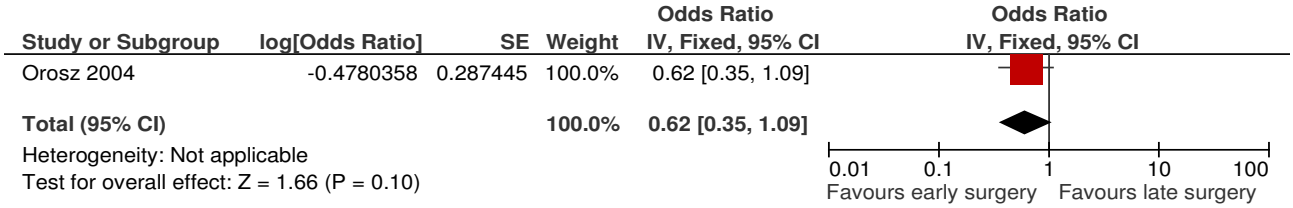


Figure G-20. Major postoperative complications: late (>24 hours) vs. early surgery with the exclusion of patients unfit for surgery

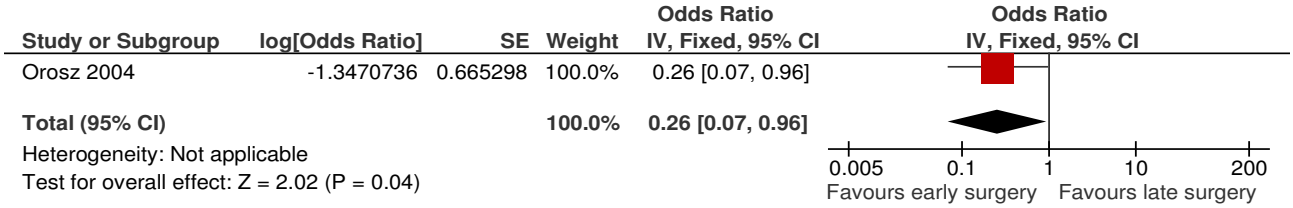


Figure G-21. Mortality: late (>48 hours) vs. early surgery with the exclusion of patients unfit for surgery

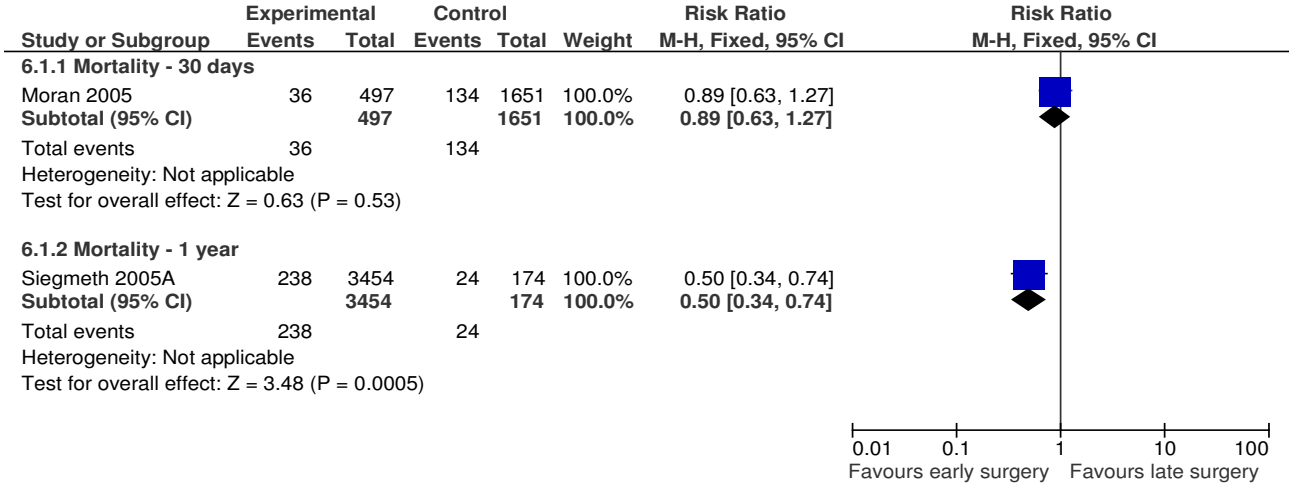


Figure G-22. Change in residence (more dependent): late (>48 hours) vs. early surgery with the exclusion of patients unfit for surgery

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Siegmeth 2005A	240	3454	22	174	100.0%	0.55 [0.37, 0.83]
Total (95% CI)		**3454**		**174**	**100.0%**	**0.55 [0.37, 0.83]**
Total events	240		22			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.87 (P = 0.004)

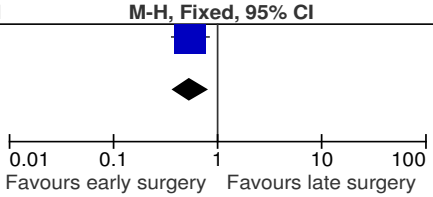
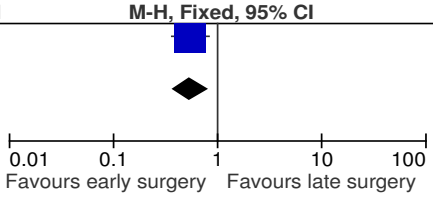


Figure G-23. Return to original residence: late (>48 hours) vs. early surgery with the exclusion of patients unfit for surgery

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Siegmeth 2005A	240	3454	22	174	100.0%	0.55 [0.37, 0.83]
Total (95% CI)		**3454**		**174**	**100.0%**	**0.55 [0.37, 0.83]**
Total events	240		22			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.87 (P = 0.004)



19.3 Analgesia

Figure G-24. Pain: Nerve blocks vs. no block (systemic drugs)

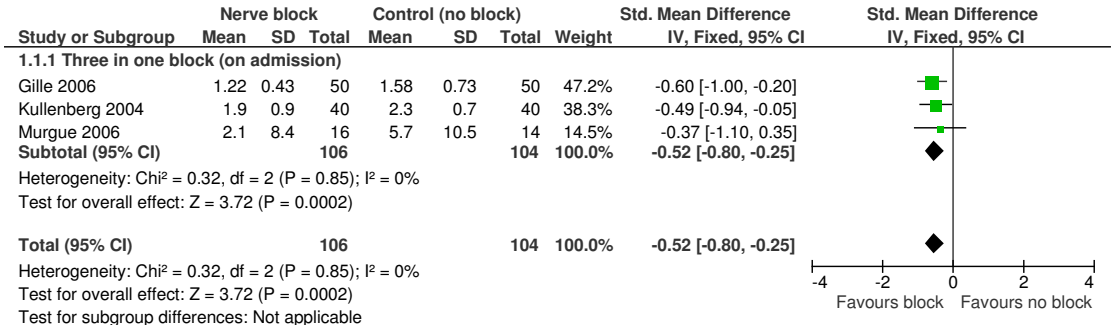


Figure G-25. Unsatisfactory pain control preoperatively or 'need for breakthrough analgesia': Nerve blocks vs. no block (systemic drugs)

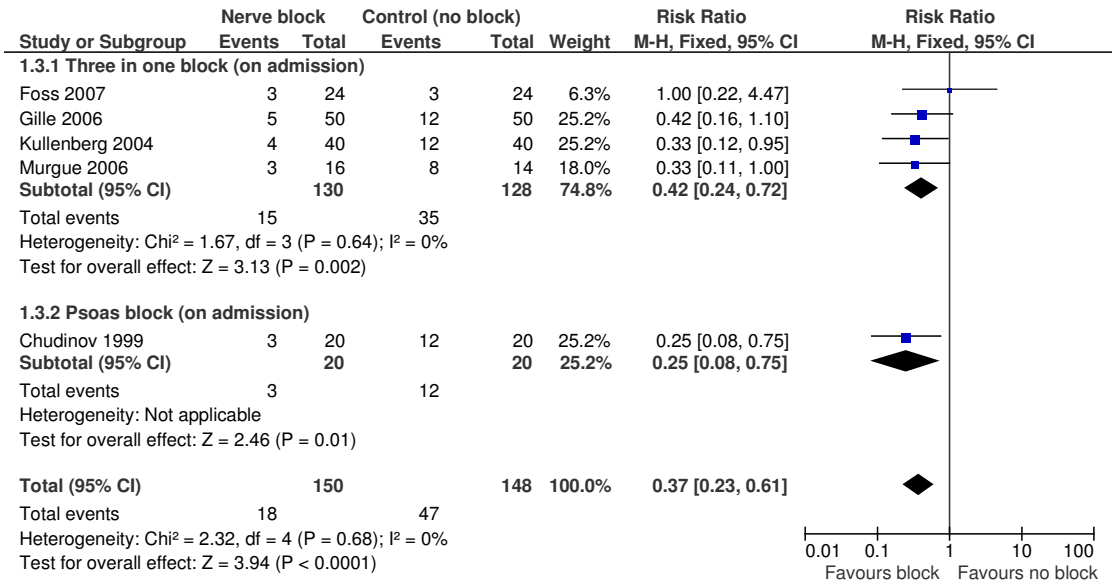


Figure G-26. Unsatisfactory pain control postoperatively: Nerve blocks vs. no block (systemic drugs)

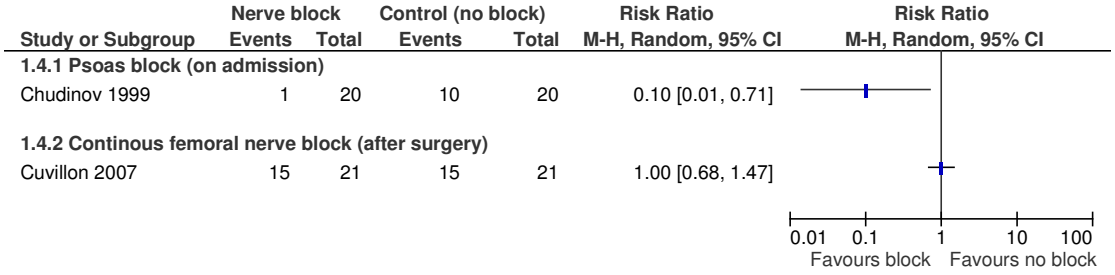


Figure G-27. Nausea and/ or vomiting: Nerve blocks vs. no block (systemic drugs)

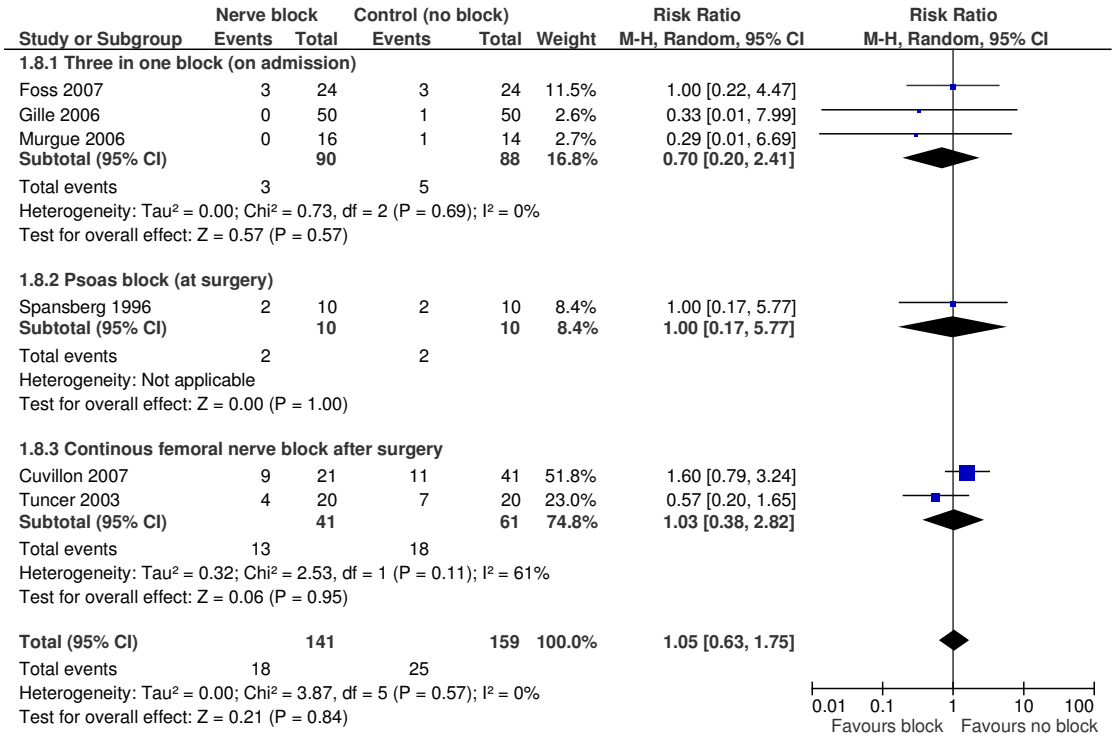


Figure G-28. Need for anti-emetics: Nerve blocks vs. no nerve block(systemic drugs)

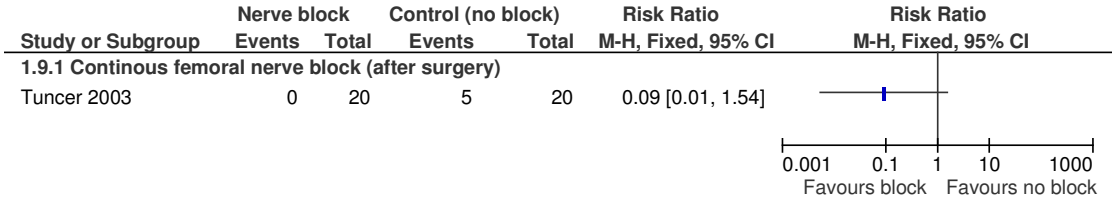


Figure G-29. Wound infection: Nerve blocks vs. no nerve block (systemic drugs)

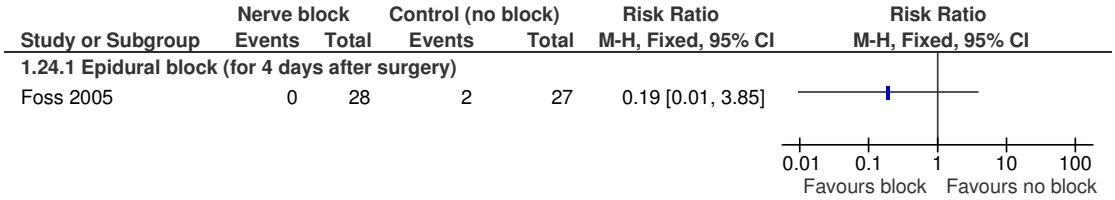


Figure G-30. Pneumonia: Nerve blocks vs. no nerve block (systemic drugs)

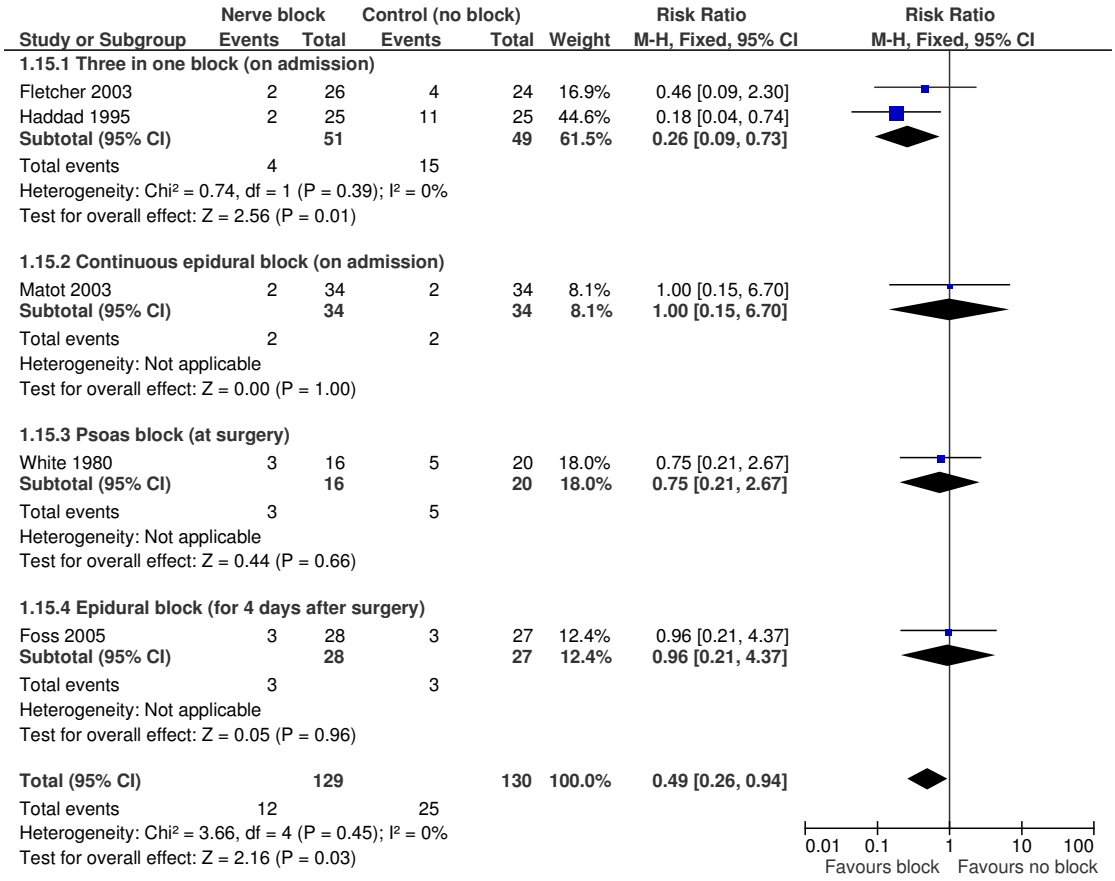


Figure G-31. Any cardiac complication: Nerve blocks vs. no nerve block (systemic drugs)

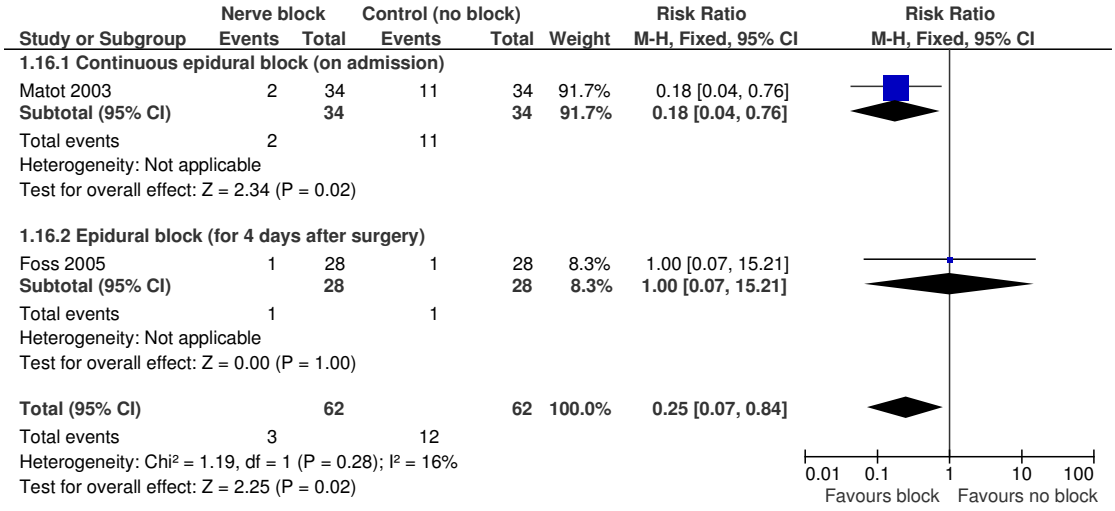


Figure G-32. Myocardial infarction: Nerve blocks vs. no nerve block (systemic drugs)

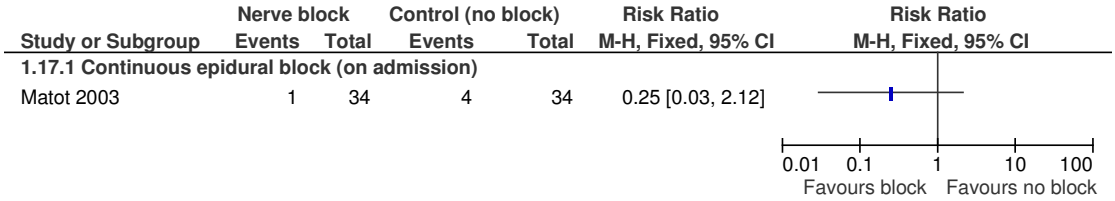


Figure G-33. Puritis: Nerve blocks vs. no nerve block (systemic drugs)

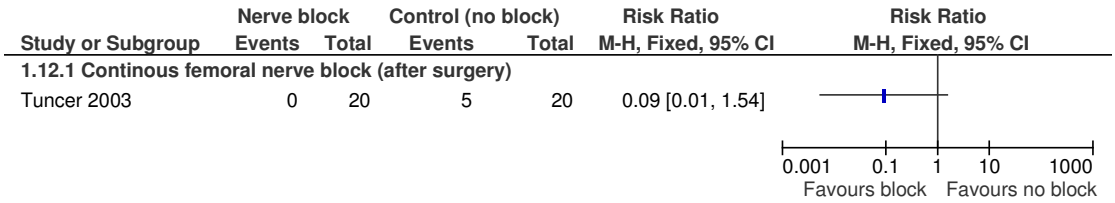


Figure G-34. Pulmonary embolism: Nerve blocks vs. no nerve block (systemic drugs)

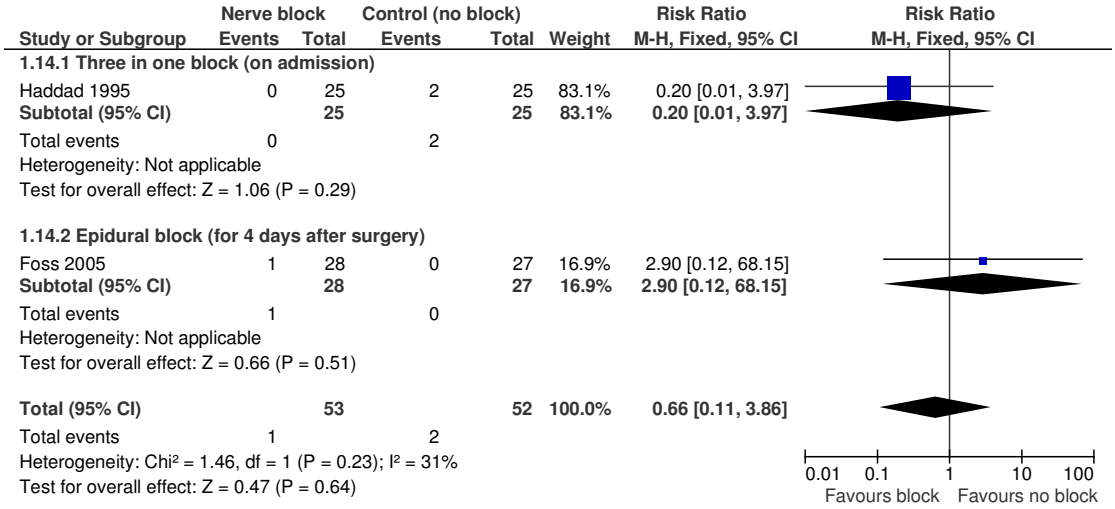


Figure G-35. Deep vein thrombosis: Nerve blocks vs. no nerve block (systemic drugs)

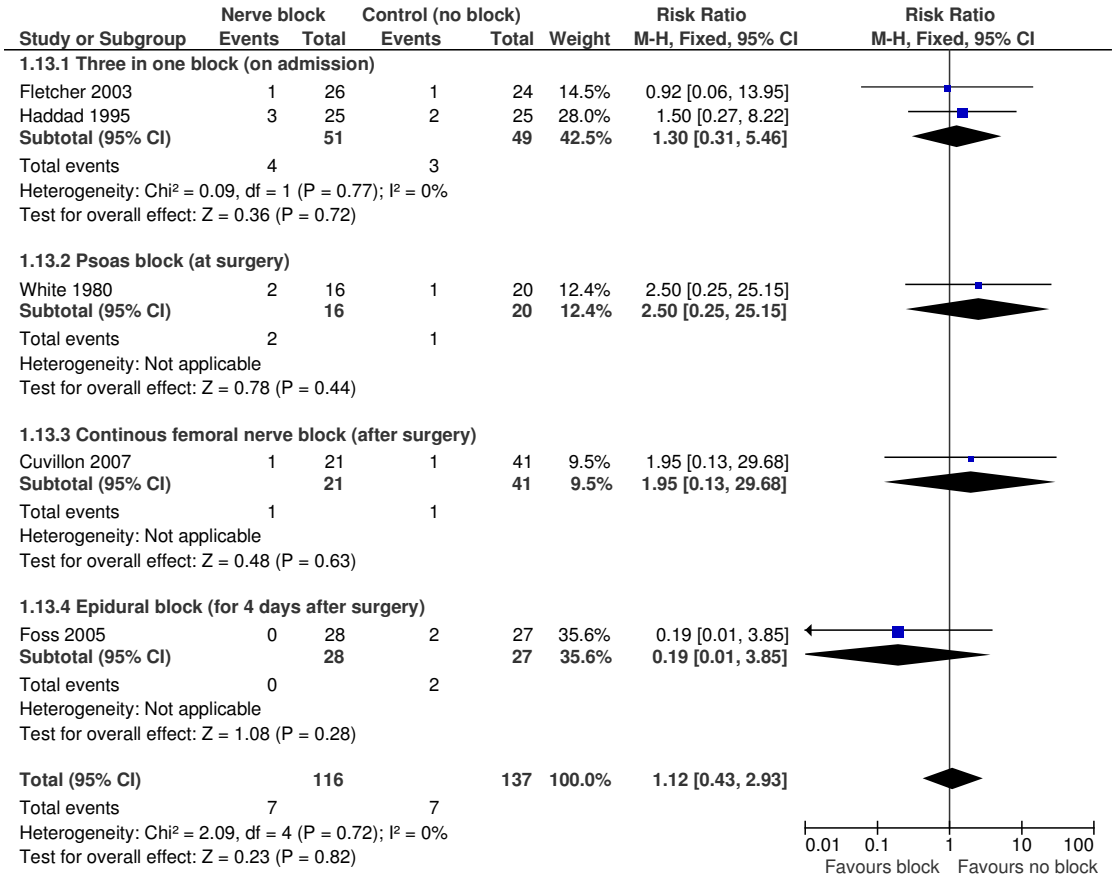


Figure G-36. Mortality: Nerve blocks vs. no nerve block (systemic drugs)

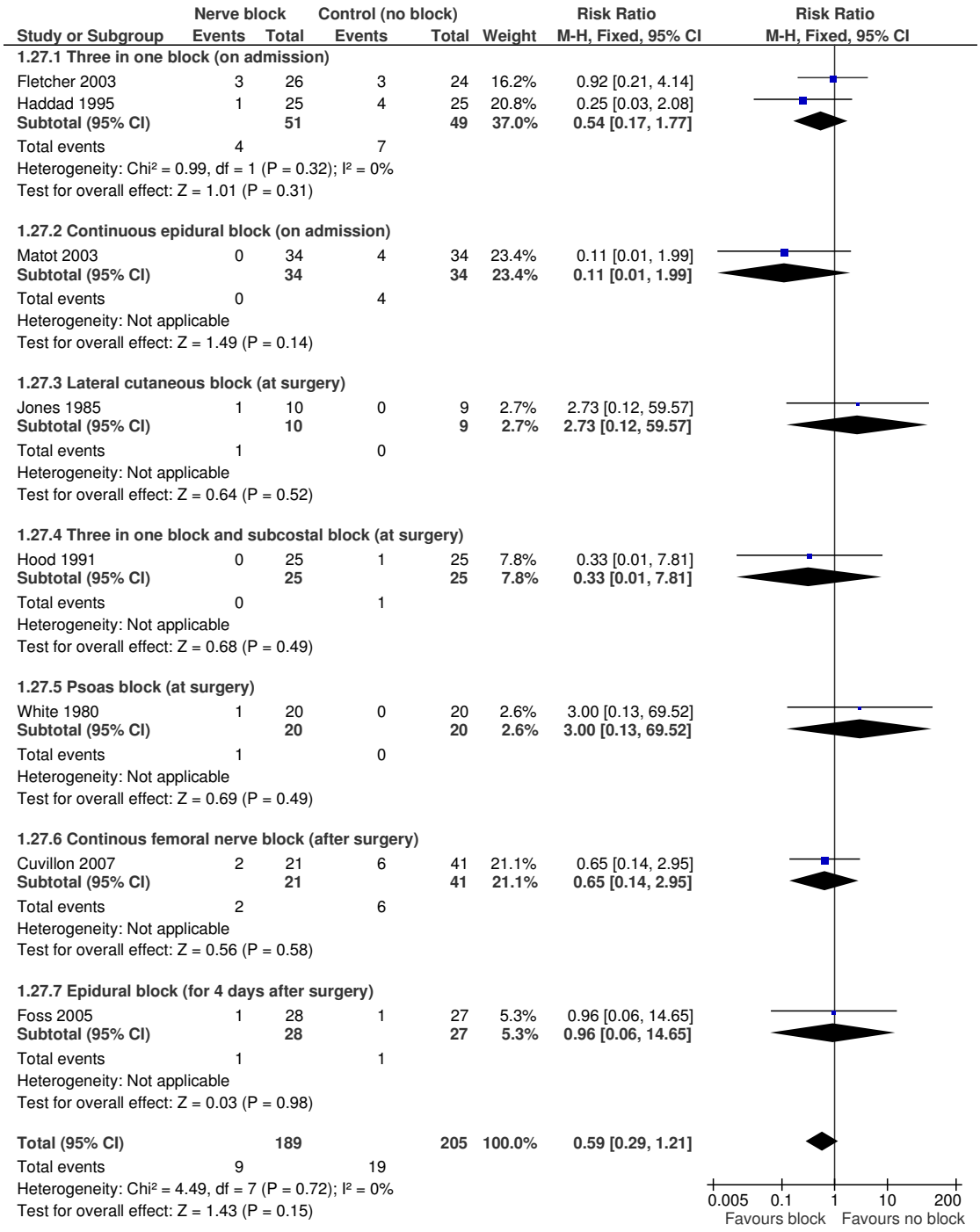


Figure G-37. Pressure sores: Nerve blocks vs. no nerve block (systemic drugs)

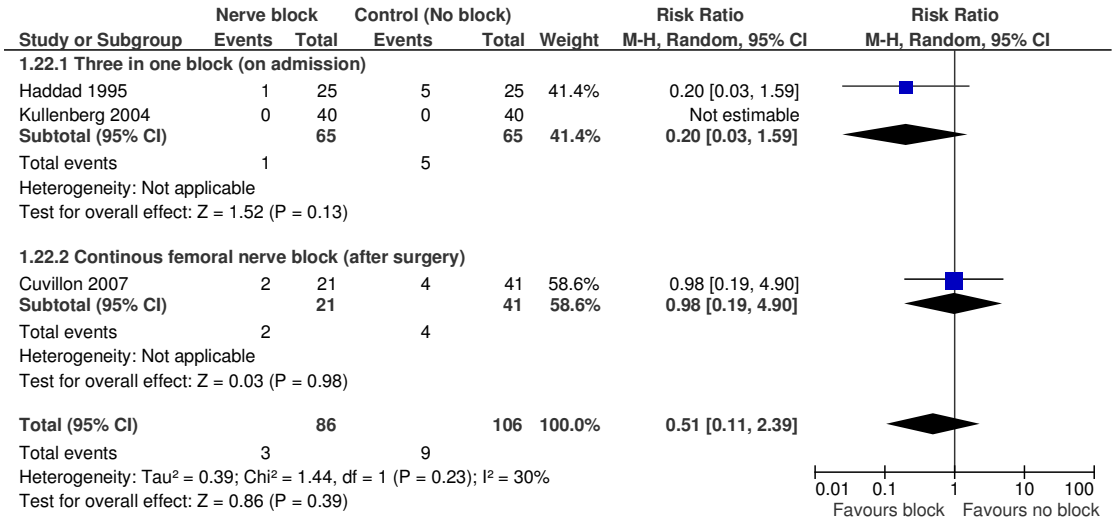
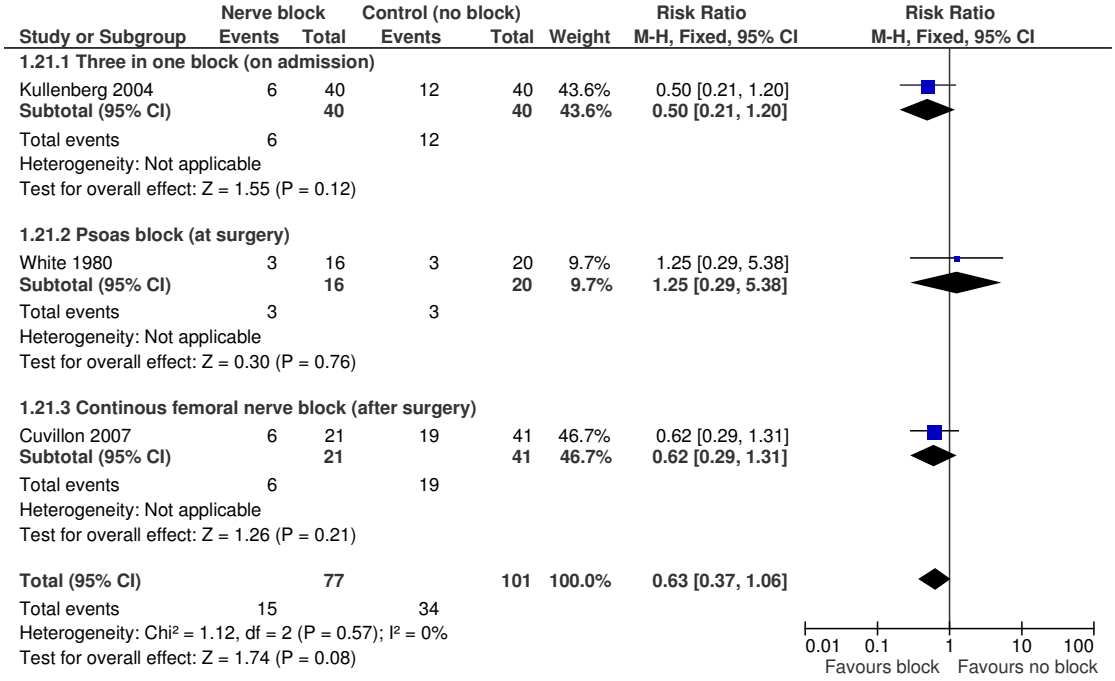


Figure G-38. Confusional state: Nerve blocks vs. no nerve block (systemic drugs)



19.4 Anaesthesia

Figure G-39. Mortality at 1 month (random effects model): Regional (spinal or epidural) versus general anaesthesia

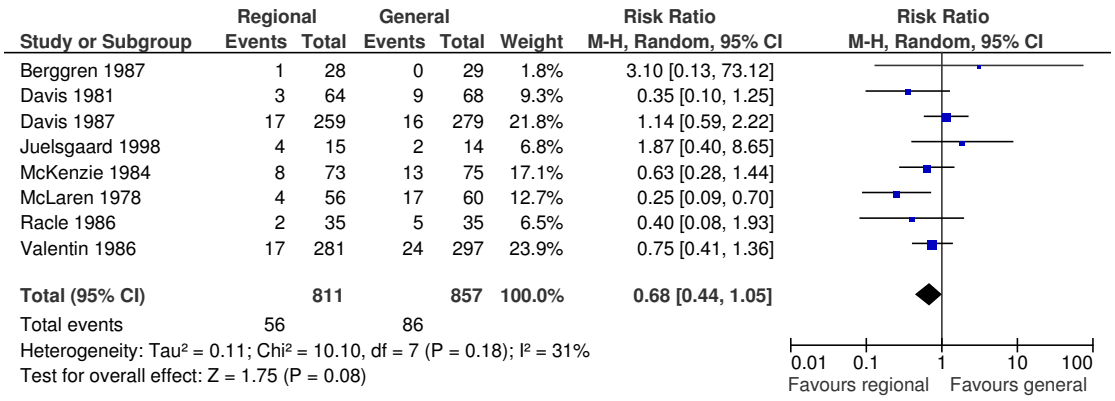


Figure G-40. Mortality- early up to 1 month: Regional (spinal or epidural) versus general anaesthesia

Additional analysis: The authors pooled mortality data from Adams 1990 and Bigler 1985 which reported early mortality during hospital stay and Ungemach 1987 which reported mortality at 2 weeks with data from the mortality at one month analysis.

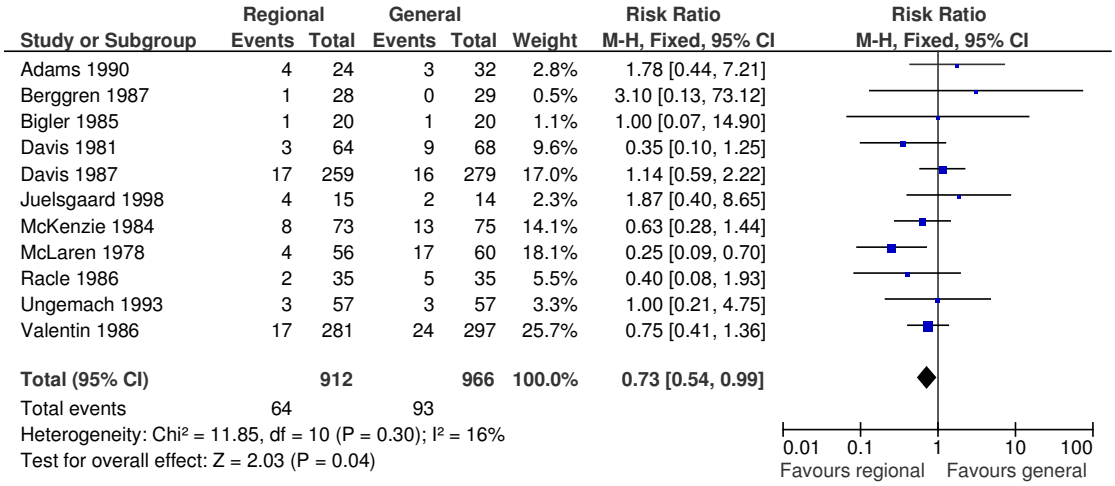


Figure G-41. Length of stay in hospital: Regional (spinal or epidural) versus general anaesthesia

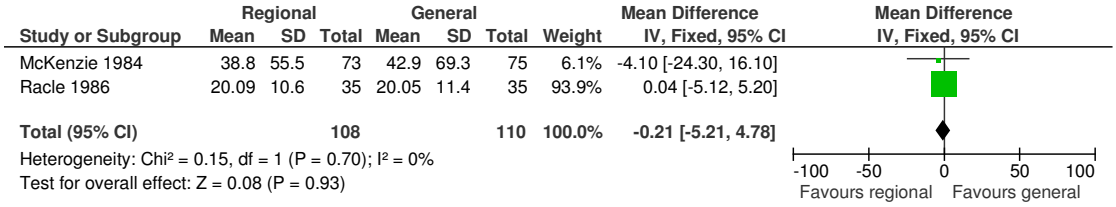


Figure G-42. Vomiting: Regional (spinal or epidural) versus general anaesthesia

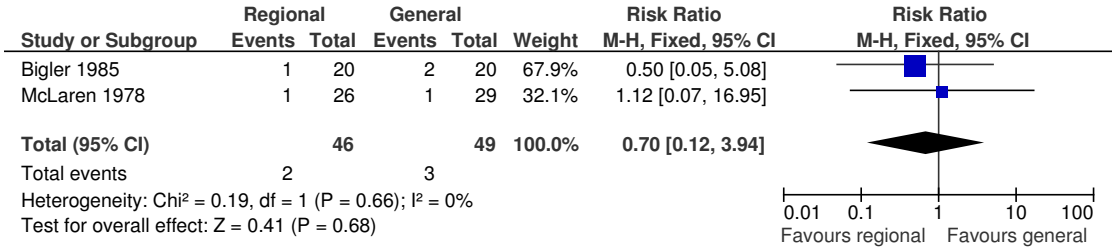


Figure G-43. Acute confusional state: Regional (spinal or epidural) versus general anaesthesia

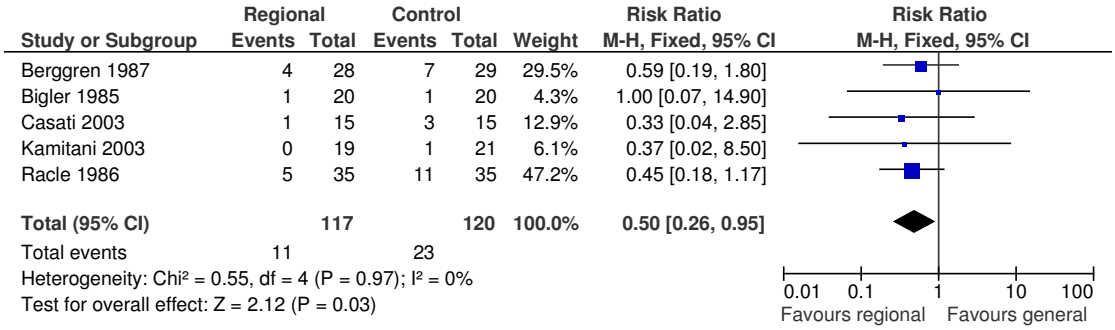


Figure G-44. Pneumonia: Regional (spinal or epidural) versus general anaesthesia

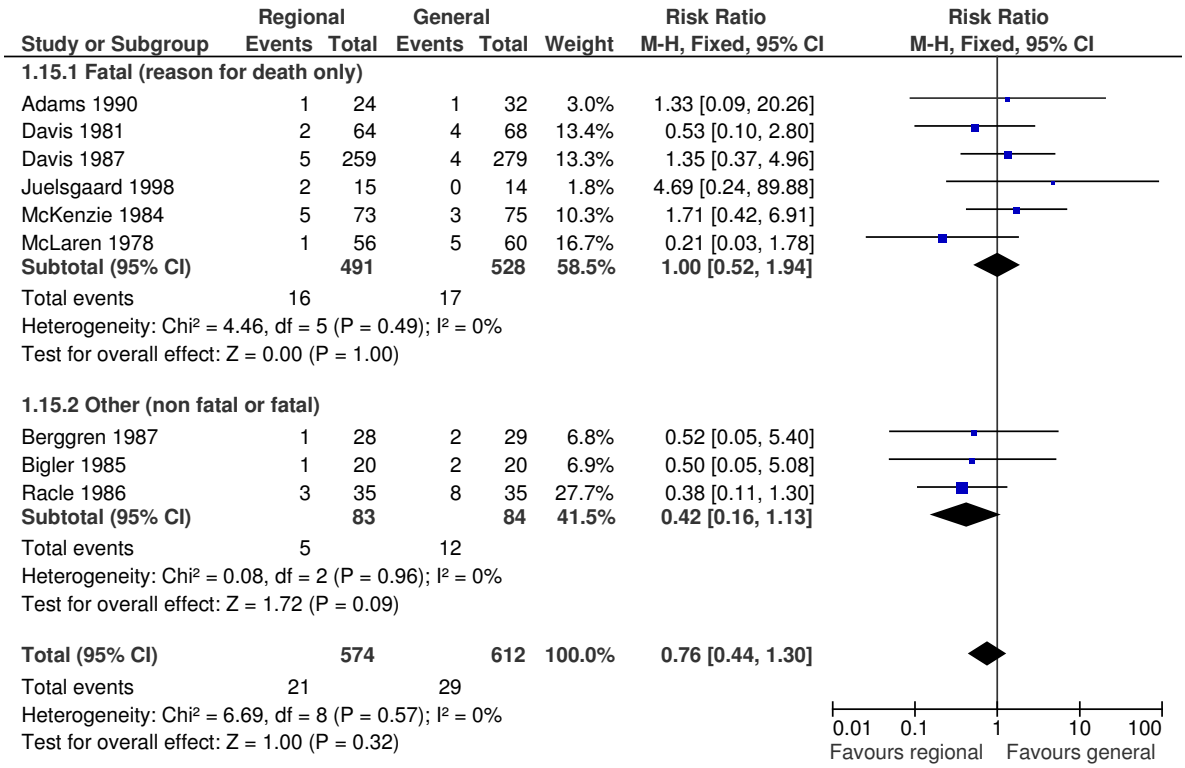


Figure G-45. Myocardial infarction: Regional (spinal or epidural) versus general anaesthesia

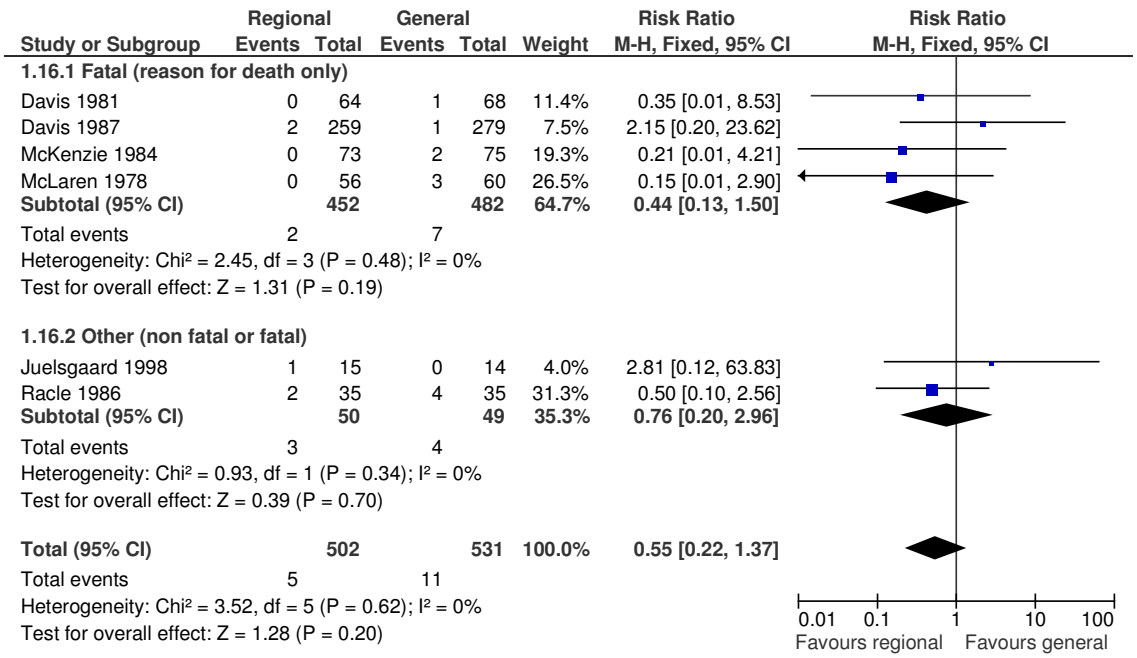


Figure G-46. Pulmonary embolism (Peto odds ratio): Regional (spinal or epidural) versus general anaesthesia

Study or Subgroup	Regional Events	Regional Total	General Events	General Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Adams 1990	1	24	0	32	4.6%	10.31 [0.20, 541.25]
Berggren 1987	2	28	0	29	9.2%	7.95 [0.48, 130.33]
Bigler 1985	2	20	0	20	9.1%	7.79 [0.47, 129.11]
Brichant 1995	1	46	0	42	4.7%	6.77 [0.13, 342.76]
Davis 1981	0	64	4	68	18.2%	0.14 [0.02, 1.00]
Davis 1987	0	259	1	279	4.7%	0.15 [0.00, 7.35]
McKenzie 1984	1	73	3	75	18.3%	0.37 [0.05, 2.68]
McLaren 1978	1	56	5	60	26.7%	0.27 [0.05, 1.37]
Racle 1986	1	35	0	35	4.7%	7.39 [0.15, 372.38]
Total (95% CI)		**605**		**640**	**100.0%**	**0.72 [0.31, 1.69]**
Total events	9		13			

Heterogeneity: Chi² = 15.11, df = 8 (P = 0.06); I² = 47%
Test for overall effect: Z = 0.74 (P = 0.46)

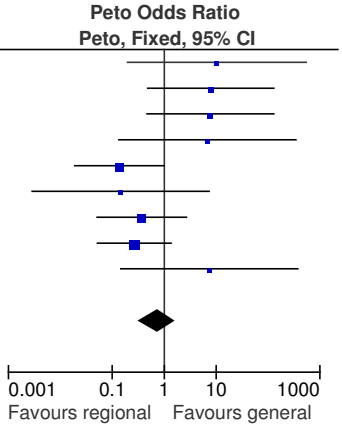


Figure G-47. Pulmonary embolism (random effects model): Regional (spinal or epidural) versus general anaesthesia

Study or Subgroup	Regional Events	Regional Total	General Events	General Total	Weight	Risk Ratio M-H, Random, 95% CI
Adams 1990	1	24	0	32	9.0%	3.96 [0.17, 93.17]
Berggren 1987	2	28	0	29	9.9%	5.17 [0.26, 103.18]
Bigler 1985	2	20	0	20	10.0%	5.00 [0.26, 98.00]
Brichant 1995	1	46	0	42	8.9%	2.74 [0.11, 65.59]
Davis 1981	0	64	4	68	10.4%	0.12 [0.01, 2.15]
Davis 1987	0	259	1	279	8.8%	0.36 [0.01, 8.77]
McKenzie 1984	1	73	3	75	16.2%	0.34 [0.04, 3.22]
McLaren 1978	1	56	5	60	17.8%	0.21 [0.03, 1.78]
Racle 1986	1	35	0	35	8.9%	3.00 [0.13, 71.22]
Total (95% CI)		**605**		**640**	**100.0%**	**0.88 [0.32, 2.39]**
Total events	9		13			

Heterogeneity: Tau² = 0.29; Chi² = 9.14, df = 8 (P = 0.33); I² = 12%
Test for overall effect: Z = 0.25 (P = 0.80)

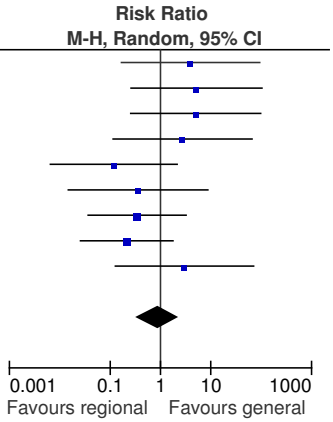


Figure G-48. Pulmonary embolism (fatal and non fatal): Regional (spinal or epidural) versus general anaesthesia

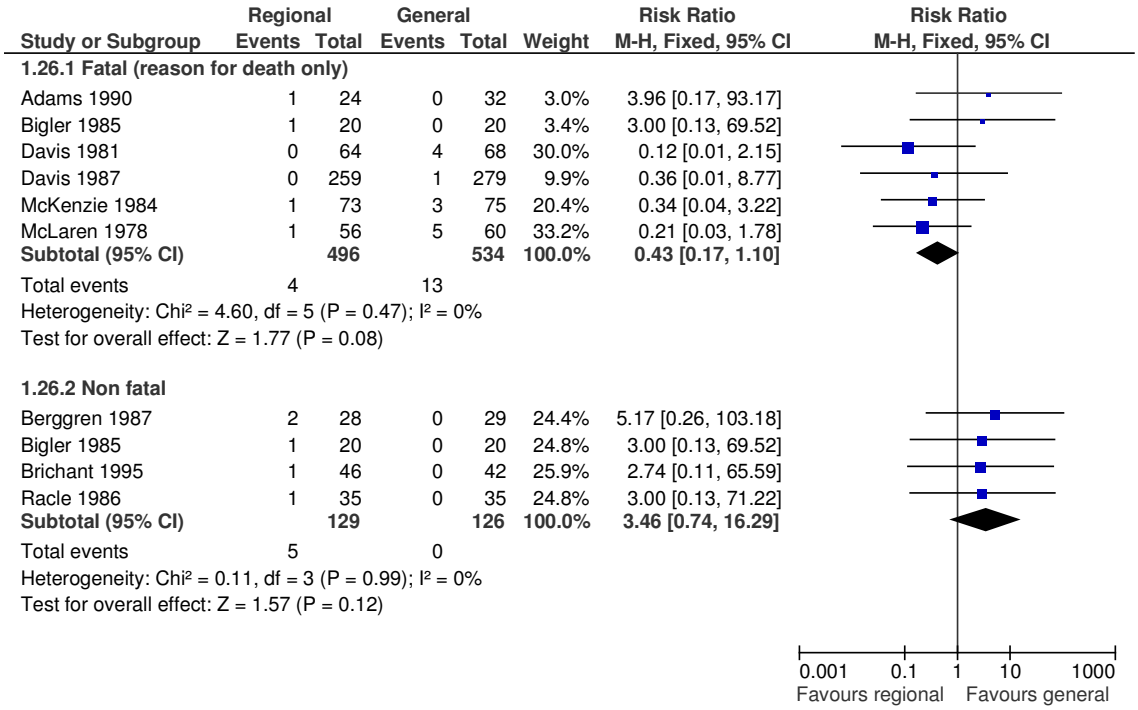
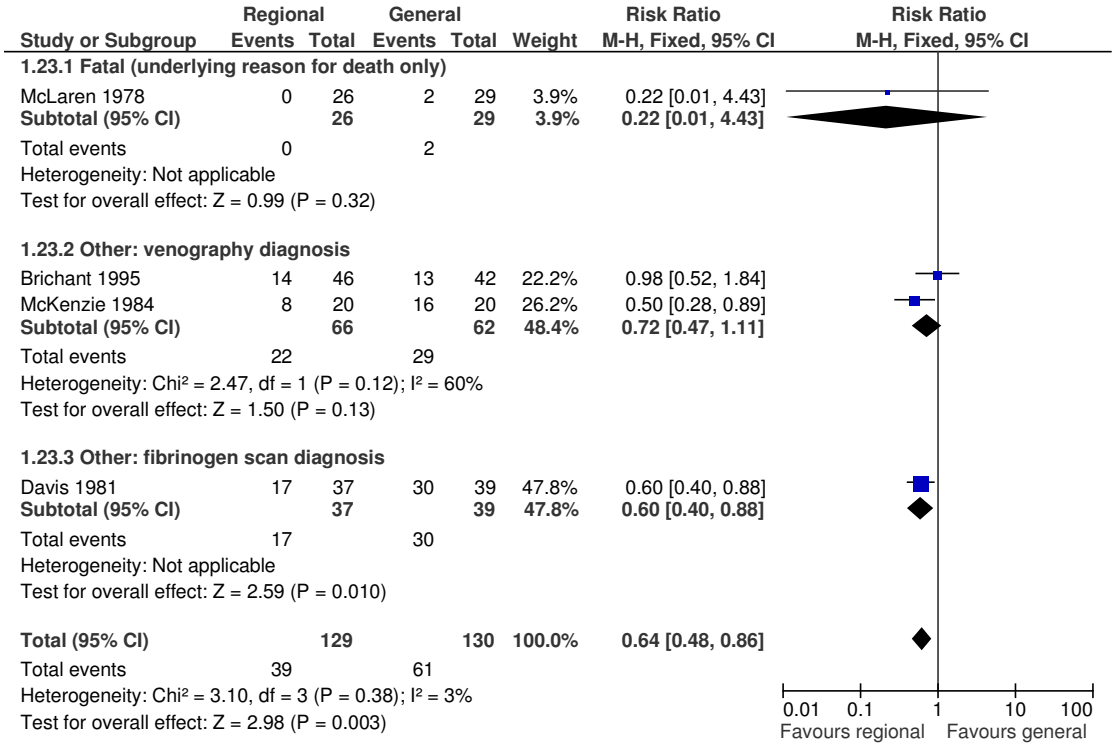


Figure G-49. Deep vein thrombosis: Regional (spinal or epidural) versus general anaesthesia



19.5 Surgical interventions

19.5.1 Surgeon seniority

Figure G-50. Reoperation rate for technically demanding hip fractures at 6 months: Senior/higher grade surgeon versus junior/lower grade surgeon

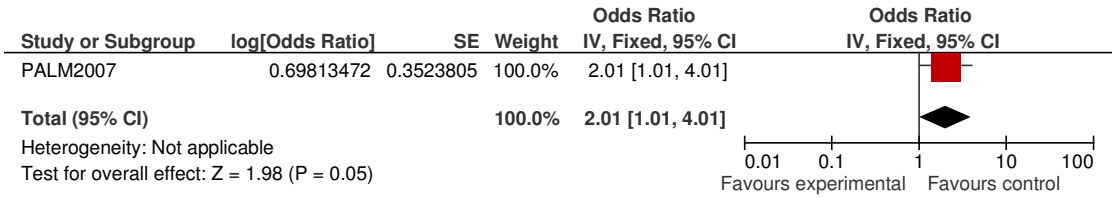
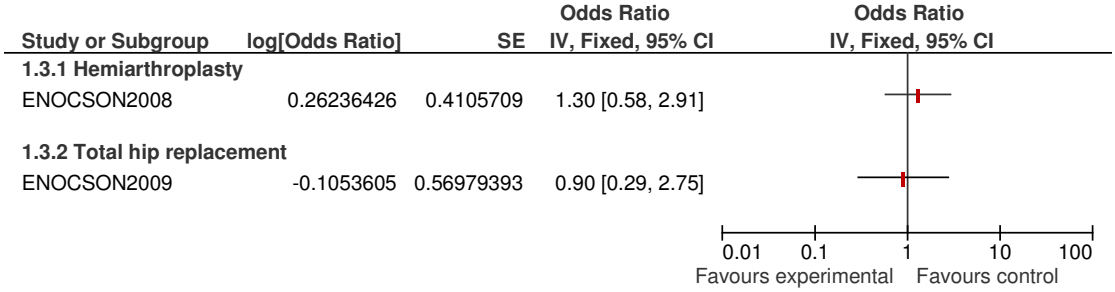


Figure G-51. Dislocation rate for arthroplasty: Senior/higher grade surgeon versus junior/lower grade surgeon



19.5.2 Cement in older designs of arthroplasty

Figure G-52. Perioperative mortality - older designs of arthroplasty: cemented vs. uncemented.

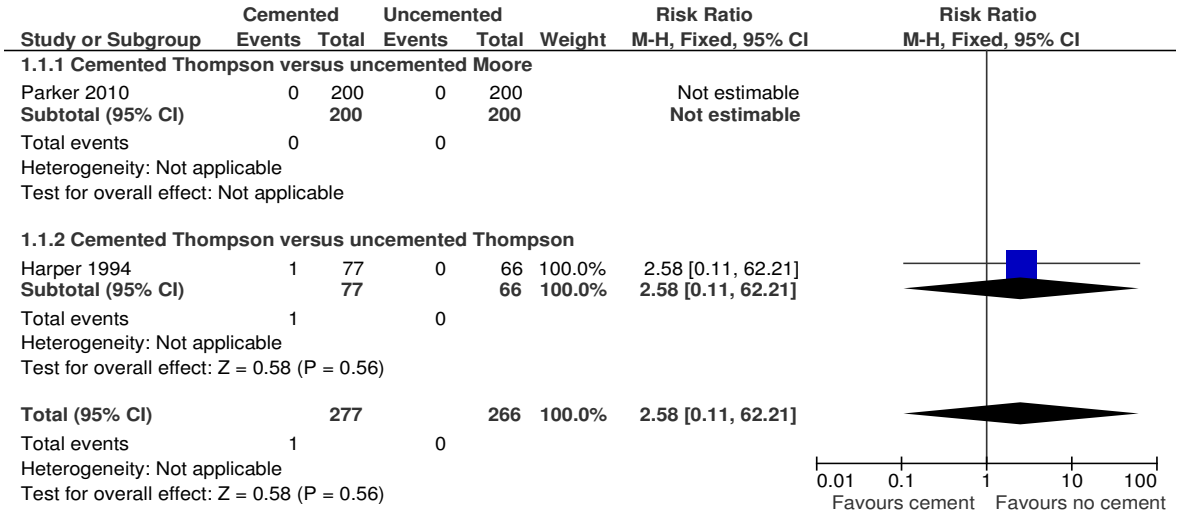


Figure G-53. Mortality – at up to 1 month - older designs of arthroplasty: cemented vs. uncemented.

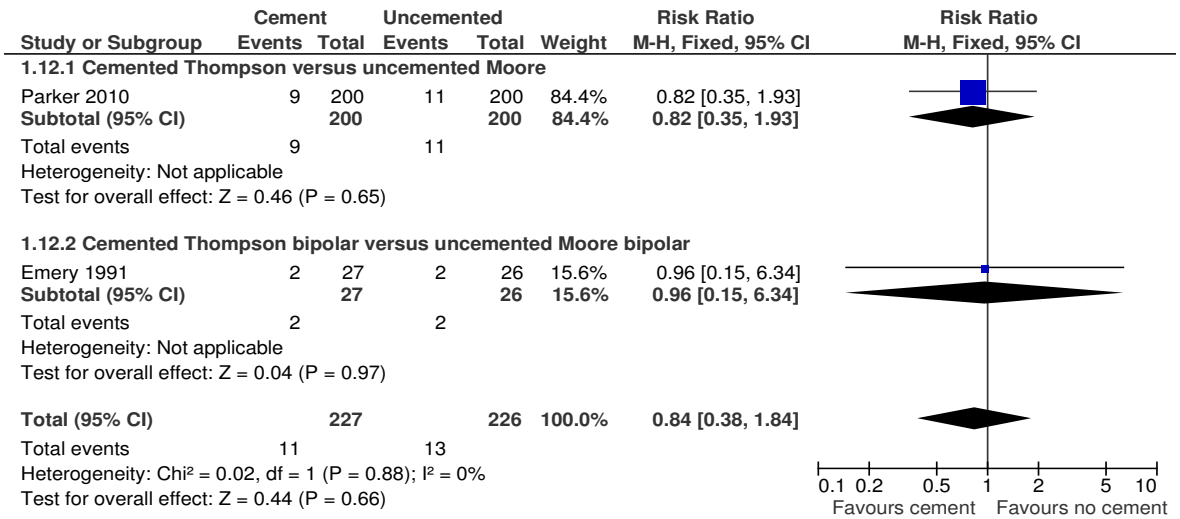


Figure G-54. Mortality at between 1 and 3 months - older designs of arthroplasty: cemented vs. uncemented.

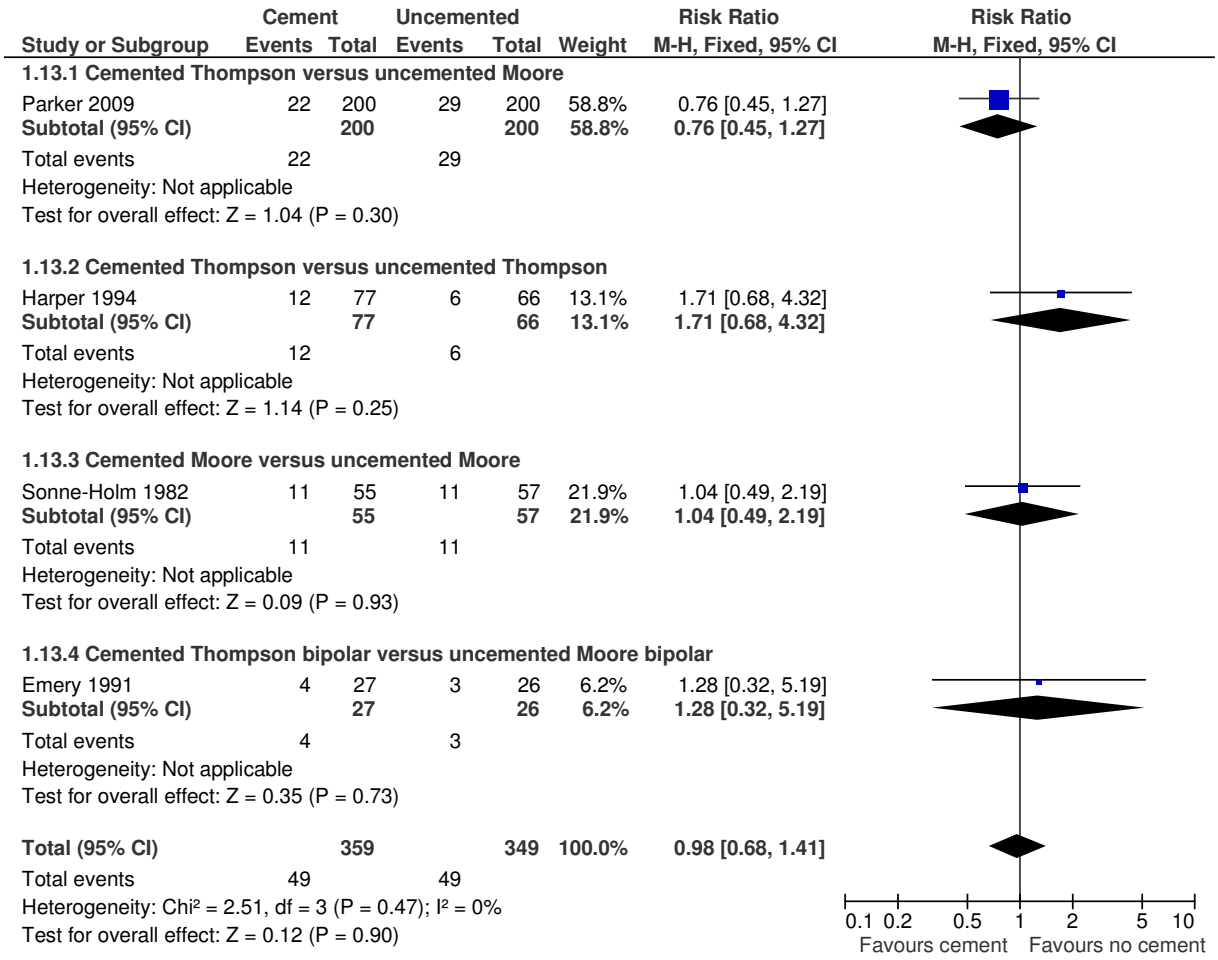


Figure G-55. Mortality at 1 year - older designs of arthroplasty: cemented vs. uncemented.

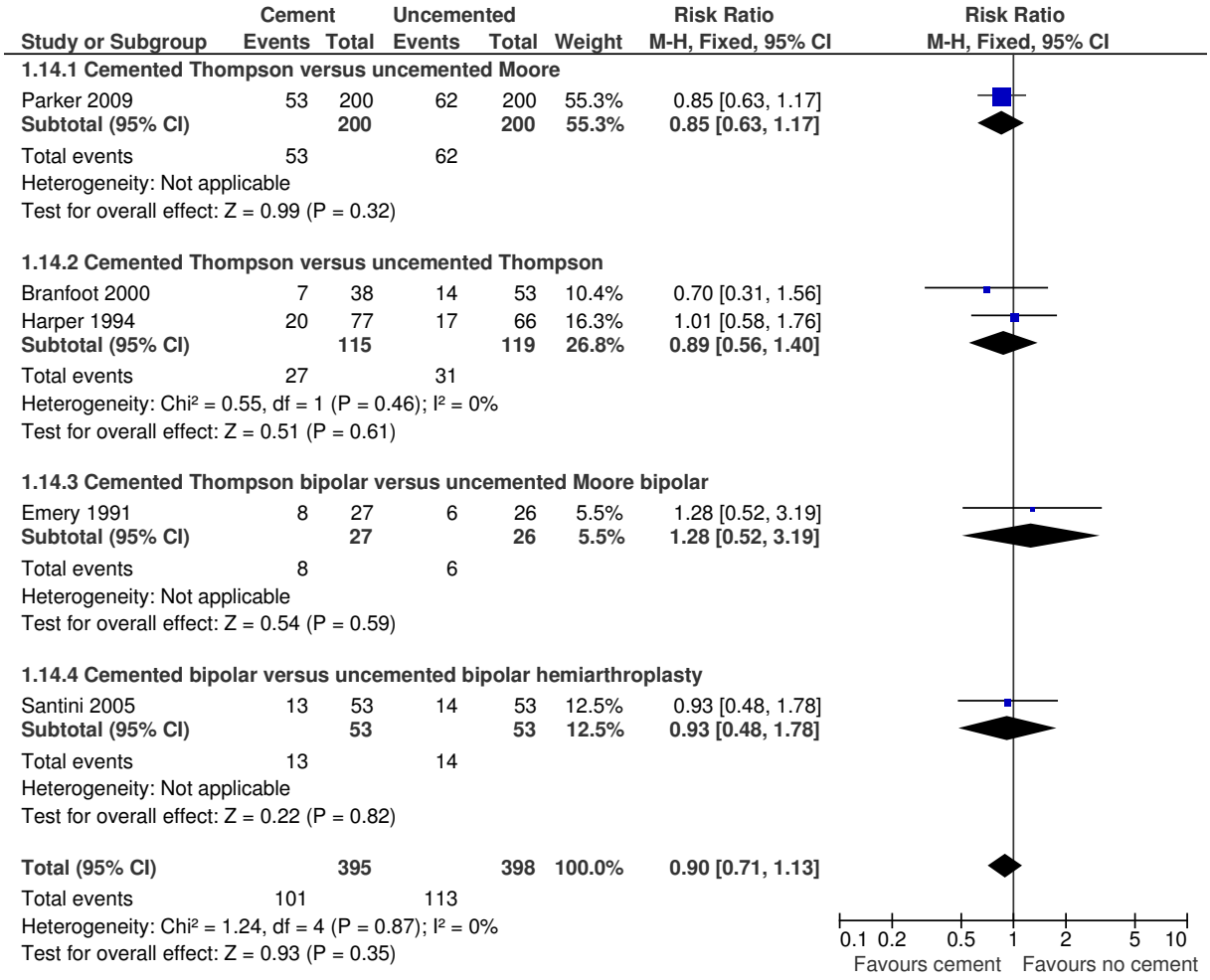


Figure G-56. Mortality at 3 years - older designs of arthroplasty: cemented vs. uncemented.

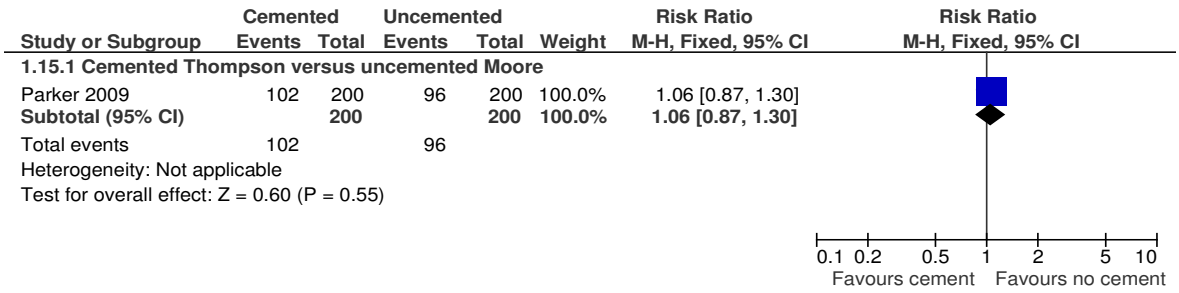


Figure G-57. Number of patients failing to regain mobility - older designs of arthroplasty: cemented vs. uncemented.

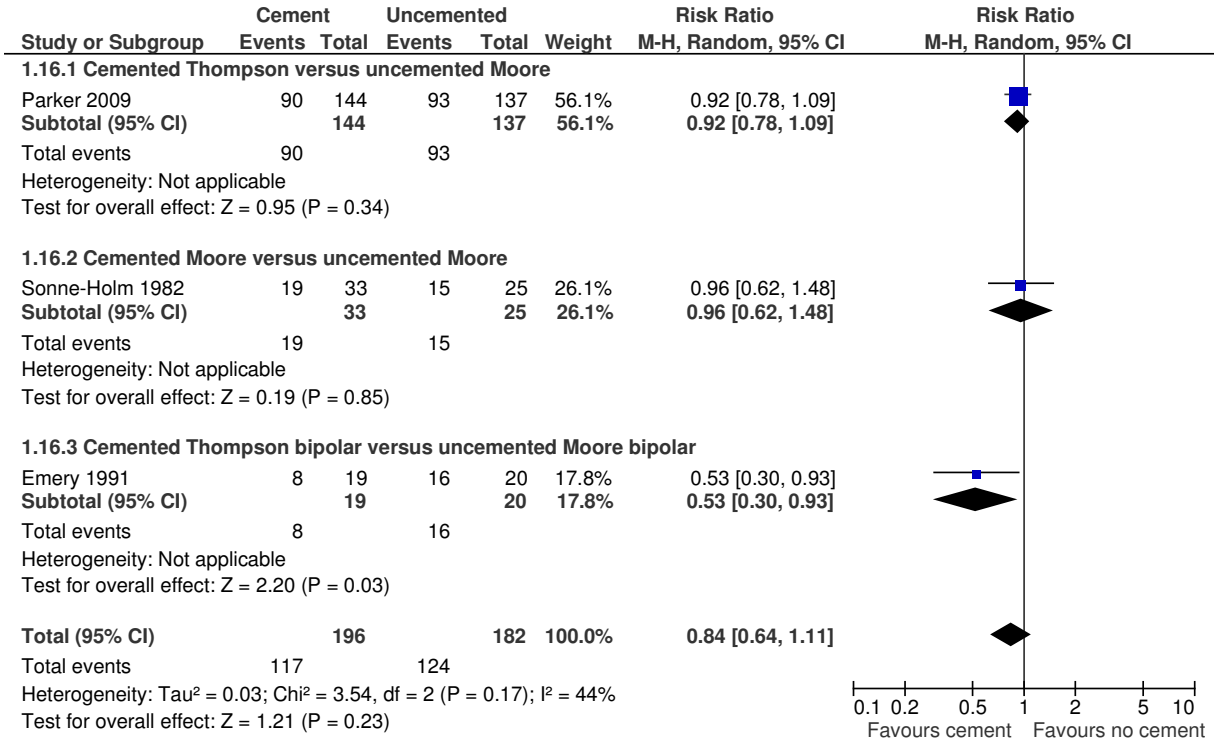


Figure G-58. Change in mobility score - older designs of arthroplasty: cemented vs. uncemented.

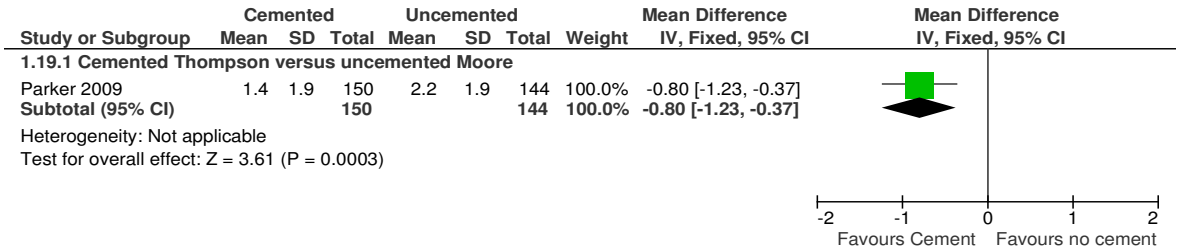


Figure G-59. Length of hospital stay - older designs of arthroplasty: cemented vs. uncemented.

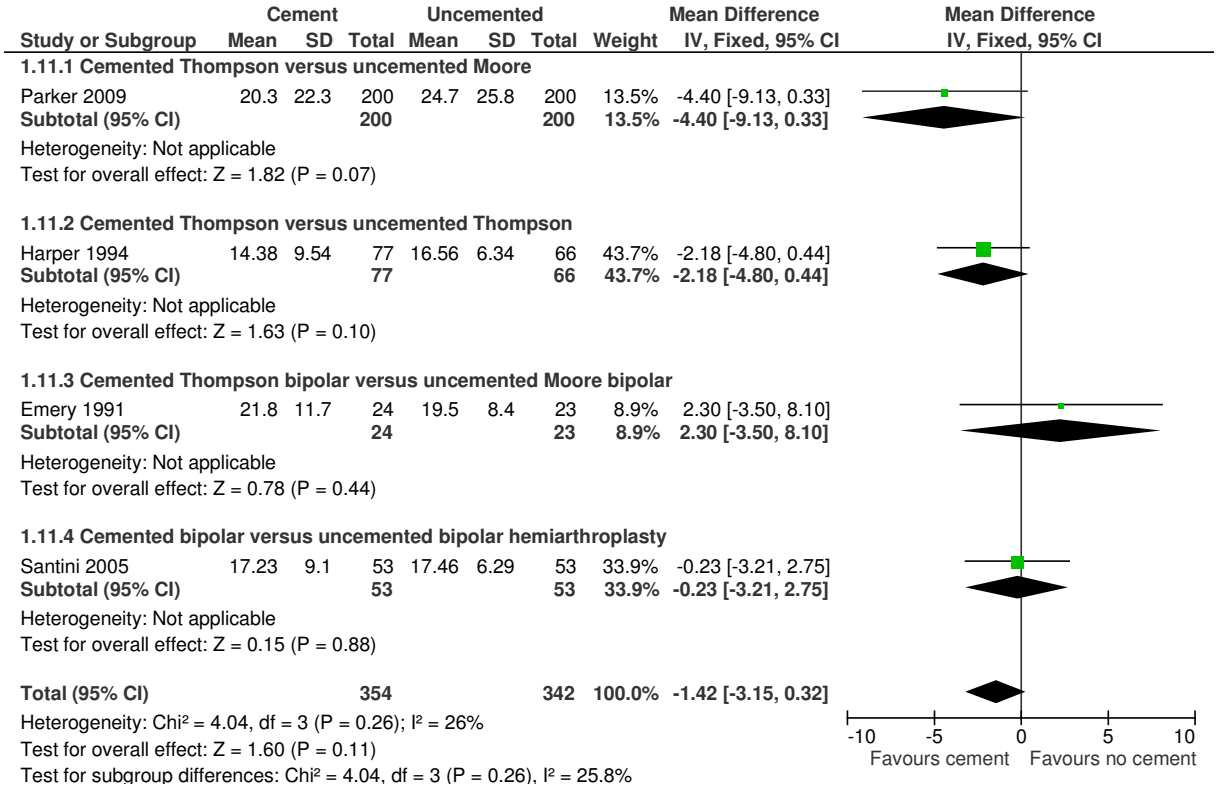


Figure G-60. Number of patients failing to return home - older designs of arthroplasty: cemented vs. uncemented.

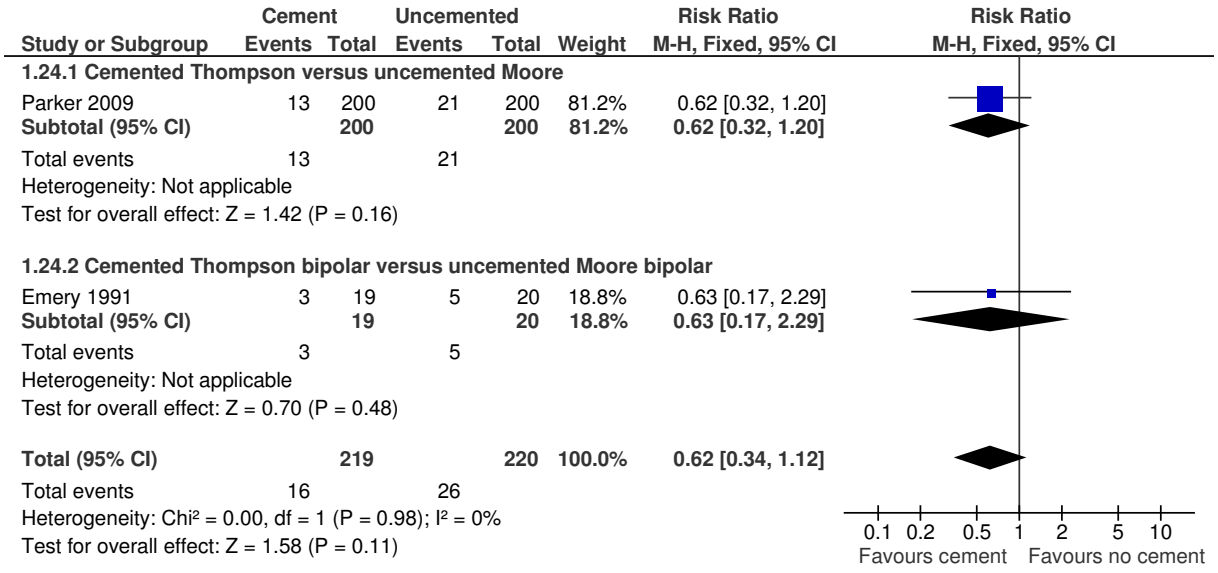


Figure G-61. Number of patients reporting pain at 3 months - older designs of arthroplasty: cemented vs. uncemented.

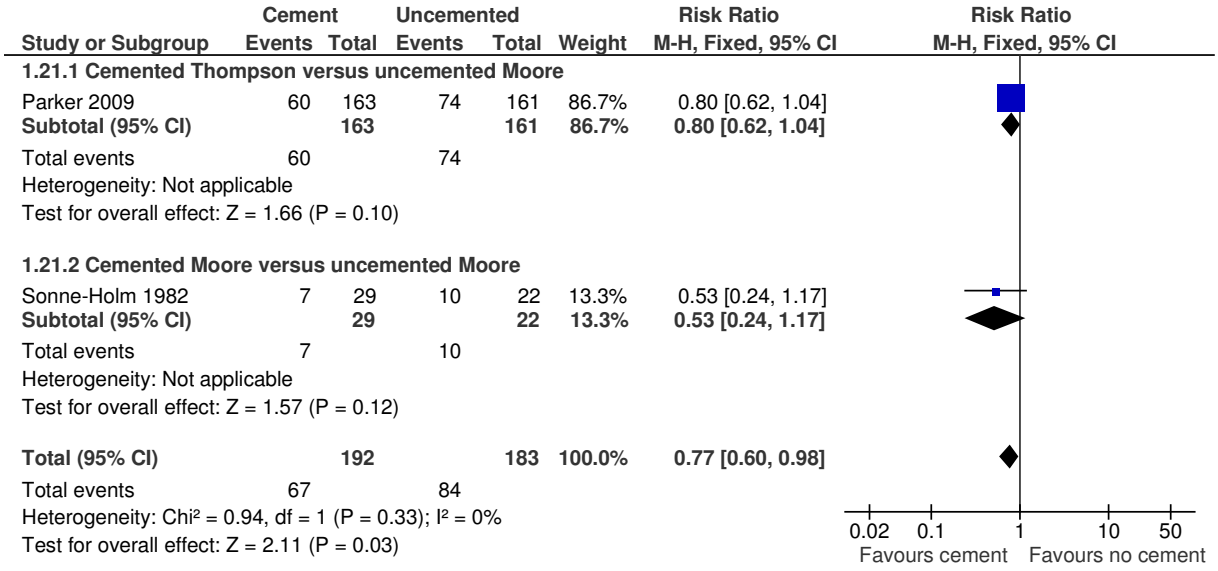


Figure G-62. Number of patients reporting pain at 1 to 2 years - older designs of arthroplasty: cemented vs. uncemented.

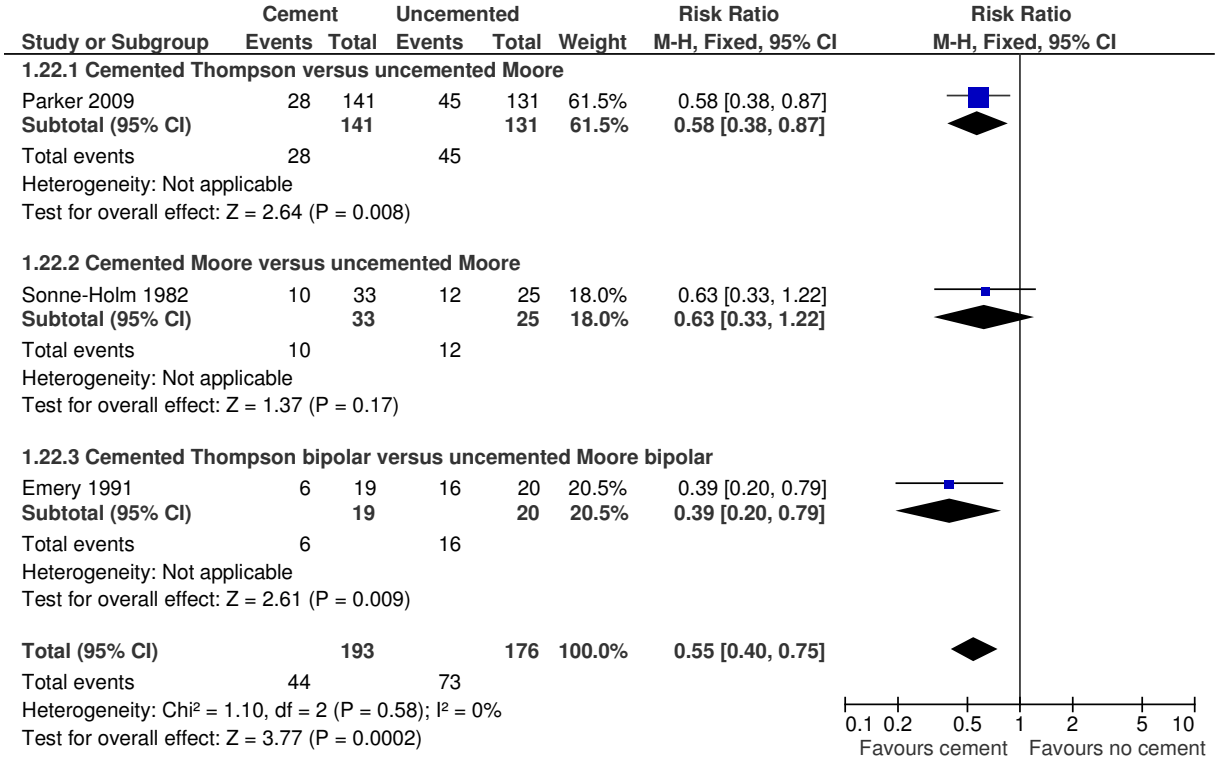


Figure G-63. Pain score at 6 months - older designs of arthroplasty: cemented vs. uncemented.

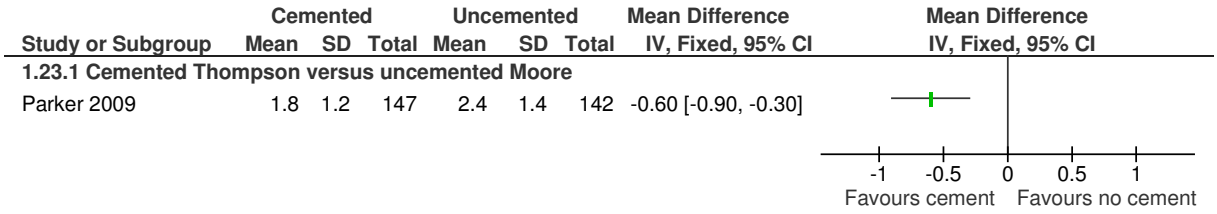


Figure G-64. Reoperations - older designs of arthroplasty: cemented vs. uncemented.

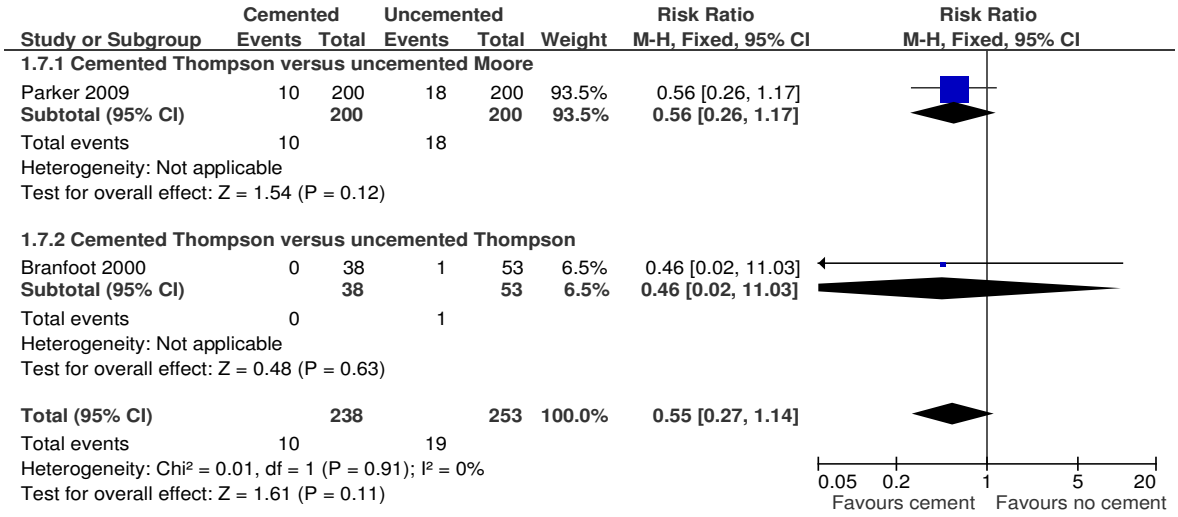


Figure G-65. Deep sepsis - older designs of arthroplasty: cemented vs. uncemented.

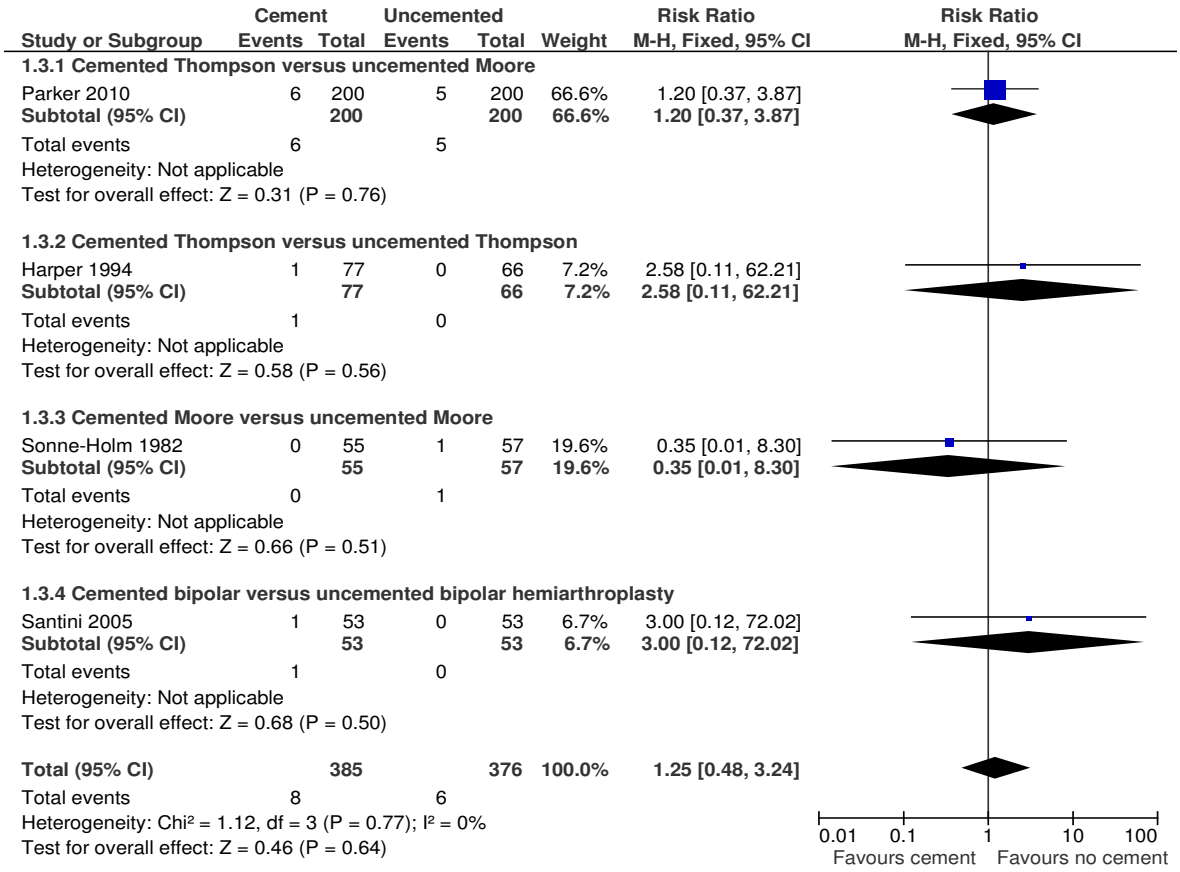
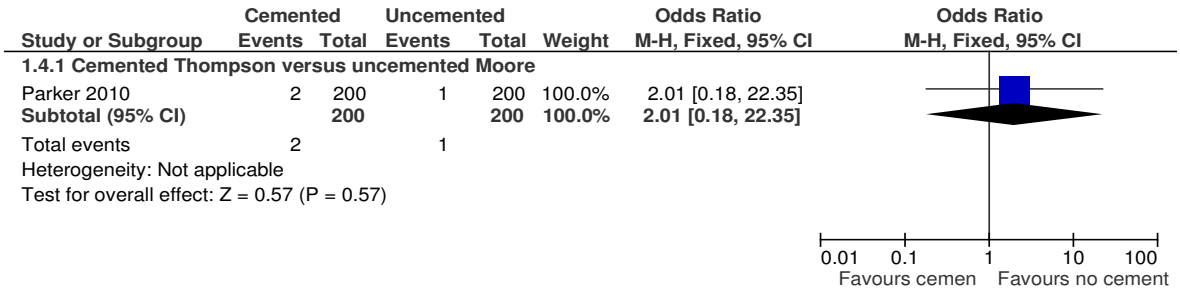


Figure G-66. Wound haematoma - older designs of arthroplasty: cemented vs. uncemented.



19.5.3 Cement in newer designs of arthroplasty

Figure G-67. Mortality - newer designs of arthroplasty: cemented vs. uncemented.

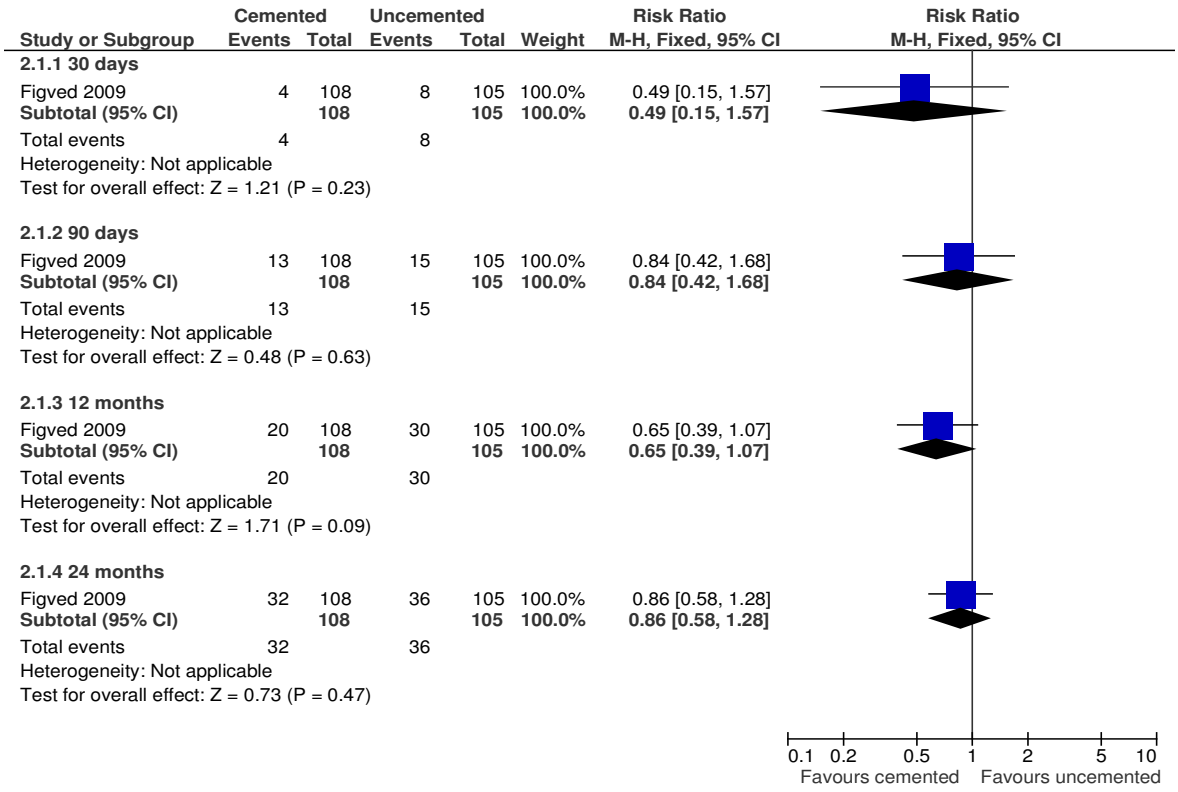


Figure G-68. Reoperations - newer designs of arthroplasty: cemented vs. uncemented.

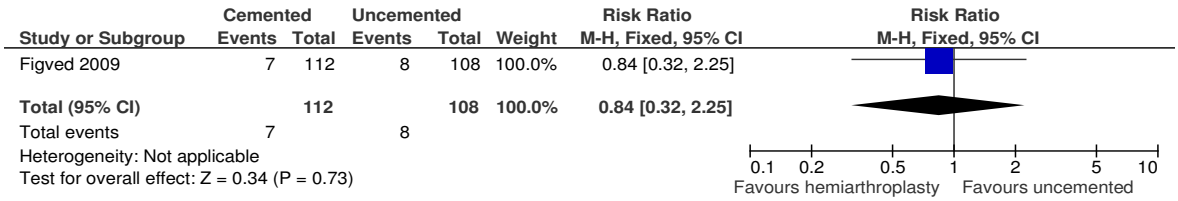


Figure G-69. Pain – need for pain medication - newer designs of arthroplasty: cemented vs. uncemented.

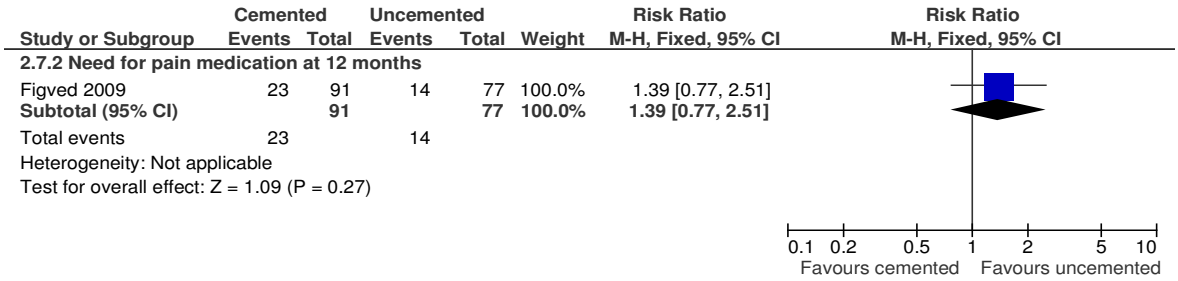


Figure G-70. Unable to walk without aids at 12 months –newer designs of arthroplasty: cemented vs. uncemented.

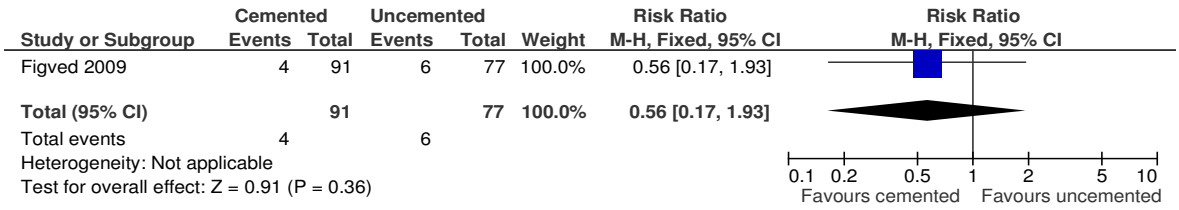


Figure G-71. Barthel Index –newer designs of arthroplasty: cemented vs. uncemented.

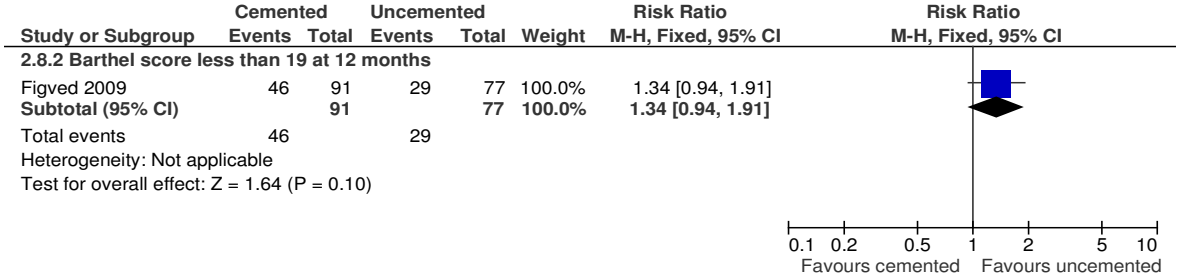


Figure G-72. Harris Hip Score and Eq-5d scores –newer designs of arthroplasty: cemented vs. uncemented.

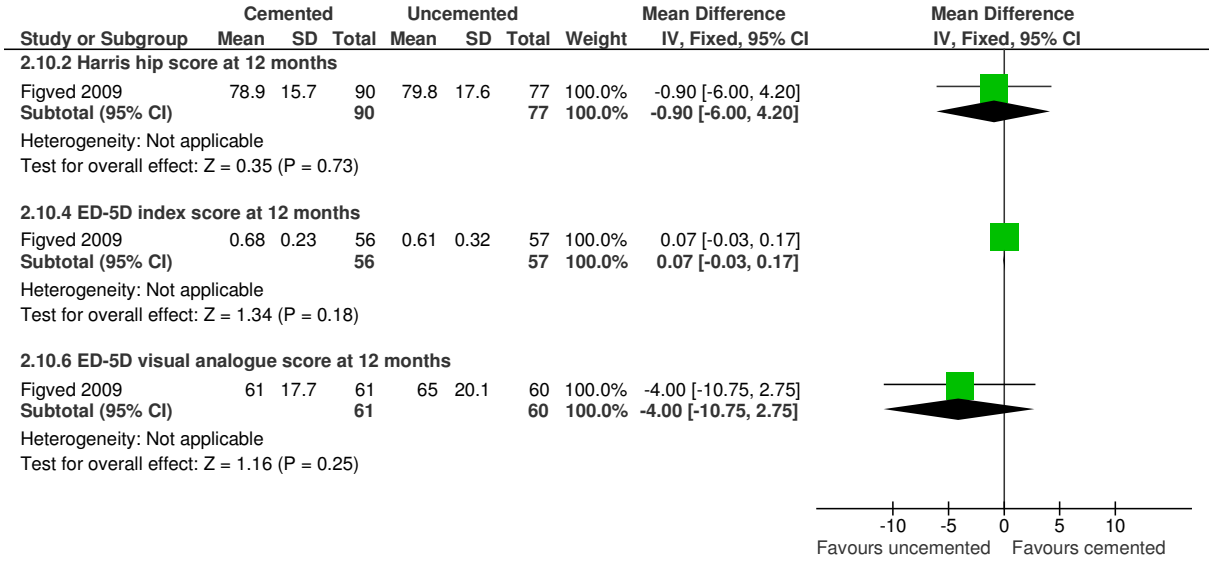
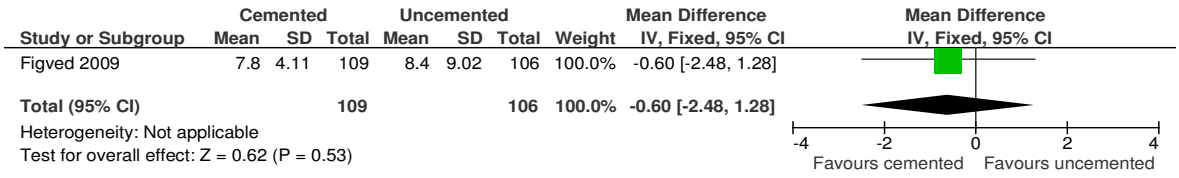


Figure G-73. Length of hospital stay –newer designs of arthroplasty: cemented vs. uncemented.



19.5.4 Internal fixation versus hemiarthroplasty

Figure G-74. Mortality: Internal fixation versus hemiarthroplasty

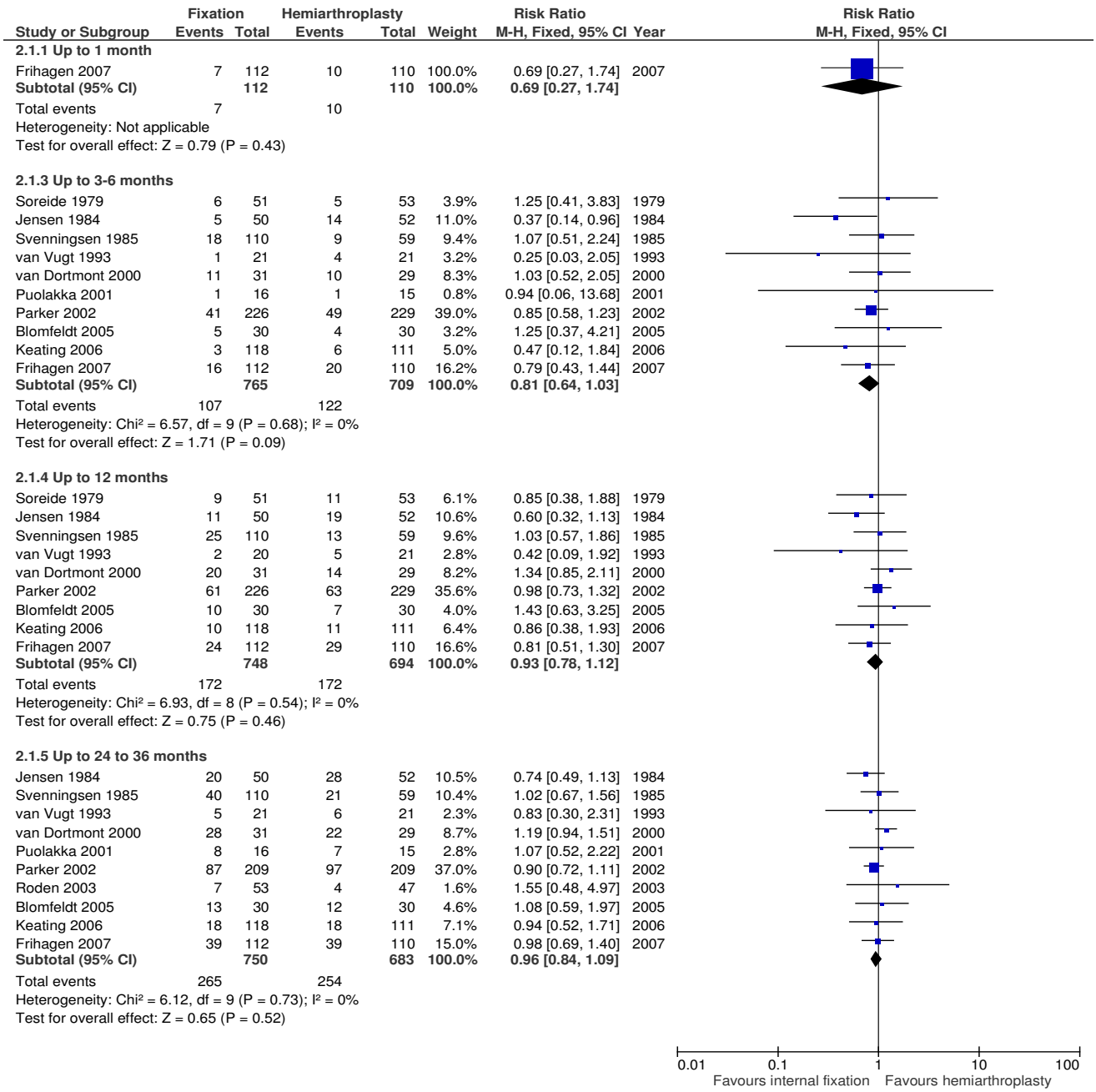


Figure G-75. Reoperations: Internal fixation versus hemiarthroplasty

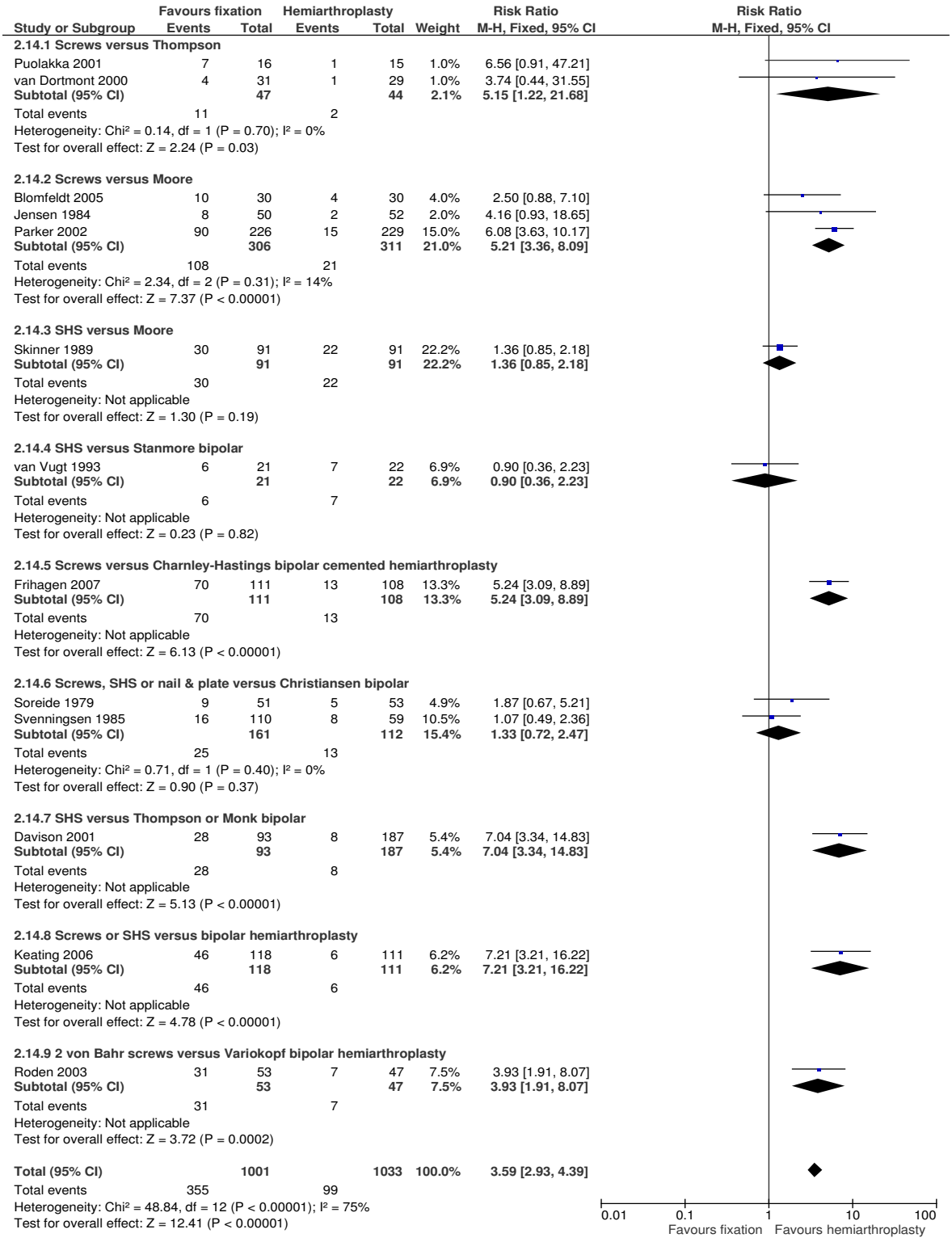


Figure G-76. Failure to return to same residence by final follow up: Internal fixation versus hemiarthroplasty

Figure G-77. Failure to regain mobility: Internal fixation versus hemiarthroplasty

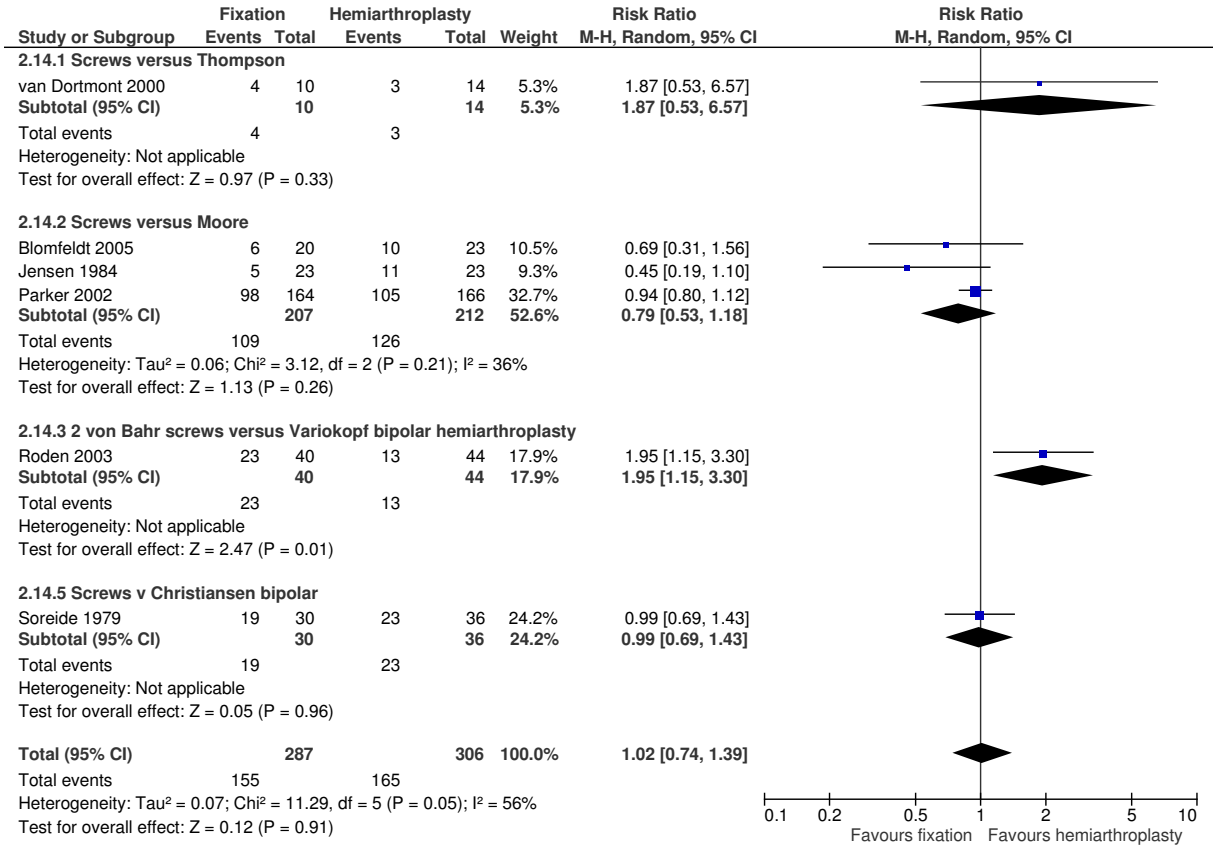


Figure G-78. Patients reporting pain at 1 year: Internal fixation versus hemiarthroplasty

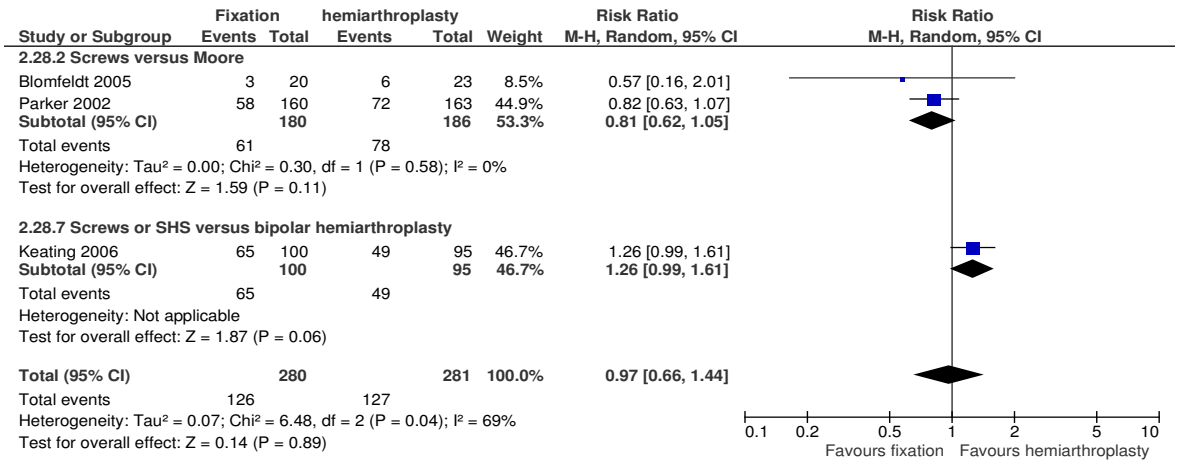


Figure G-79. Harris Hip Score: Internal fixation versus hemiarthroplasty

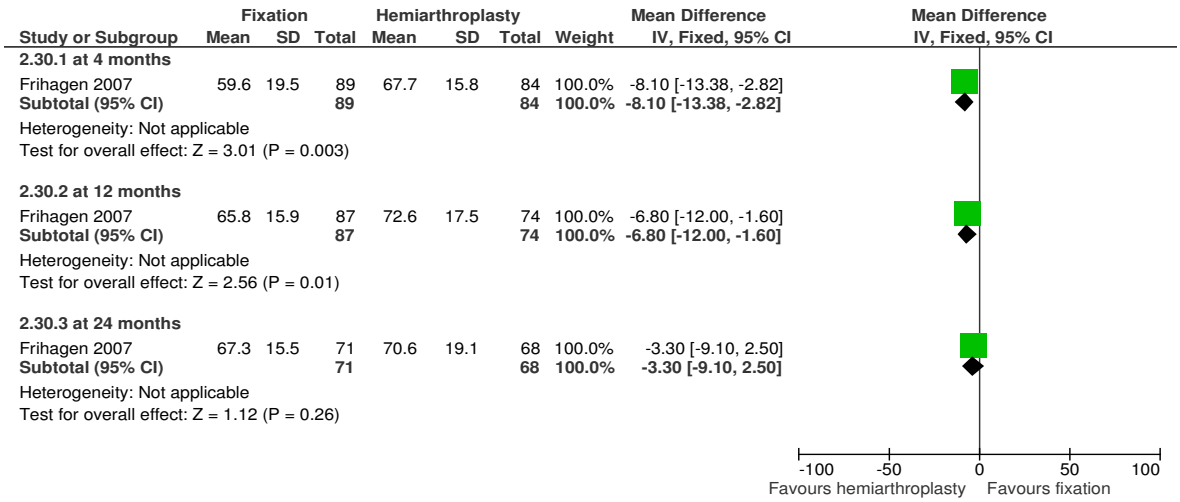


Figure G-80. Number of patients with Barthel Index Score of 95 or 100: Internal fixation versus hemiarthroplasty

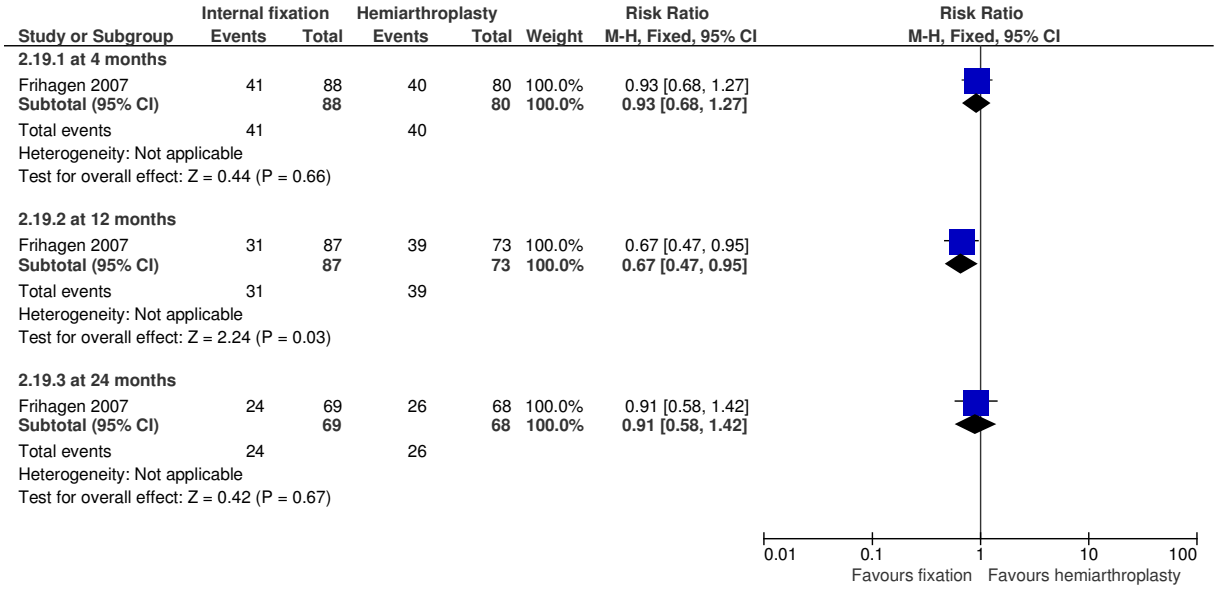


Figure G-81. Euroquol Eq-5d score: Internal fixation versus hemiarthroplasty

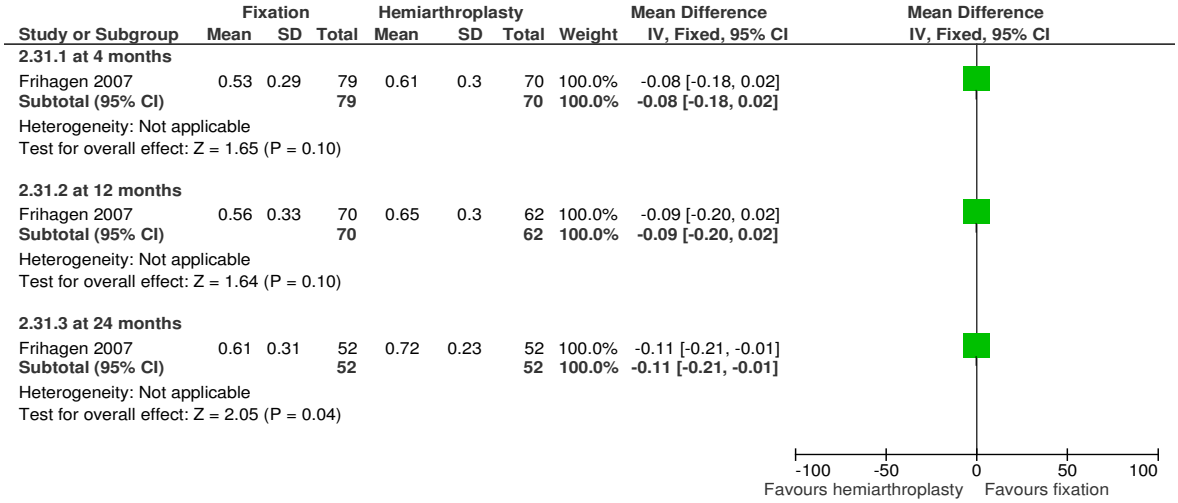
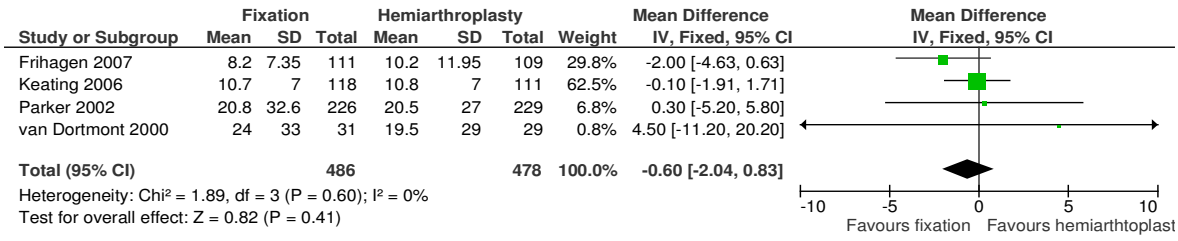


Figure G-82. Length of hospital stay: Internal fixation versus hemiarthroplasty



19.5.5 Internal fixation versus total hip replacement

Figure G-83. Mortality: Internal fixation versus total hip replacement

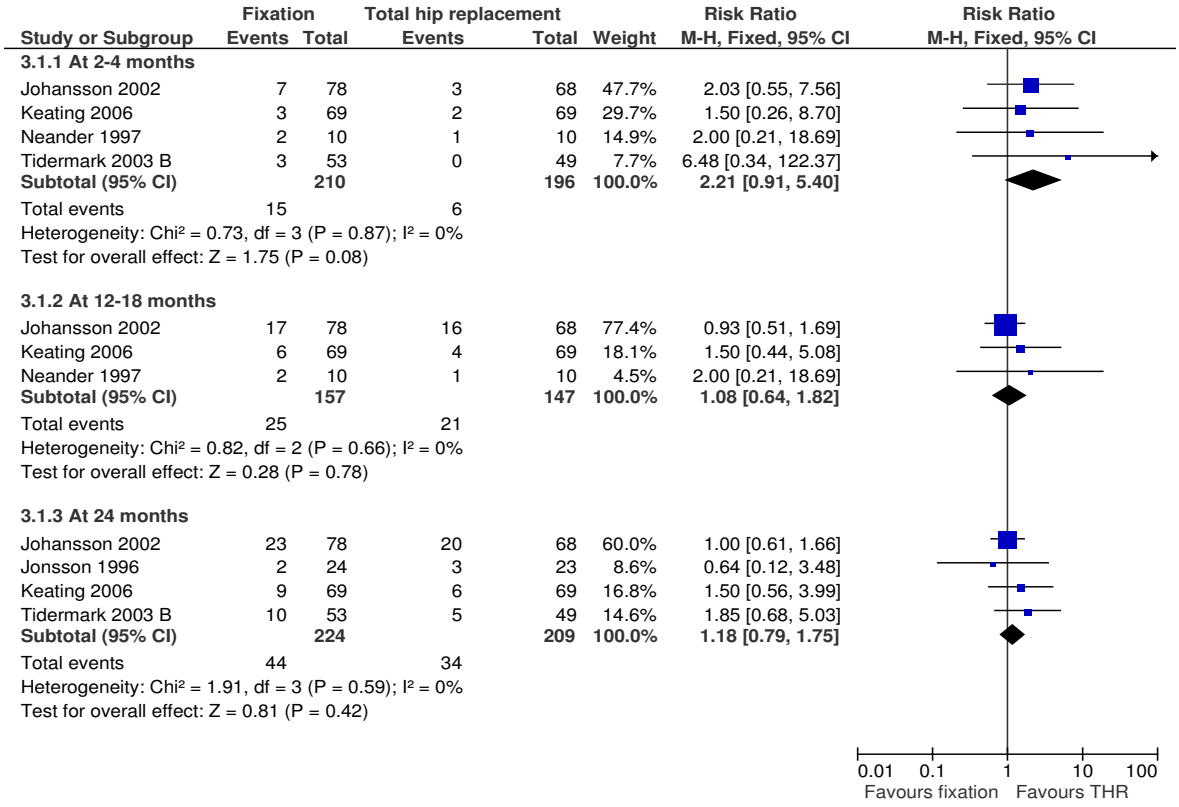


Figure G-84. Reoperations – all – at final follow up of study: Internal fixation versus total hip replacement

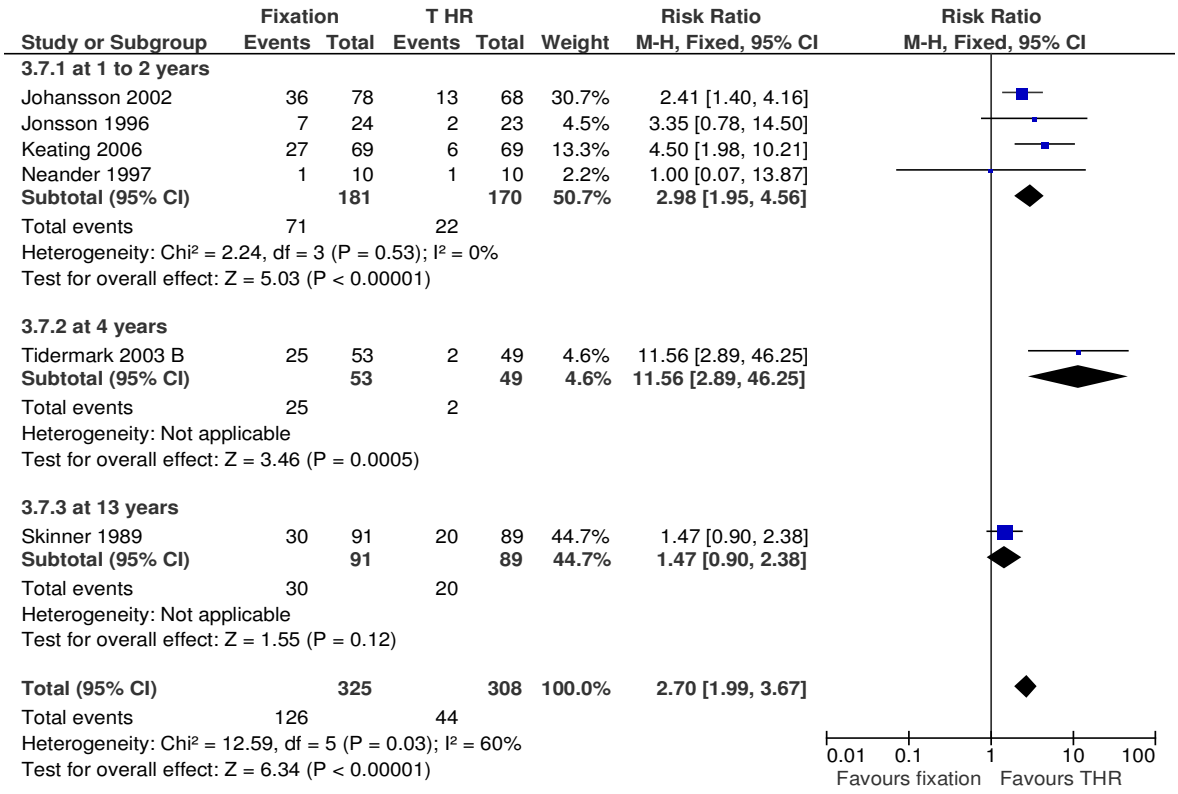


Figure G-85. Number of patients reporting pain at 1 year: Internal fixation versus total hip replacement

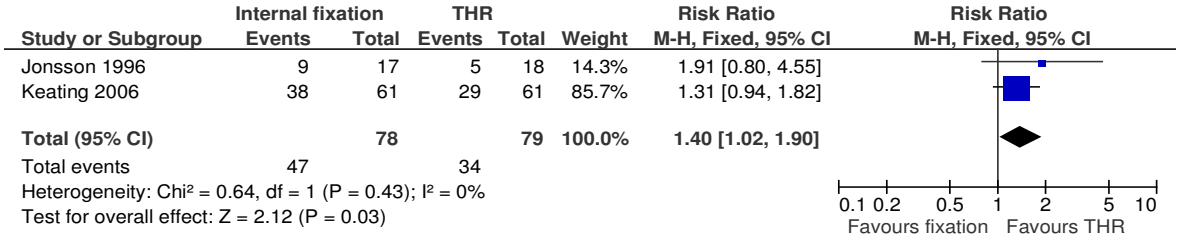
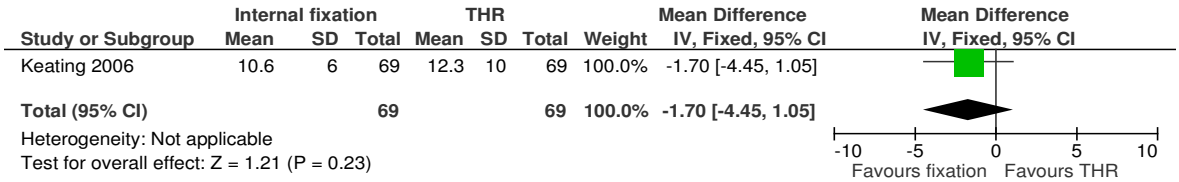


Figure G-86. Length of hospital stay: Internal fixation versus total hip replacement



19.5.6 Hemiarthroplasty versus total hip replacement

Figure G-87. Mortality: Hemiarthroplasty versus total hip replacement

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Total hip replacement Events	Total hip replacement Total	Weight	Risk Ratio M-H, Fixed, 95% CI
7.1.1 at 3-6 months						
Keating 2006	5	69	2	69	16.6%	2.50 [0.50, 12.45]
Macaulay 2008	5	23	1	17	9.6%	3.70 [0.47, 28.81]
Skinner 1989	15	100	8	80	73.8%	1.50 [0.67, 3.36]
Subtotal (95% CI)		**192**		**166**	**100.0%**	**1.88 [0.96, 3.68]**
Total events	25		11			
Heterogeneity: Chi² = 0.84, df = 2 (P = 0.66); I² = 0%						
Test for overall effect: Z = 1.83 (P = 0.07)						
7.1.2 at 1 year						
Blomfeldt 2007	3	60	4	60	11.8%	0.75 [0.18, 3.21]
Keating 2006	6	69	4	69	11.8%	1.50 [0.44, 5.08]
Mouzopoulos 2008	6	43	6	43	17.6%	1.00 [0.35, 2.86]
Skinner 1989	27	100	18	80	58.8%	1.20 [0.71, 2.02]
Subtotal (95% CI)		**272**		**252**	**100.0%**	**1.15 [0.76, 1.74]**
Total events	42		32			
Heterogeneity: Chi² = 0.61, df = 3 (P = 0.89); I² = 0%						
Test for overall effect: Z = 0.65 (P = 0.52)						
7.1.3 at 2 to 4 years						
Baker 2006	7	41	3	40	10.2%	2.28 [0.63, 8.19]
Keating 2006	9	69	6	69	20.1%	1.50 [0.56, 3.99]
Macaulay 2008	9	23	5	17	19.3%	1.33 [0.54, 3.26]
Mouzopoulos 2008	13	43	15	43	50.4%	0.87 [0.47, 1.60]
Subtotal (95% CI)		**176**		**169**	**100.0%**	**1.23 [0.80, 1.87]**
Total events	38		29			
Heterogeneity: Chi² = 2.33, df = 3 (P = 0.51); I² = 0%						
Test for overall effect: Z = 0.95 (P = 0.34)						

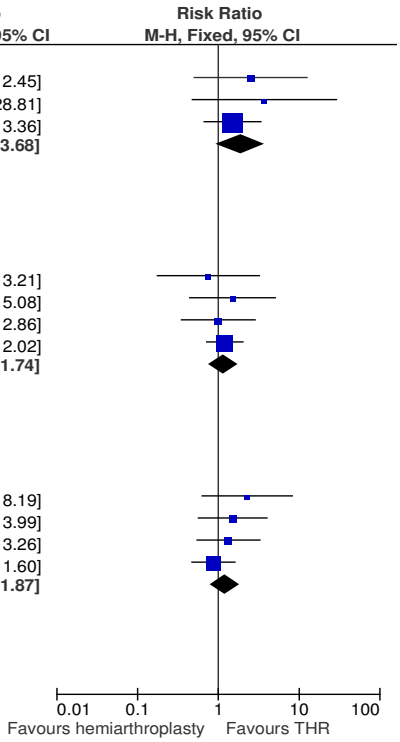


Figure G-88. Reoperations - all: Hemiarthroplasty versus total hip replacement

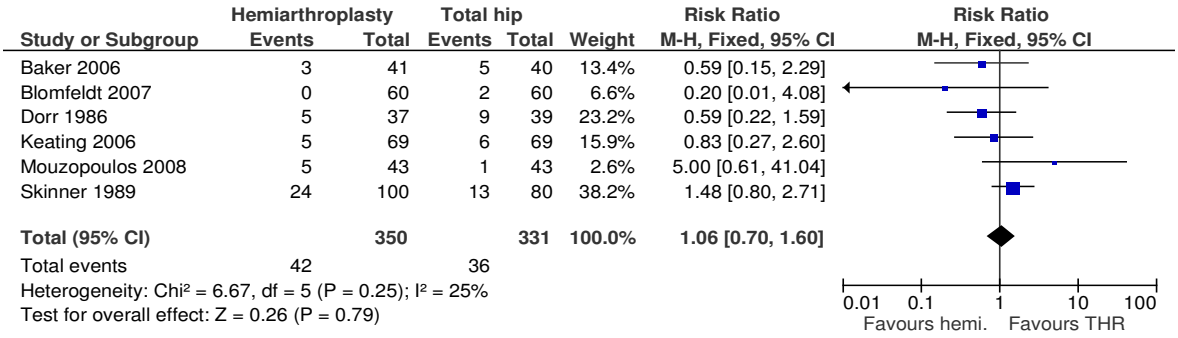


Figure G-89. Number of patients reporting pain at 1 year: Hemiarthroplasty versus total hip replacement

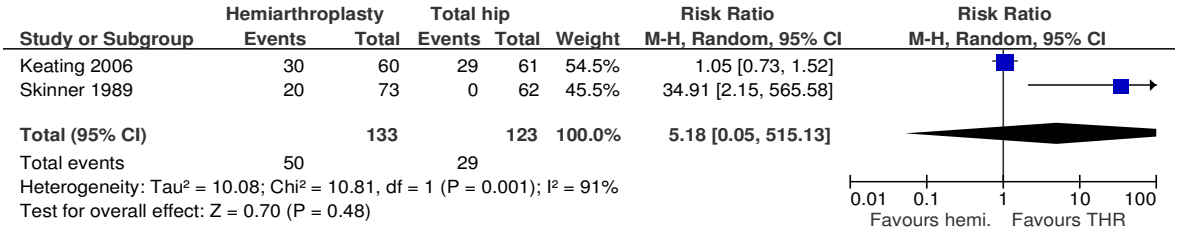


Figure G-90. Pain scores: Hemiarthroplasty versus total hip replacement

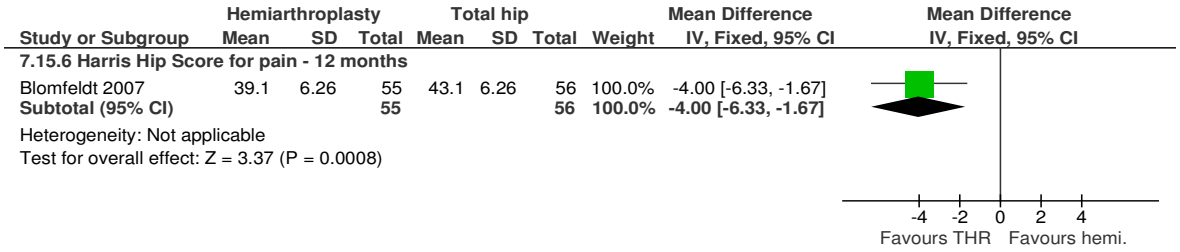


Figure G-91. Failure to regain mobility at end of study: Hemiarthroplasty versus total hip replacement

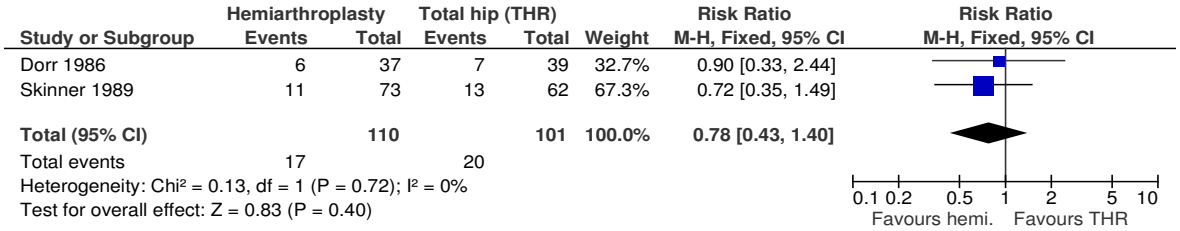


Figure G-92. Functional scores (lower scores advantageous): Hemiarthroplasty versus total hip replacement

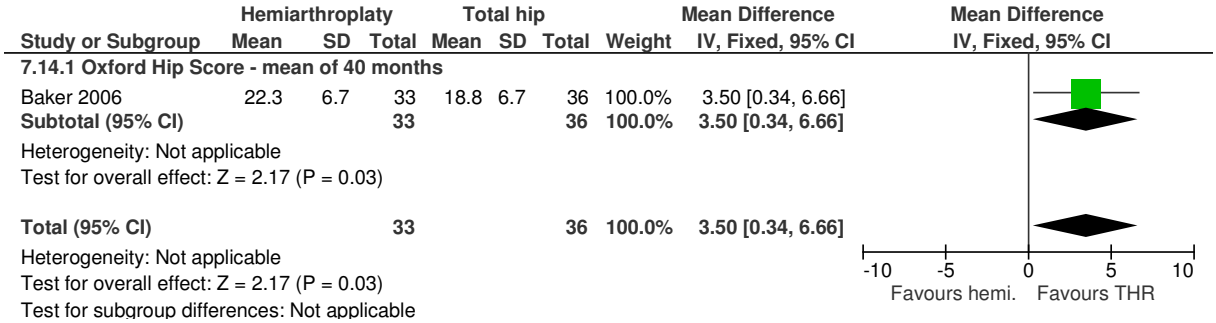


Figure G-93. Functional status (higher scores advantageous): Hemiarthroplasty versus total hip replacement

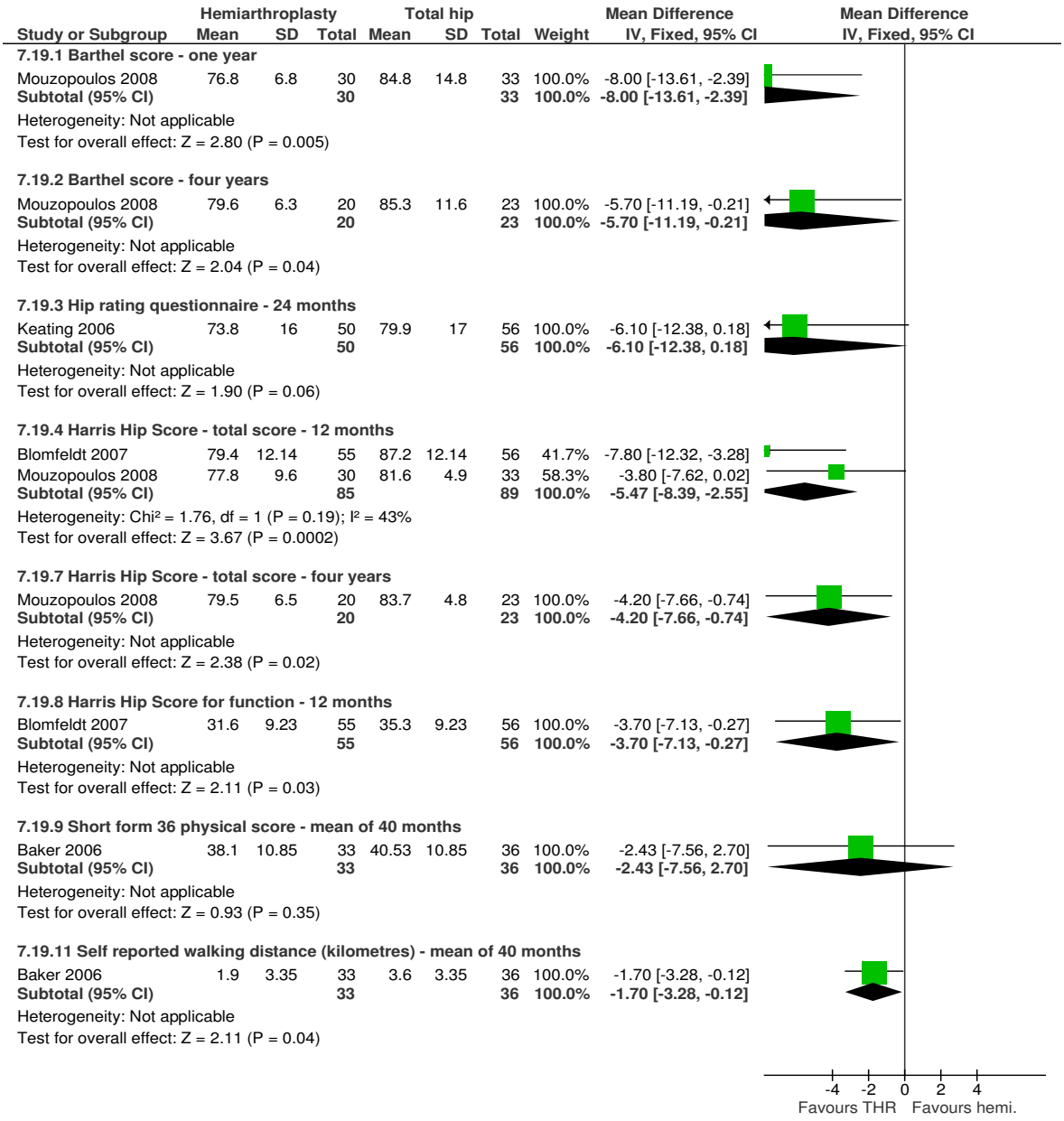


Figure G-94. Quality of life scores: Hemiarthroplasty versus total hip replacement

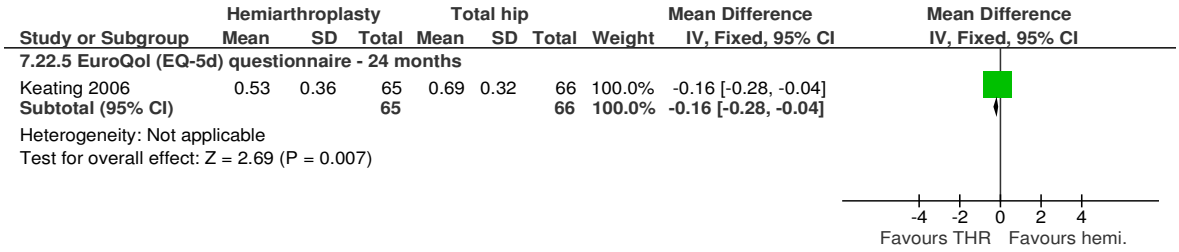
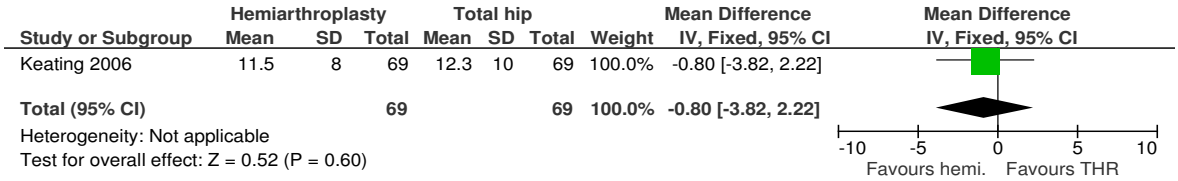


Figure G-95. Length of hospital stay: Hemiarthroplasty versus total hip replacement



19.5.7 Trochanteric extracapsular fracture – all studies

Figure G-96. 30 days mortality: Intramedullary implants versus extramedullary implants

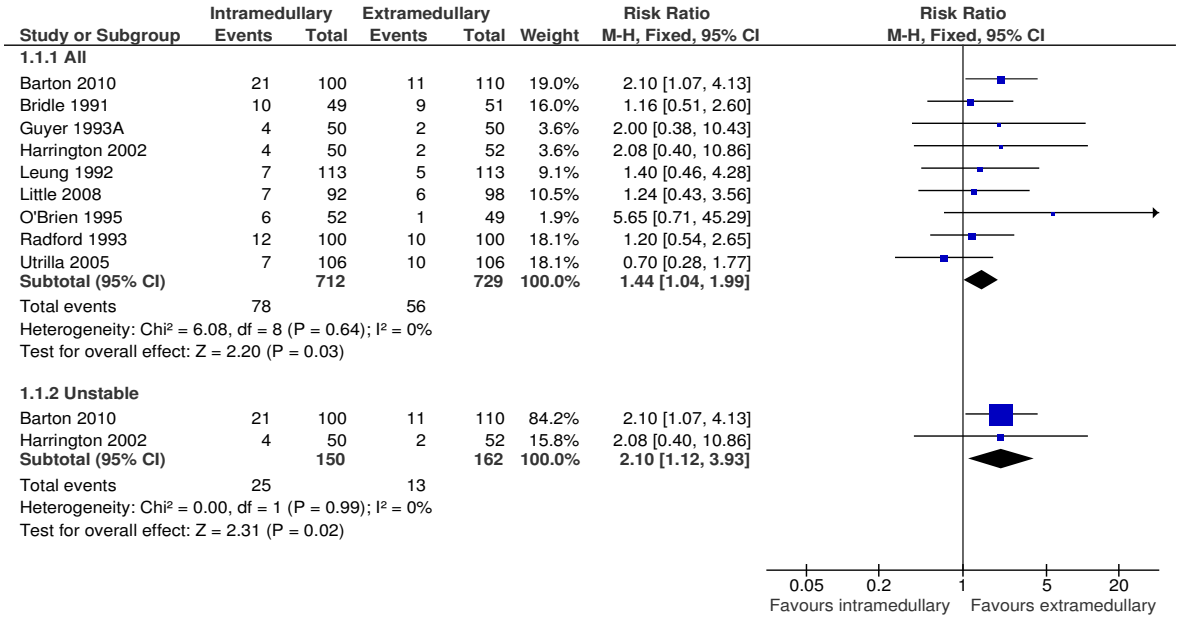


Figure G-97. 3 months mortality: Intramedullary implants versus extramedullary implants

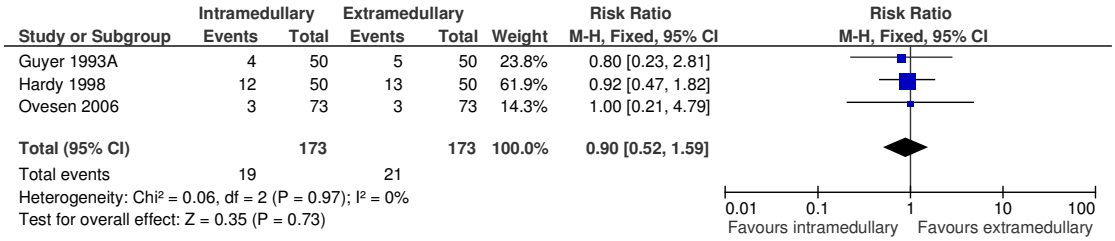


Figure G-98. 12 months mortality: Intramedullary implants versus extramedullary implants

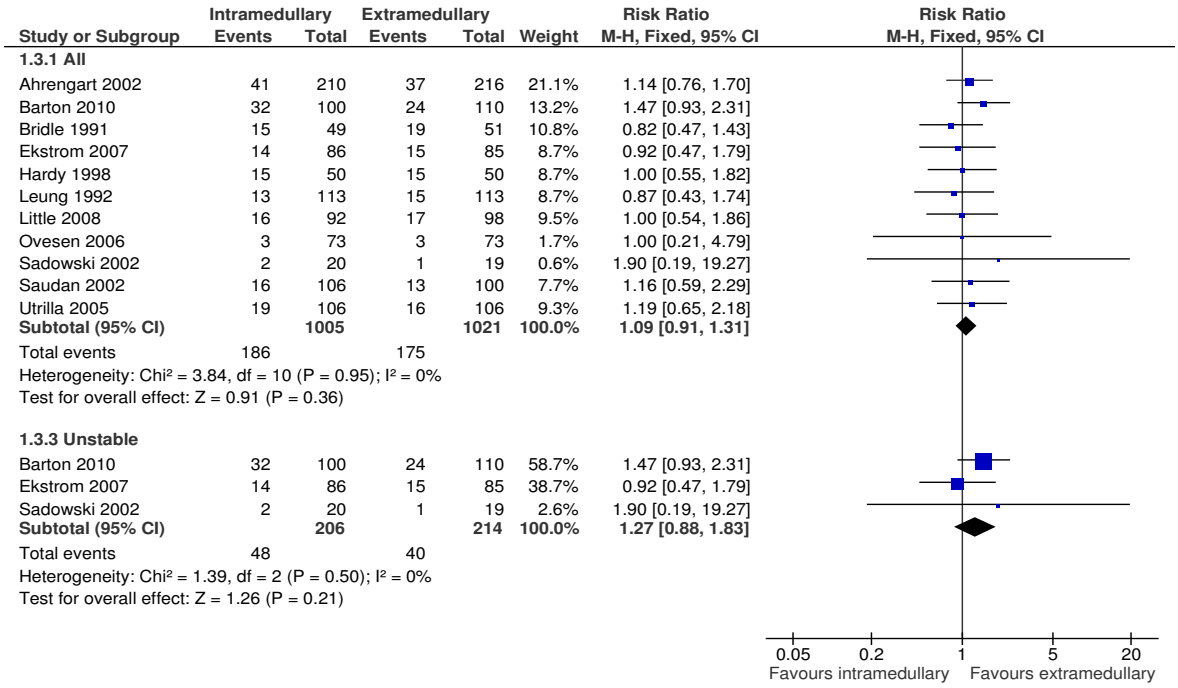


Figure G-99. Reoperation – within the follow up period of the study: Intramedullary implants versus extramedullary implants

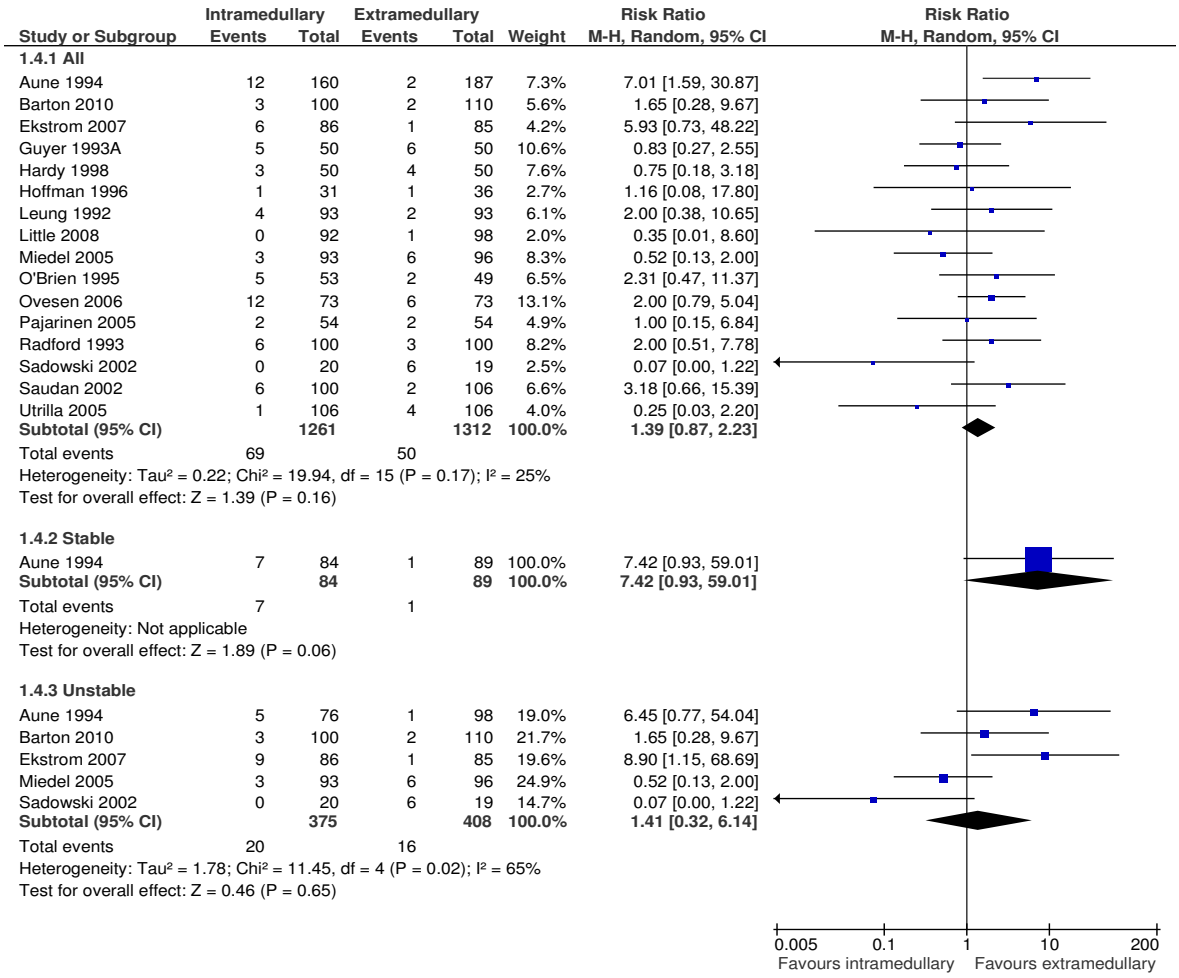


Figure G-100. Operative or postoperative fracture of femur - within the follow up period of the study: Intramedullary implants versus extramedullary implants

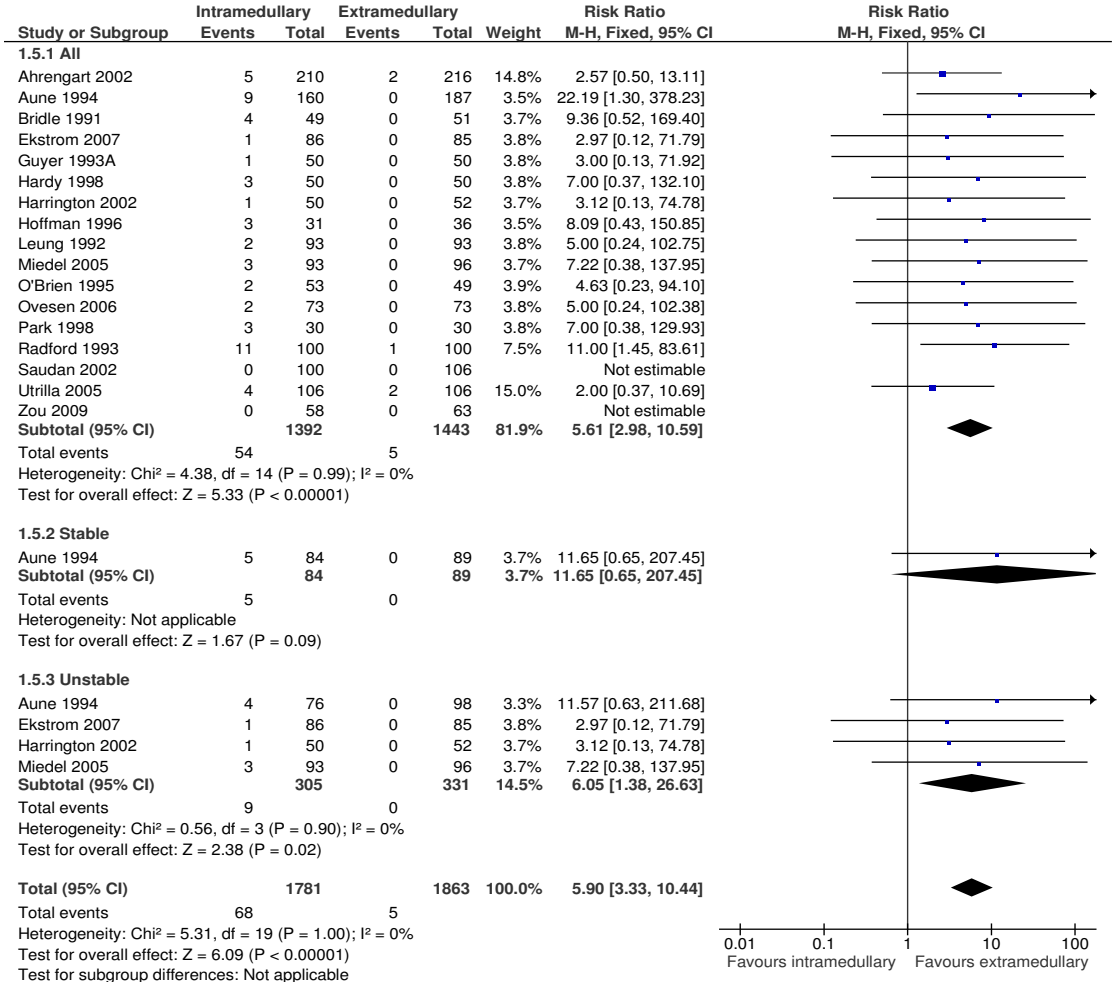


Figure G-101. Cut-out (at latest follow up): Intramedullary implants versus extramedullary implants

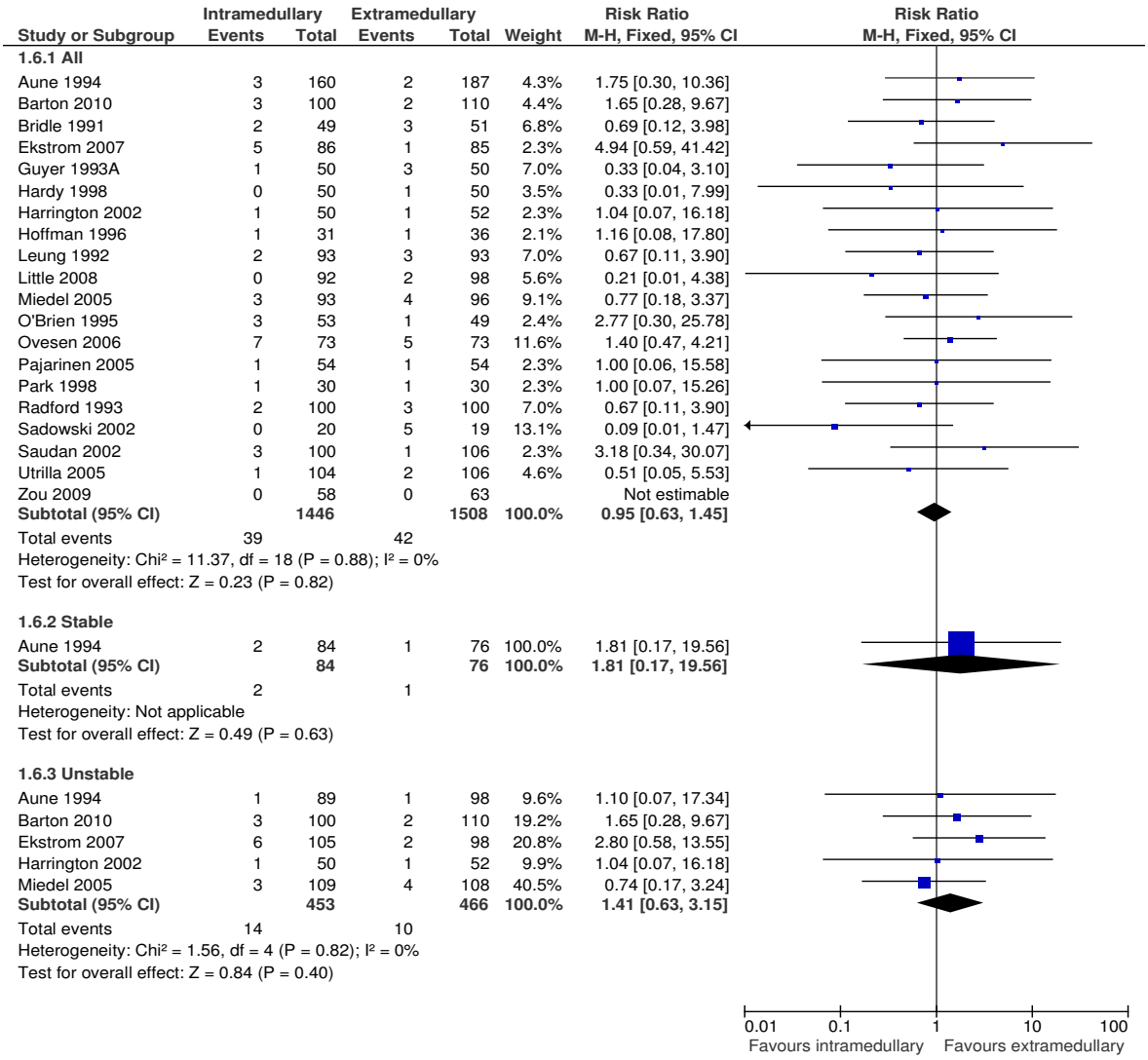


Figure G-102. Infection (deep infection or requires reoperation – at latest follow up): Intramedullary implants versus extramedullary implants

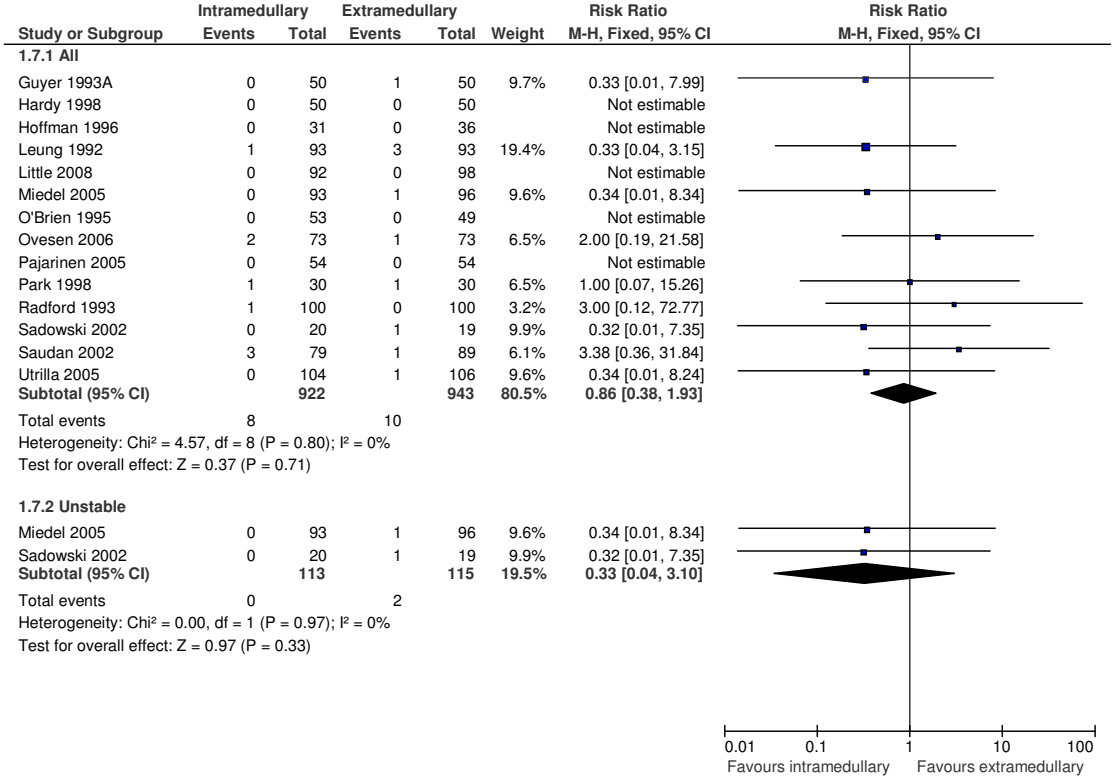


Figure G-103. Non-union (at latest follow-up): Intramedullary implants versus extramedullary implants

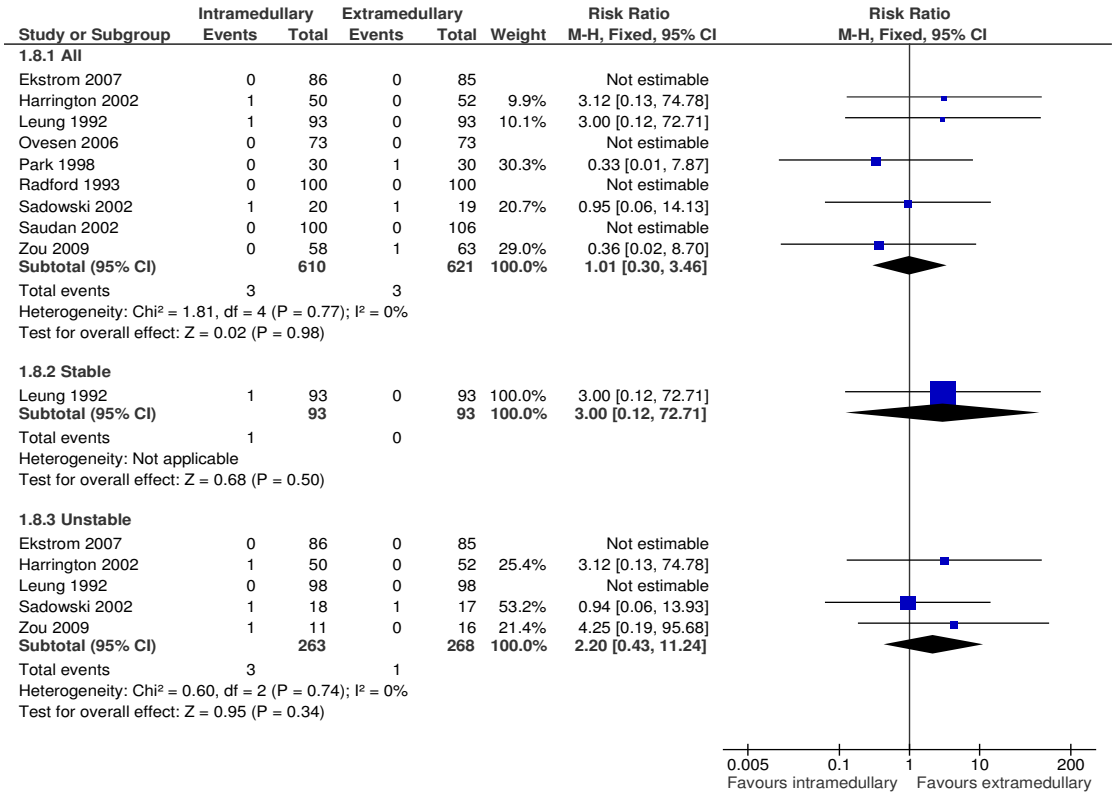


Figure G-104. Pain – patient reported outcomes: Intramedullary implants versus extramedullary implants

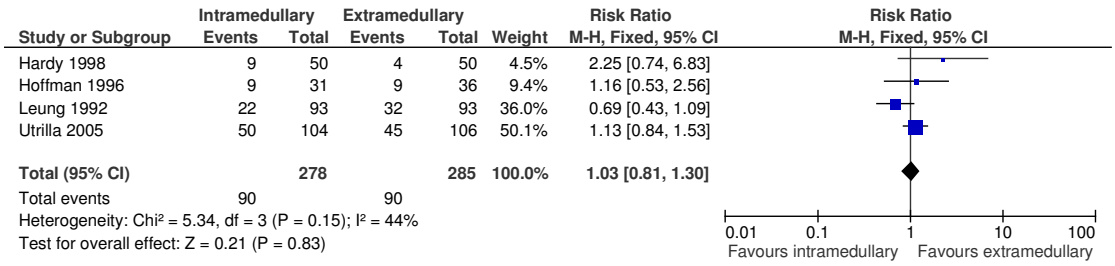


Figure G-105. Length of stay in hospital (in days): Intramedullary implants versus extramedullary implants

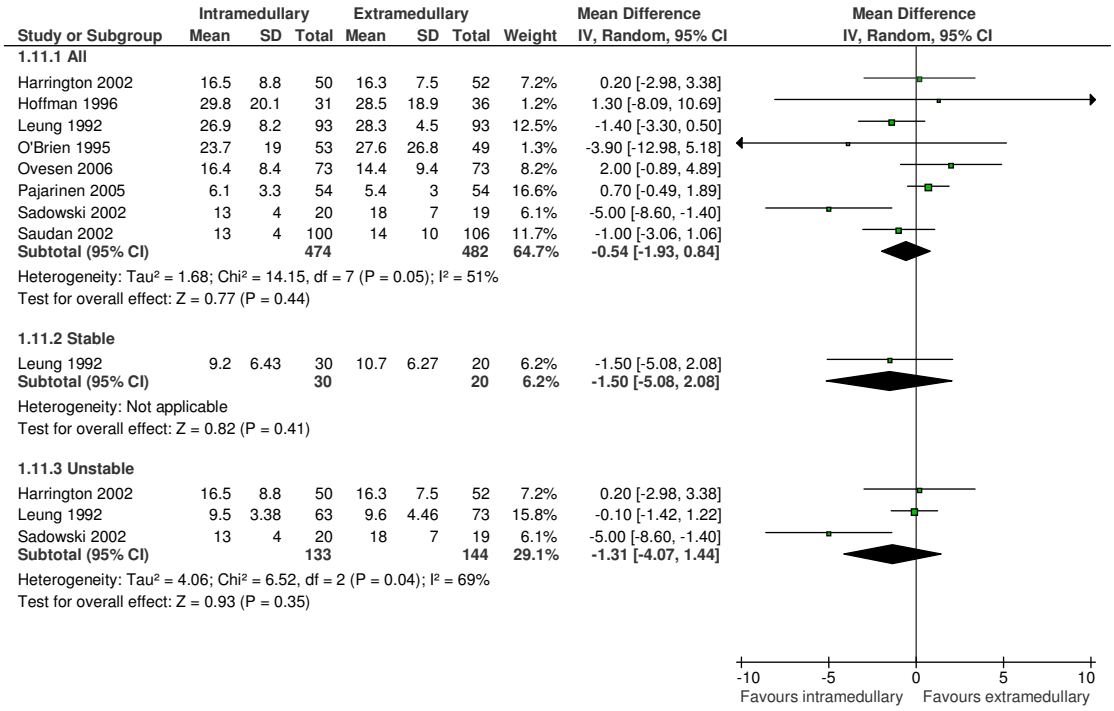
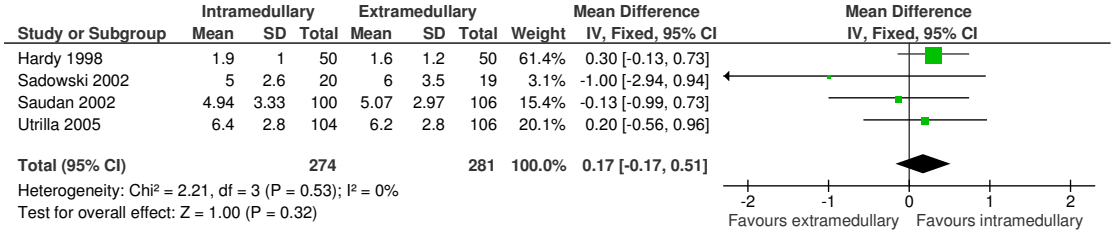


Figure G-106. Mean mobility score (Parker Palmer score): Intramedullary implants versus extramedullary implants



19.5.8 Trochanteric extracapsular fracture – studies from 2000

Figure G-107. 30 days mortality: Intramedullary implants versus extramedullary implants

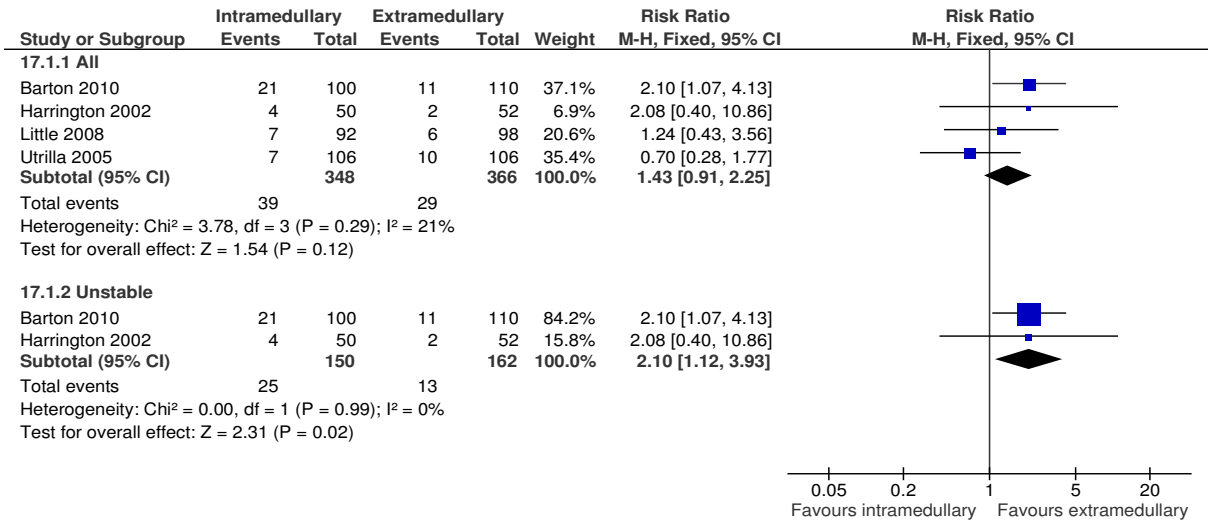


Figure G-108. 3 months mortality: Intramedullary implants versus extramedullary implants

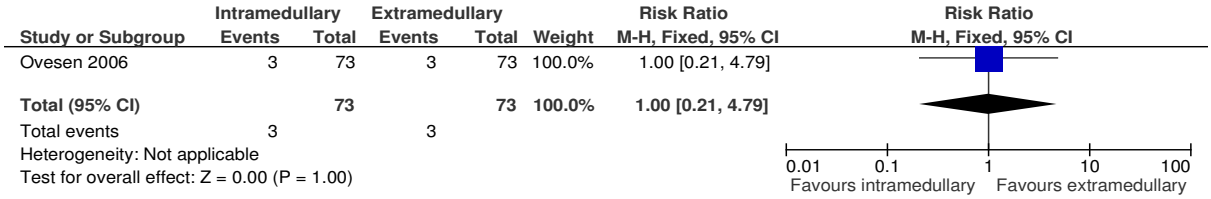


Figure G-109. 12 months mortality: Intramedullary implants versus extramedullary implants

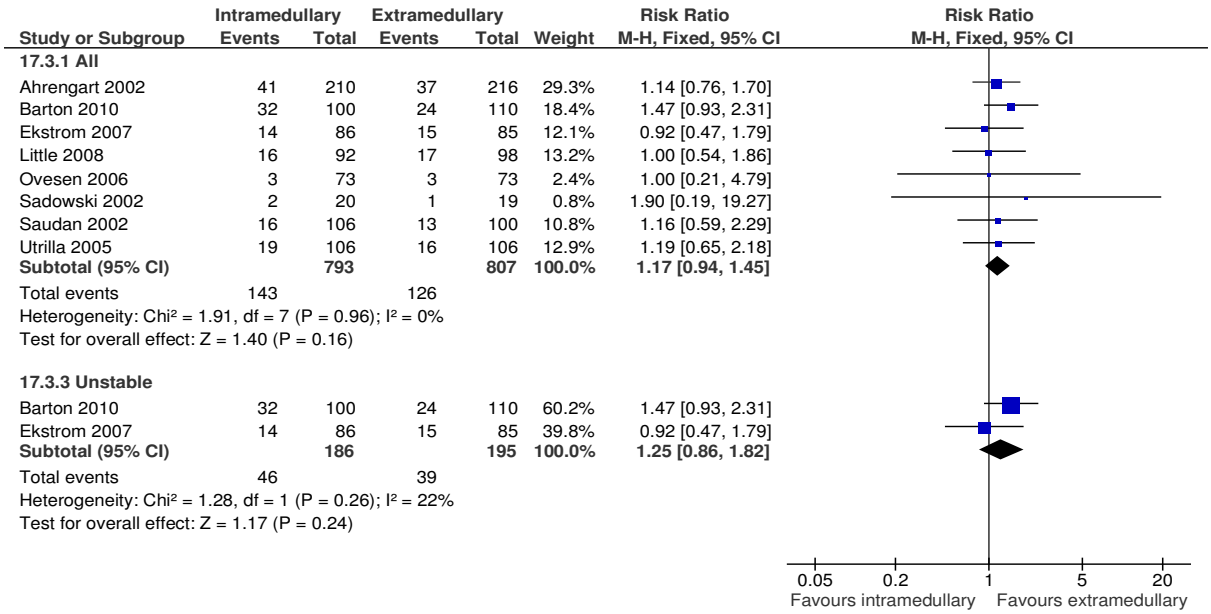


Figure G-110. Reoperation – within the follow up period of the study: Intramedullary implants versus extramedullary implants

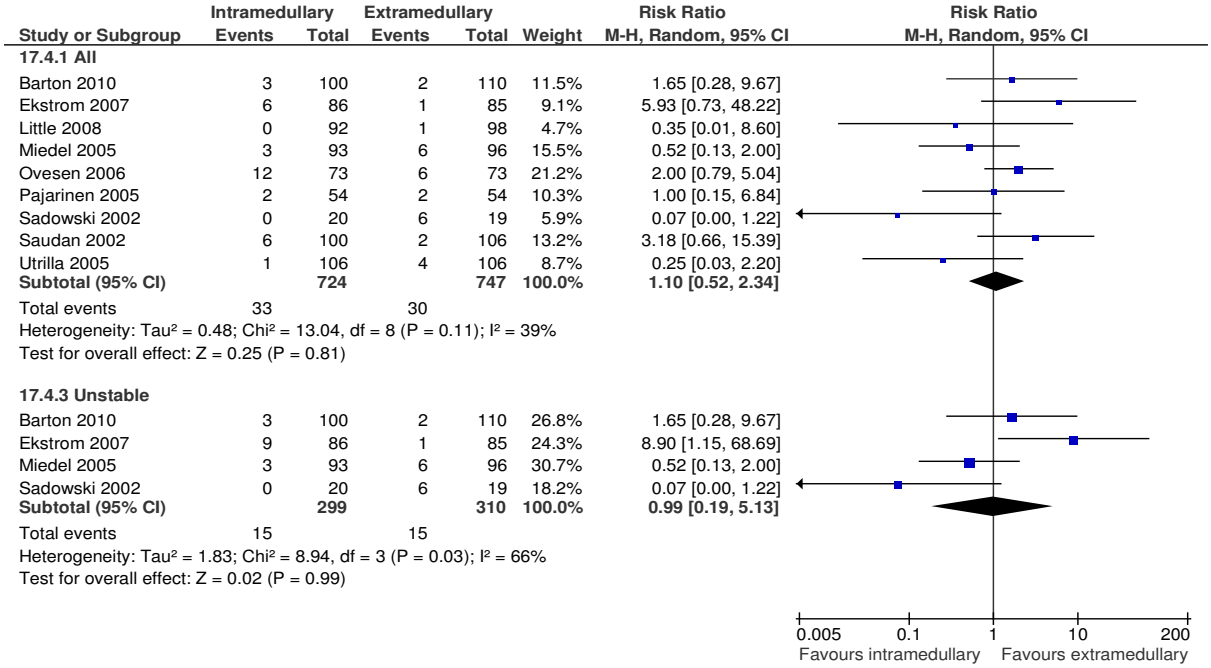


Figure G-111. Operative or postoperative fracture of femur - within the follow up period of the study: Intramedullary implants versus extramedullary implants

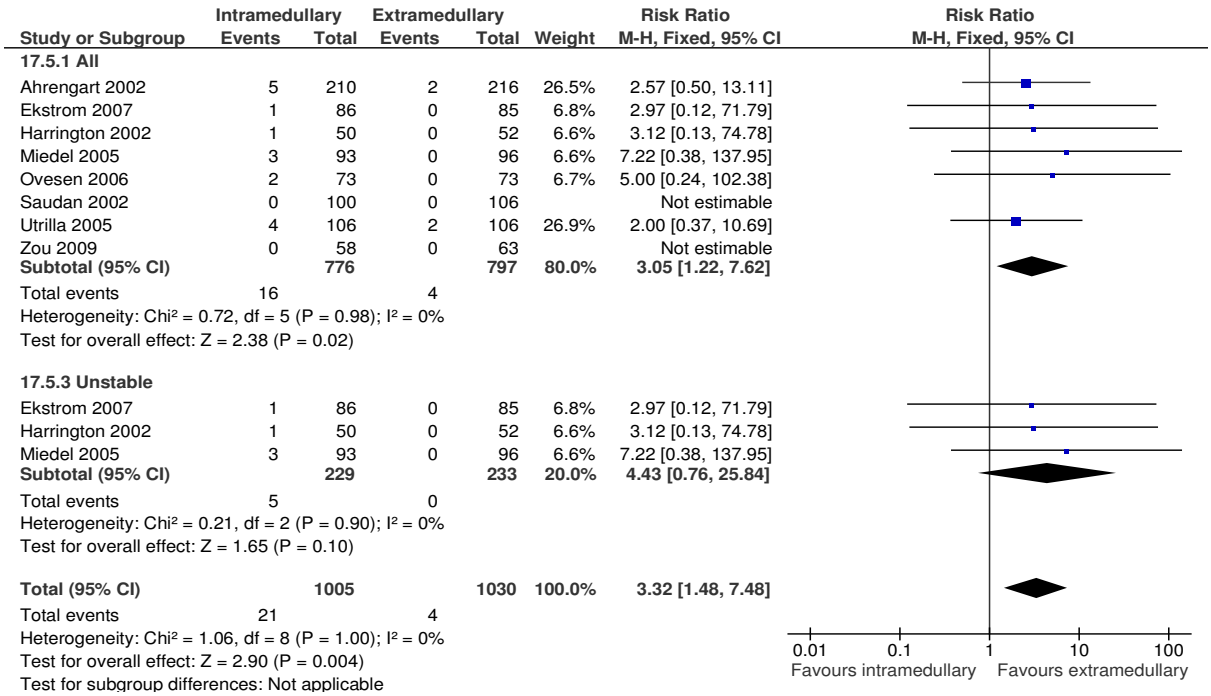

Intramedullary
Extramedullary
Risk Ratio
Risk Ratio
Study or Subgroup Events Total Events Total Weight M-H, Fixed, 95% CI
M-H, Fixed, 95% CI
17.5.1 All
Ahrengart 2002 5 210 2 216 26.5% 2.57 [0.50, 13.11]
Ekstrom 2007 1 86 0 85 6.8% 2.97 [0.12, 71.79]
Harrington 2002 1 50 0 52 6.6% 3.12 [0.13, 74.78]
Miedel 2005 3 93 0 96 6.6% 7.22 [0.38, 137.95]
Ovesen 2006 2 73 0 73 6.7% 5.00 [0.24, 102.38]
Saudan 2002 0 100 0 106 Not estimable
Utrilla 2005 4 106 2 106 26.9% 2.00 [0.37, 10.69]
Zou 2009 0 58 0 63 Not estimable
Subtotal (95% CI) 776 797 80.0% 3.05 [1.22, 7.62]
Total events 16 4
Heterogeneity: Chi² = 0.72, df = 5 (P = 0.98); I² = 0%
Test for overall effect: Z = 2.38 (P = 0.02)
17.5.3 Unstable
Ekstrom 2007 1 86 0 85 6.8% 2.97 [0.12, 71.79]
Harrington 2002 1 50 0 52 6.6% 3.12 [0.13, 74.78]
Miedel 2005 3 93 0 96 6.6% 7.22 [0.38, 137.95]
Subtotal (95% CI) 229 233 20.0% 4.43 [0.76, 25.84]
Total events 5 0
Heterogeneity: Chi² = 0.21, df = 2 (P = 0.90); I² = 0%
Test for overall effect: Z = 1.65 (P = 0.10)
Total (95% CI) 1005 1030 100.0% 3.32 [1.48, 7.48]
Total events 21 4
Heterogeneity: Chi² = 1.06, df = 8 (P = 1.00); I² = 0%
Test for overall effect: Z = 2.90 (P = 0.004)
Test for subgroup differences: Not applicable
0.01 0.1 1 10 100
Favours intramedullary Favours extramedullary

Figure G-112. Cut-out (at latest follow up): Intramedullary implants versus extramedullary implants

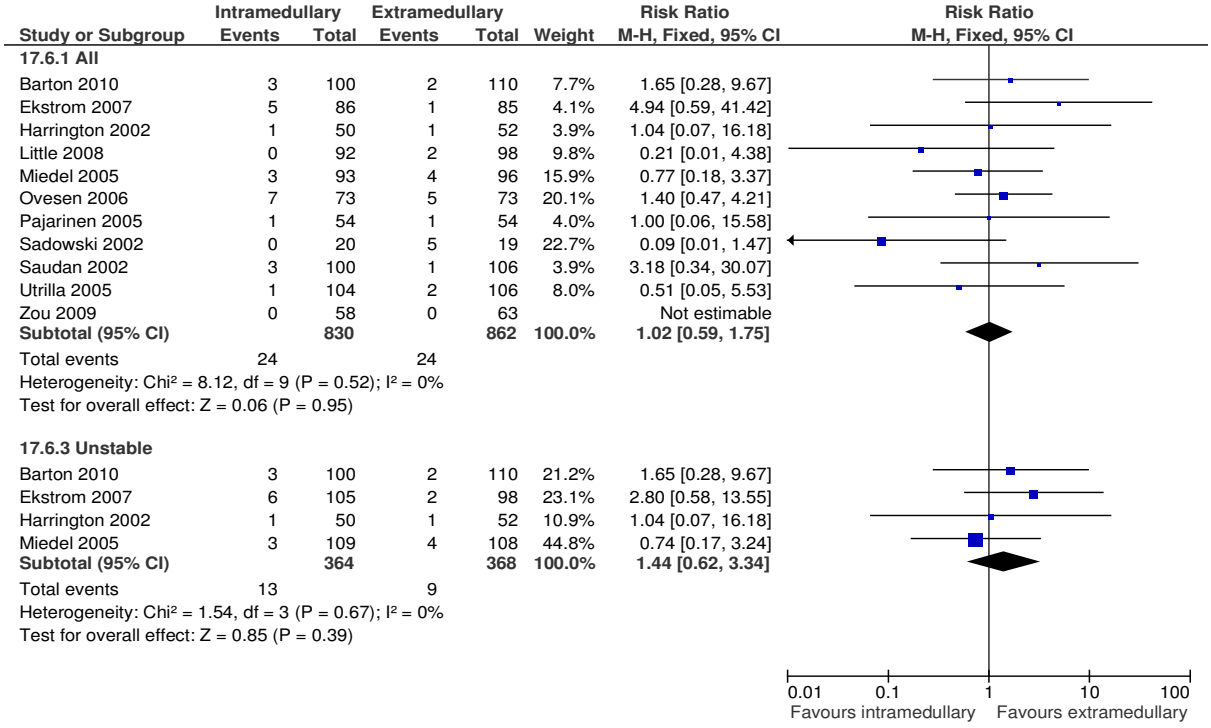


Figure G-113. Infection (deep infection or requires reoperation – at latest follow up): Intramedullary implants versus extramedullary implants

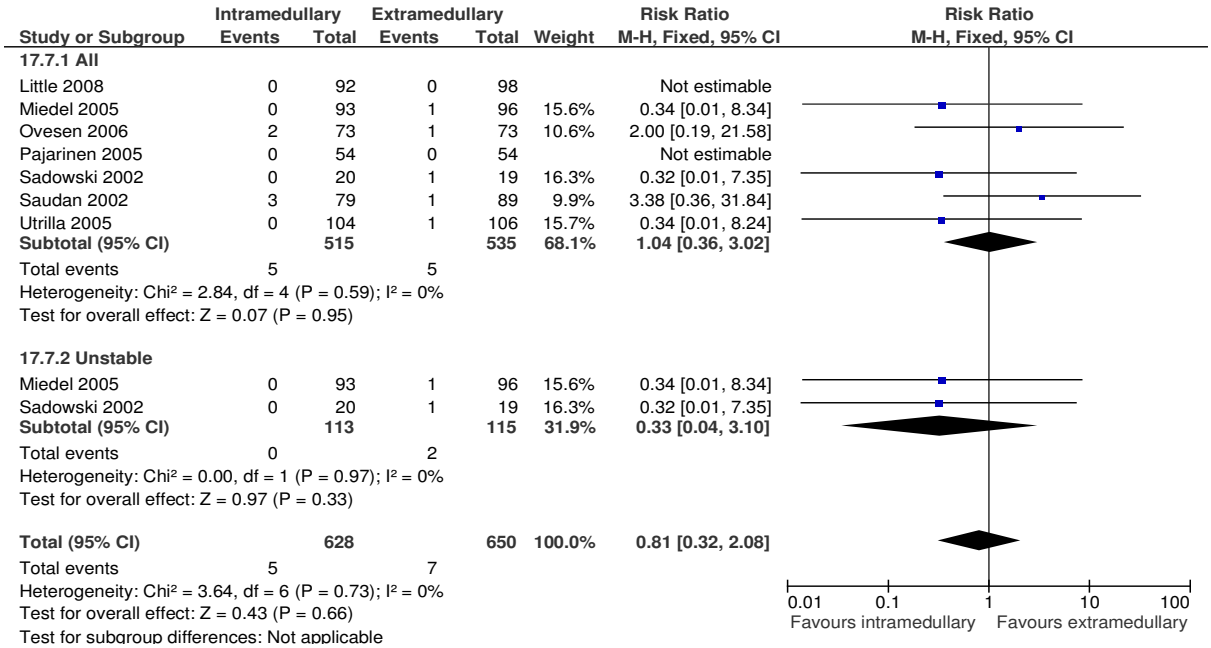


Figure G-114. Non-union (at latest follow-up): Intramedullary implants versus extramedullary implants

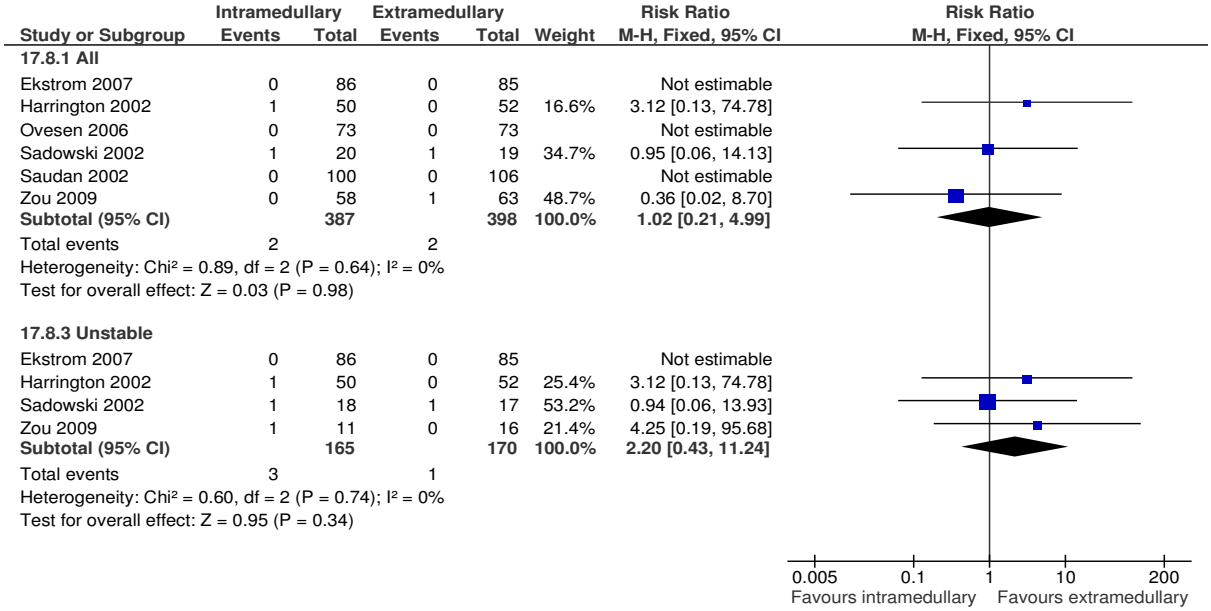


Figure G-115. Pain – patient reported outcomes: Intramedullary implants versus extramedullary implants

Figure G-116. Length of stay in hospital (in days): Intramedullary implants versus extramedullary implants

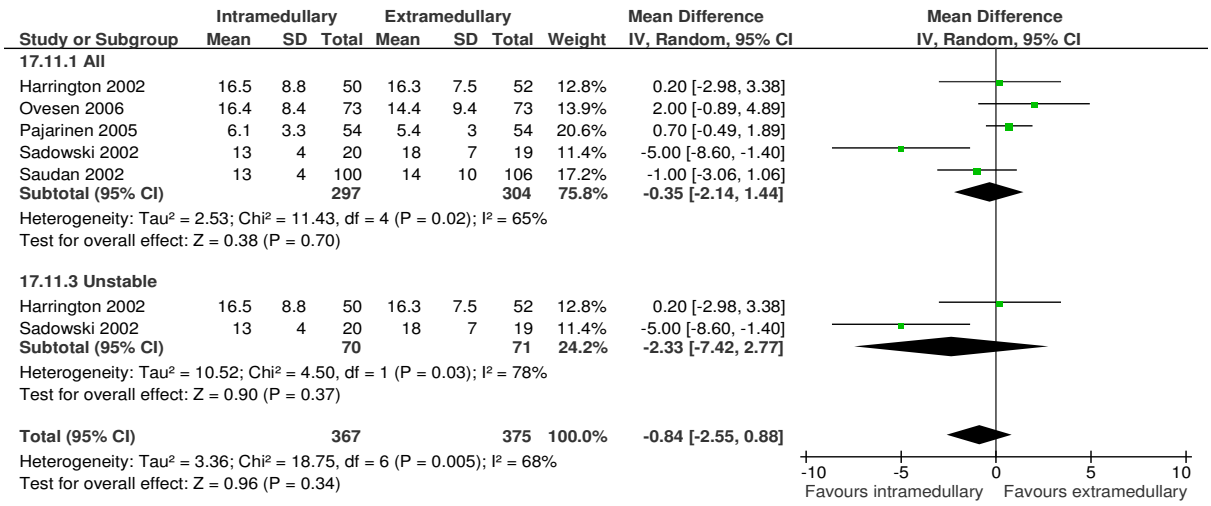
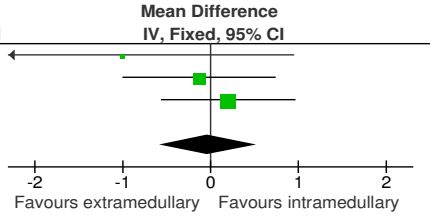


Figure G-117. Mean mobility score (Parker Palmer score): Intramedullary implants versus extramedullary implants

Study or Subgroup	Intramedullary Mean	SD	Total	Extramedullary Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Sadowski 2002	5	2.6	20	6	3.5	19	7.9%	-1.00 [-2.94, 0.94]
Saudan 2002	4.94	3.33	100	5.07	2.97	106	40.0%	-0.13 [-0.99, 0.73]
Utrilla 2005	6.4	2.8	104	6.2	2.8	106	52.0%	0.20 [-0.56, 0.96]
Total (95% CI)			**224**			**231**	**100.0%**	**-0.03 [-0.57, 0.52]**

Heterogeneity: Chi² = 1.36, df = 2 (P = 0.51); I² = 0%
Test for overall effect: Z = 0.10 (P = 0.92)



19.5.9 Subtrochanteric extracapsular fracture.

Figure G-118. Mortality at 12 months: Intramedullary implants versus extramedullary implants

Study or Subgroup	Intramedullary Events	Total	Extramedullary Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
2.1.3 12 months						
Ekstrom 2007	1	19	3	13	45.4%	0.23 [0.03, 1.96]
Rahme 2007	6	29	2	29	54.6%	3.00 [0.66, 13.65]
Subtotal (95% CI)		**48**		**42**	**100.0%**	**0.93 [0.08, 11.52]**
Total events	7		5			
Heterogeneity: Tau² = 2.42; Chi² = 3.69, df = 1 (P = 0.05); I² = 73%						
Test for overall effect: Z = 0.06 (P = 0.96)						
Total (95% CI)		**48**		**42**	**100.0%**	**0.93 [0.08, 11.52]**
Total events	7		5			
Heterogeneity: Tau² = 2.42; Chi² = 3.69, df = 1 (P = 0.05); I² = 73%						
Test for overall effect: Z = 0.06 (P = 0.96)						

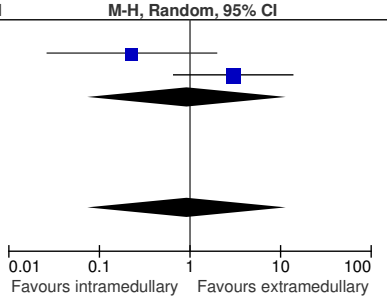


Figure G-119. Reoperation within follow up period of the study: Intramedullary implants versus extramedullary implants

Study or Subgroup	Intramedullary Events	Total	Extramedullary Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Aune 1994	1	14	0	17	23.6%	3.60 [0.16, 82.05]
Ekstrom 2007	3	19	0	13	25.3%	4.90 [0.27, 87.59]
Miedel 2005	0	16	3	12	25.3%	0.11 [0.01, 1.93]
Rahme 2007	0	29	8	29	25.8%	0.06 [0.00, 0.97]
Total (95% CI)		**78**		**71**	**100.0%**	**0.56 [0.06, 5.47]**
Total events	4		11			
Heterogeneity: Tau² = 3.23; Chi² = 7.36, df = 3 (P = 0.06); I² = 59%						
Test for overall effect: Z = 0.50 (P = 0.61)						

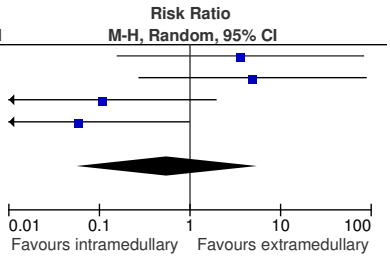


Figure G-120. Infection (deep infection or requires reoperation – at latest follow up): Intramedullary implants versus extramedullary implants

Study or Subgroup	Intramedullary Events	Total	Extramedullary Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Miedel 2005	0	16	1	12	63.0%	0.25 [0.01, 5.76]
Rahme 2007	3	29	1	29	37.0%	3.00 [0.33, 27.18]
Total (95% CI)		**45**		**41**	**100.0%**	**1.27 [0.28, 5.88]**
Total events	3		2			
Heterogeneity: Chi² = 1.60, df = 1 (P = 0.21); I² = 38%						
Test for overall effect: Z = 0.31 (P = 0.76)						

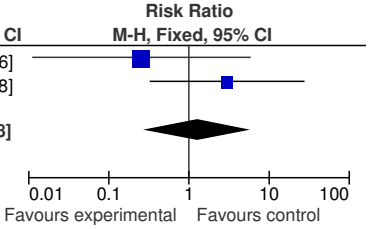
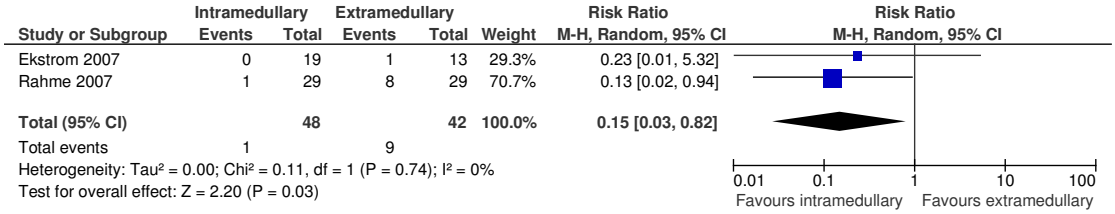


Figure G-121. Cut-out (at latest follow up): Intramedullary implants versus extramedullary implants

Figure G-122. Non-union (at latest follow up): Intramedullary implants versus extramedullary implants



19.6 Mobilisation strategies

19.6.1 Timing of mobilisation

Figure G-123. Independent to transfer at day 7: Early versus delayed mobilisation

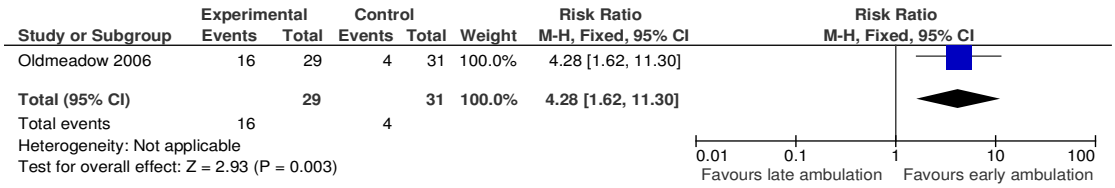


Figure G-124. Independent to step at day 7: Early versus delayed mobilisation

Figure G-125. Discharge to home or rehabilitation programme: Early versus delayed mobilisation

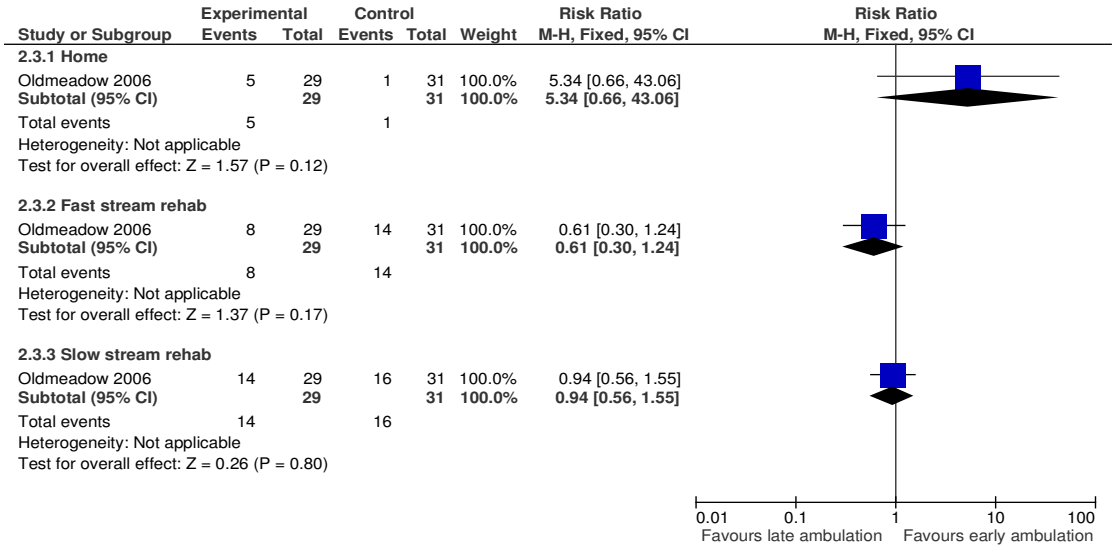
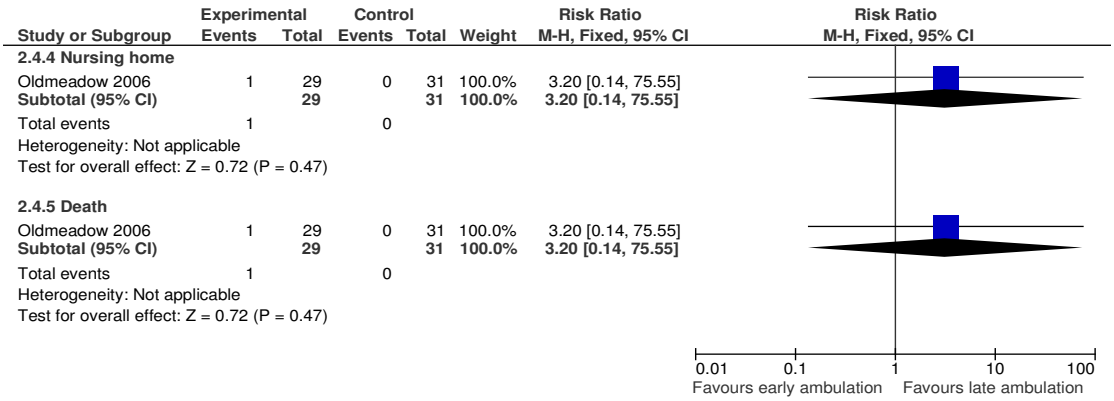


Figure G-126. Discharge to nursing home or died: Early versus delayed mobilisation



19.7 Intensive exercise or physiotherapy vs. usual care

19.7.1 Intensive physiotherapy (Strength training)

Figure G-127. Strength measures: intensive physiotherapy versus usual care

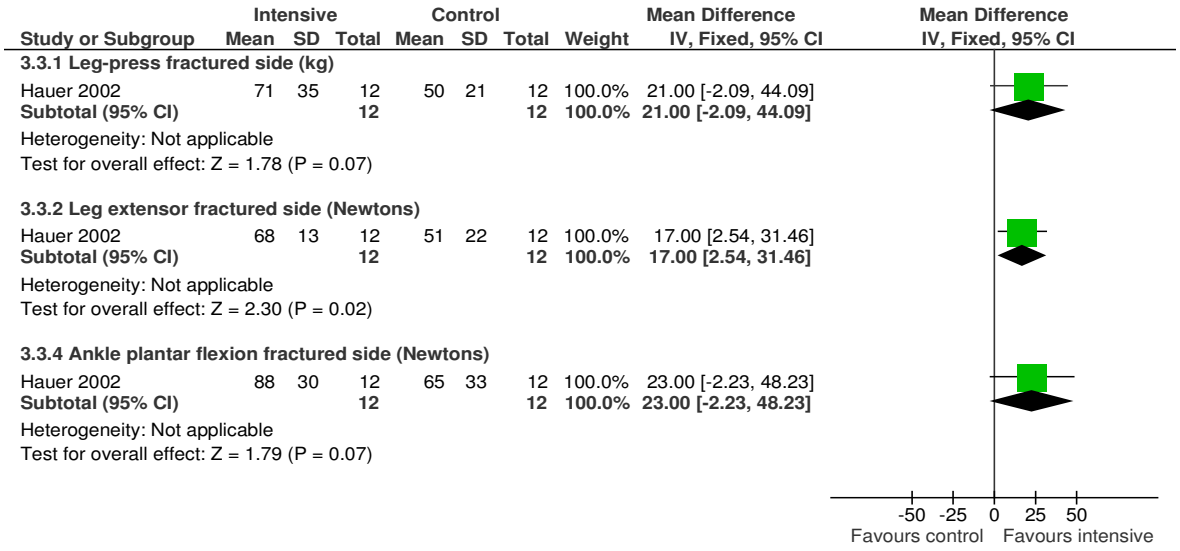


Figure G-128. Tinetti's POMA (Performance Orientated Mobility Assessment): intensive physiotherapy versus usual care

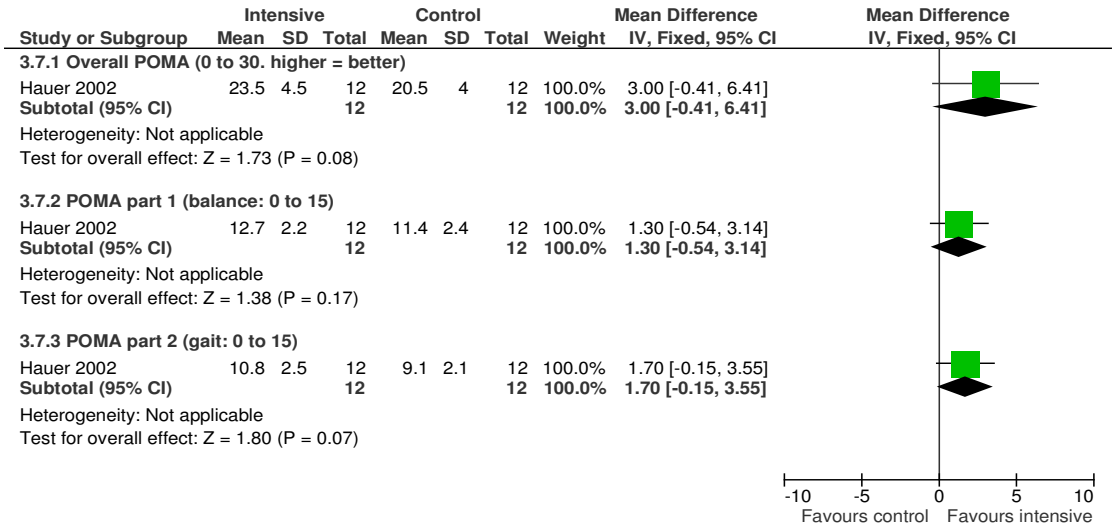


Figure G-129. Functional performance measures: intensive physiotherapy versus usual care

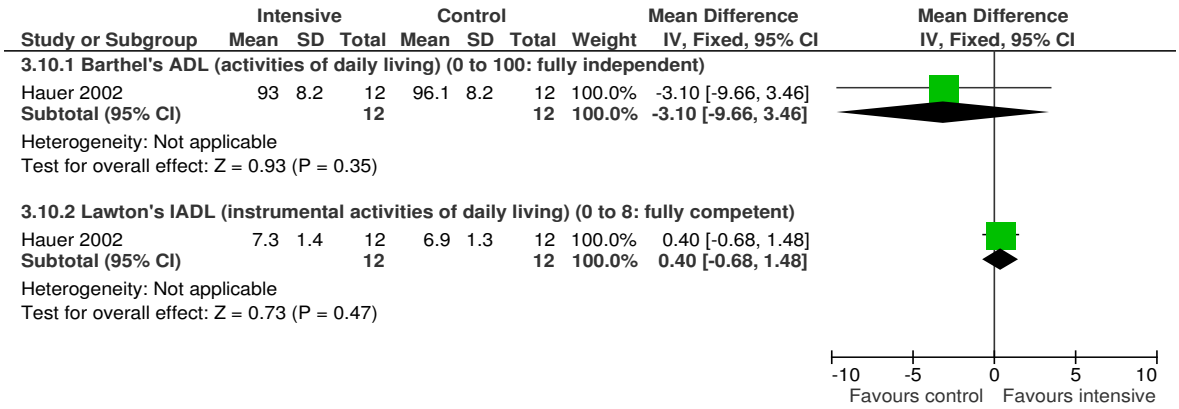


Figure G-130. Functional performance tests: intensive physiotherapy versus usual care

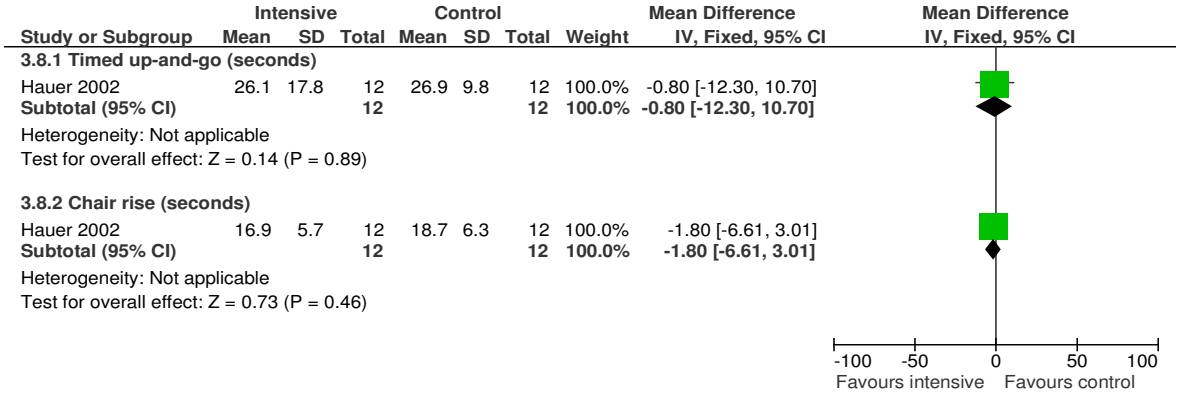
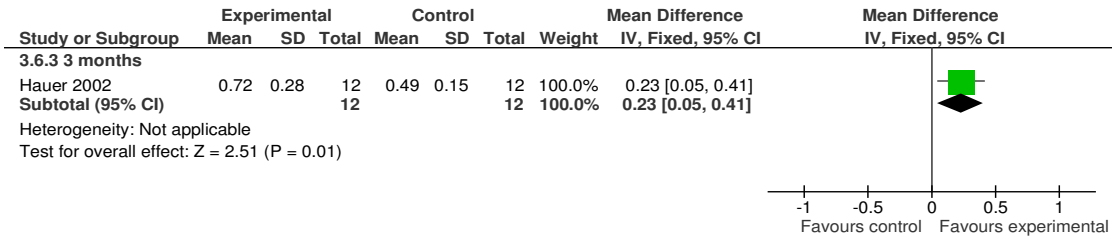


Figure G-131. Walking speed: intensive physiotherapy versus usual care



19.7.2 Intensive physiotherapy (treadmill training)

Figure G-132. Knee extensor strength: intensive physiotherapy versus usual care

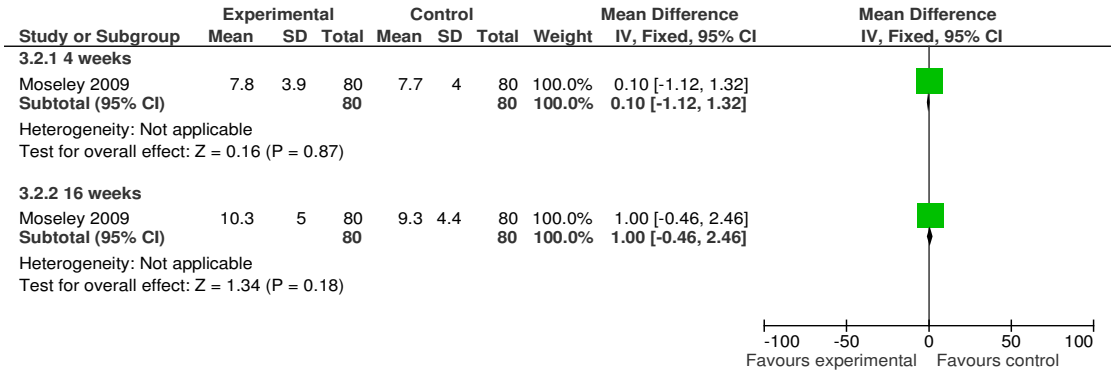


Figure G-133. Functional performance tests: intensive physiotherapy versus usual care

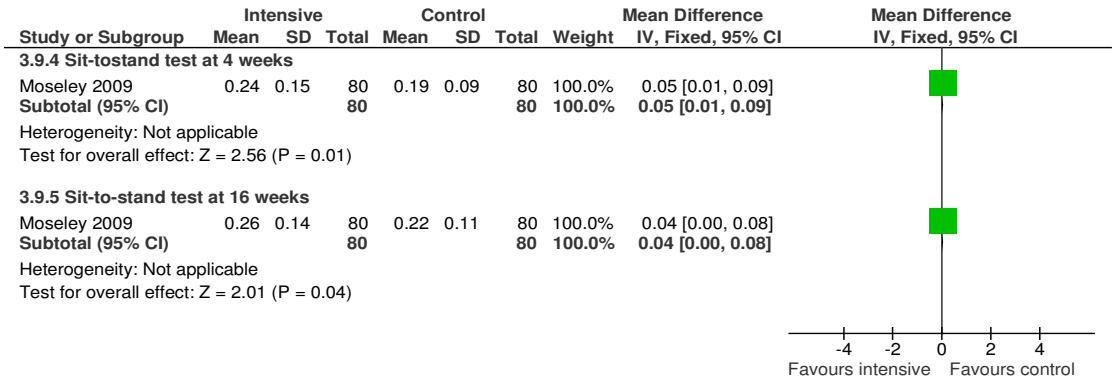


Figure G-134. Quality of life: intensive physiotherapy versus usual care

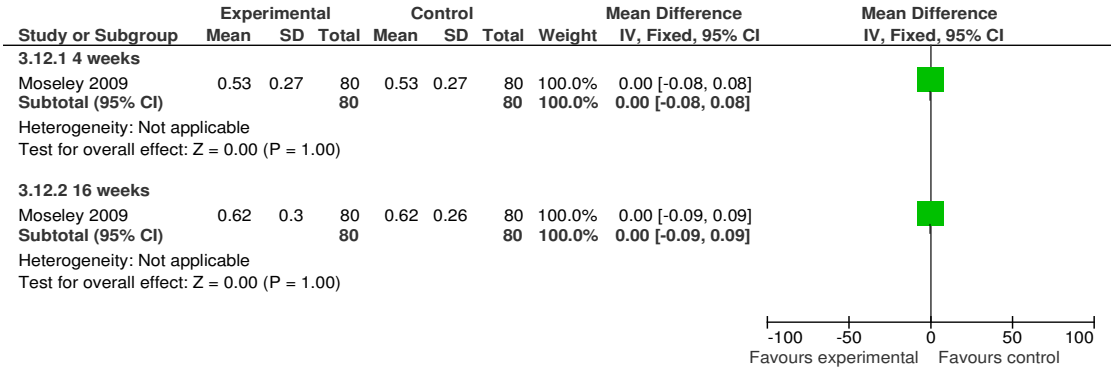


Figure G-135. Walking speed: intensive physiotherapy versus usual care

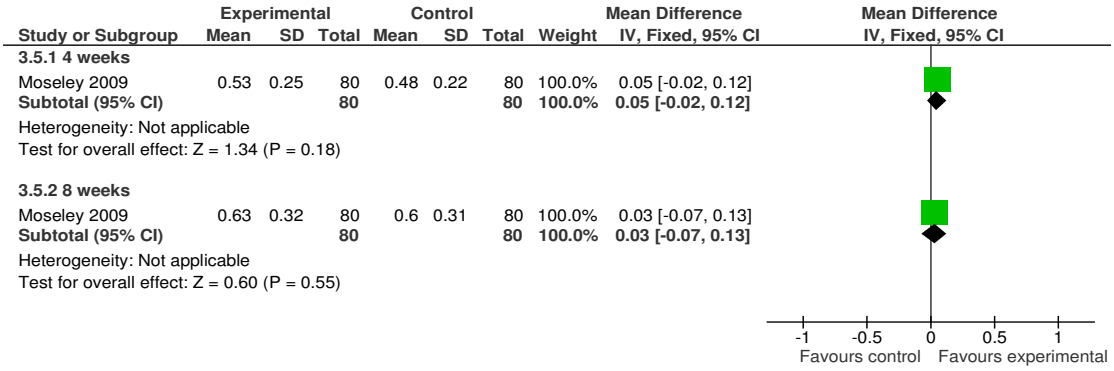


Figure G-136. Pain: intensive physiotherapy versus usual care

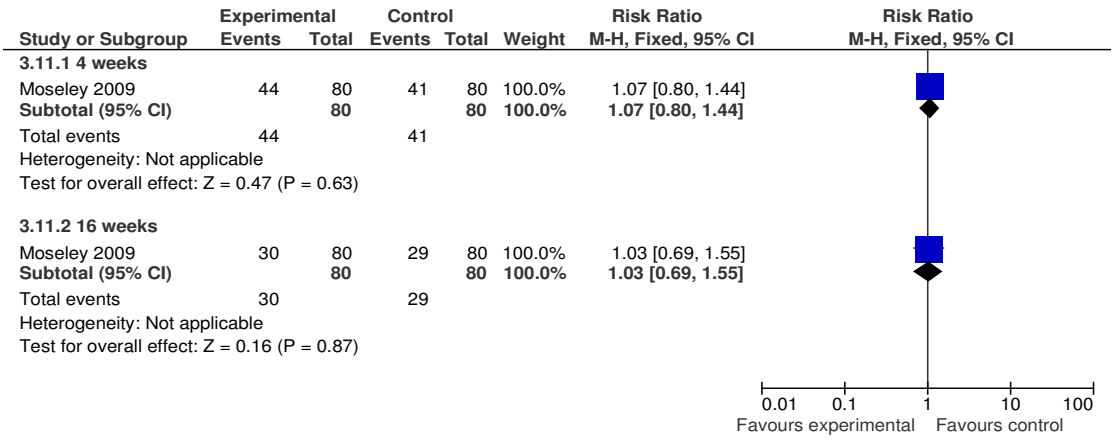
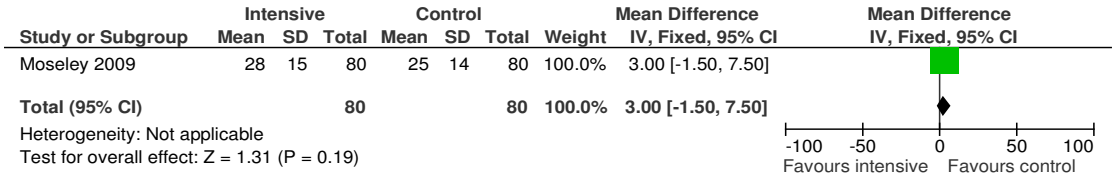


Figure G-137. Length of hospital stay: intensive physiotherapy versus usual care



19.7.3 Intensive (more frequent) physiotherapy

Figure G-138. Adductor muscle strength (kp) at 9 weeks: intensive physiotherapy versus usual care

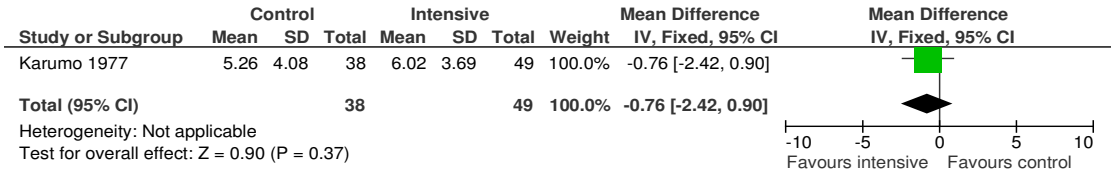
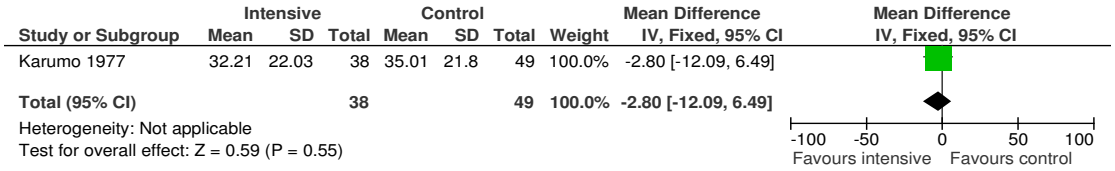


Figure G-139. Length of hospital stay: intensive physiotherapy versus usual care



19.8 Multidisciplinary rehabilitation

19.8.1 Hospital-based MDR

Hospital based MDR has been split into orthogeriatric hospital MDR (including GORU and MARU) and hip fracture programmes.

Figure G-140. Mortality at 6 months: hospital MDR versus usual care

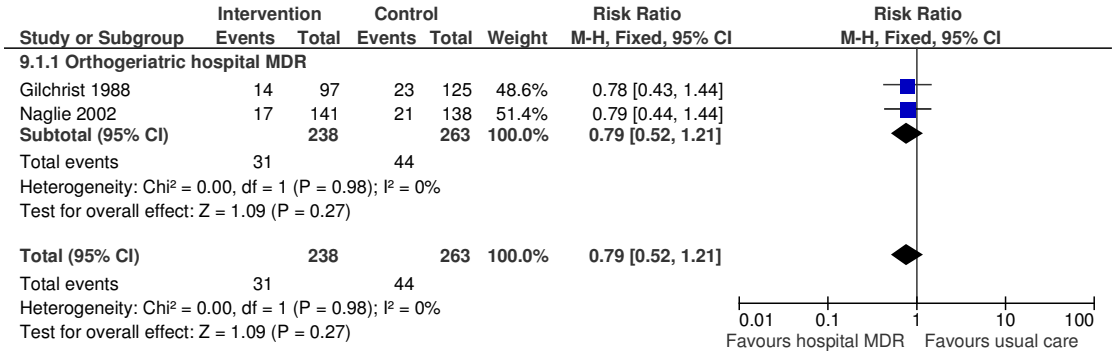


Figure G-141. Mortality at 12 months: hospital MDR versus usual care

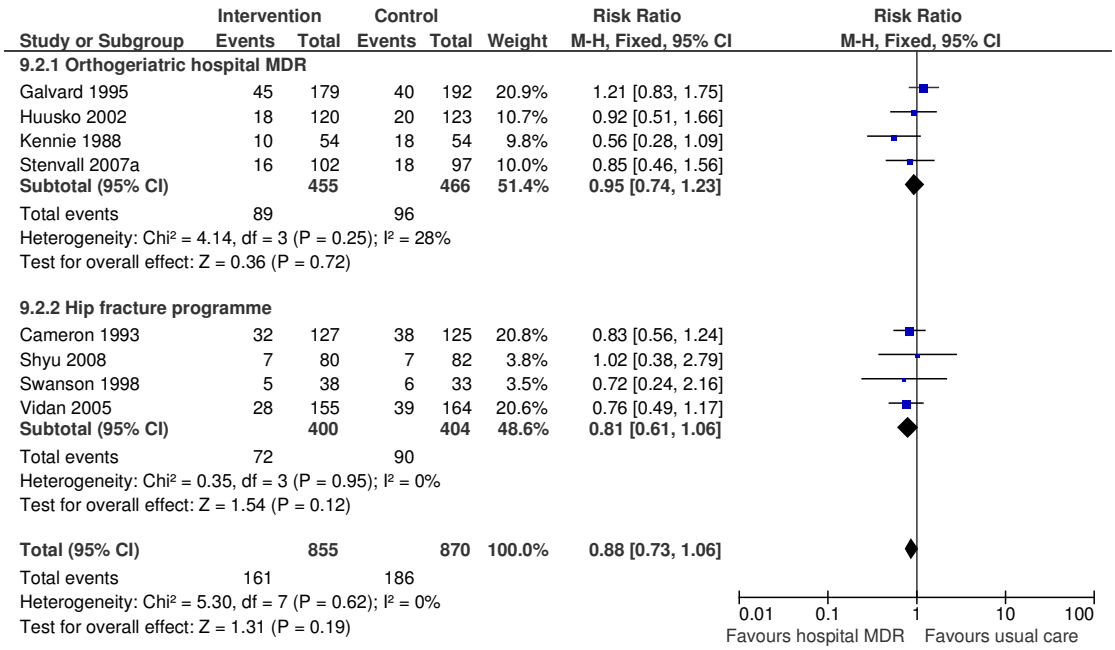


Figure G-142. Mortality (at discharge): hospital MDR versus usual care

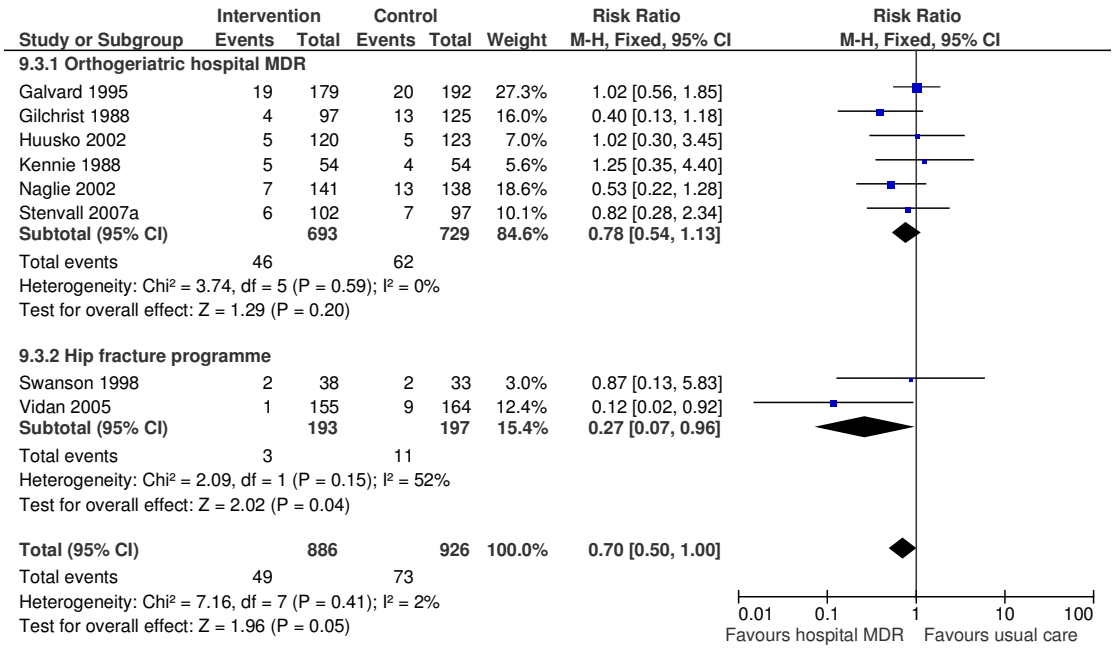


Figure G-143. Functional outcomes at 6 months: orthogeriatric hospital MDR versus usual care

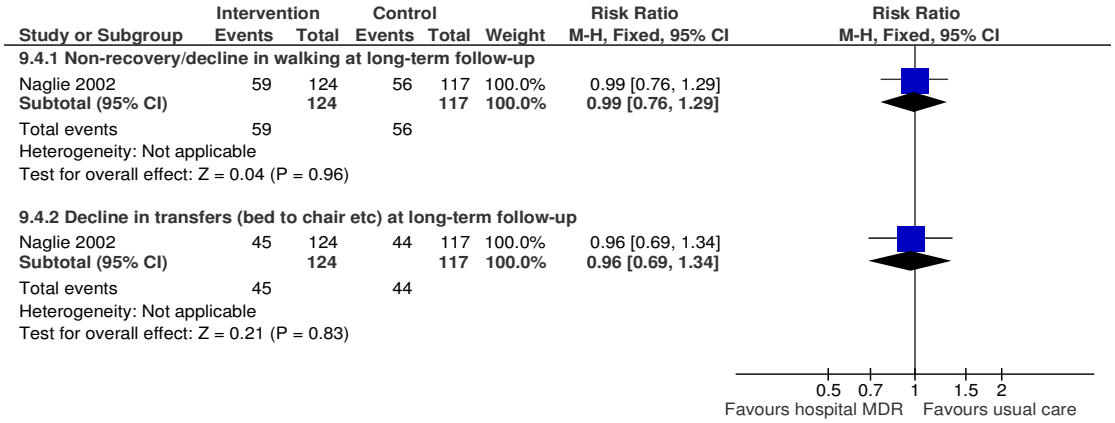


Figure G-144. Functional outcomes at 1 year: orthogeriatric hospital MDR versus usual care

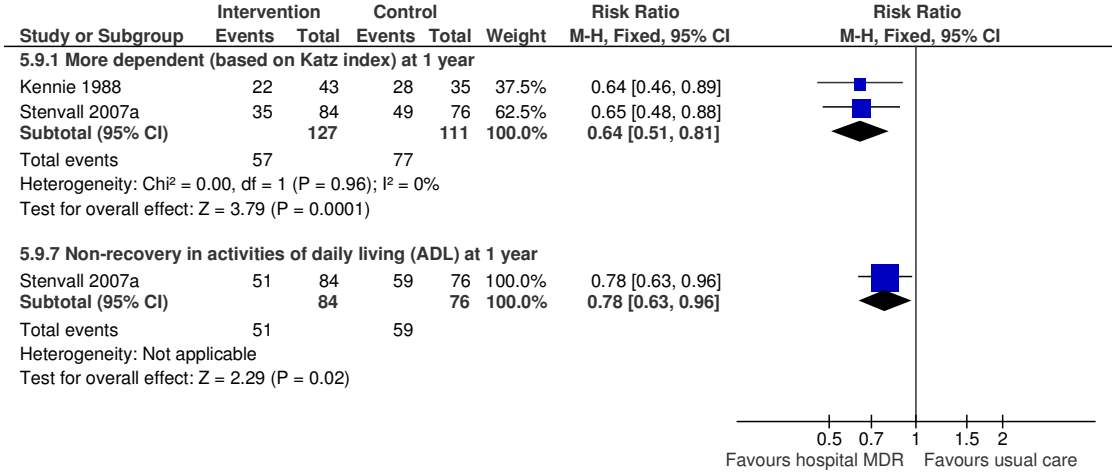


Figure G-145. Functional outcomes at 1 year: hip fracture programme versus usual care

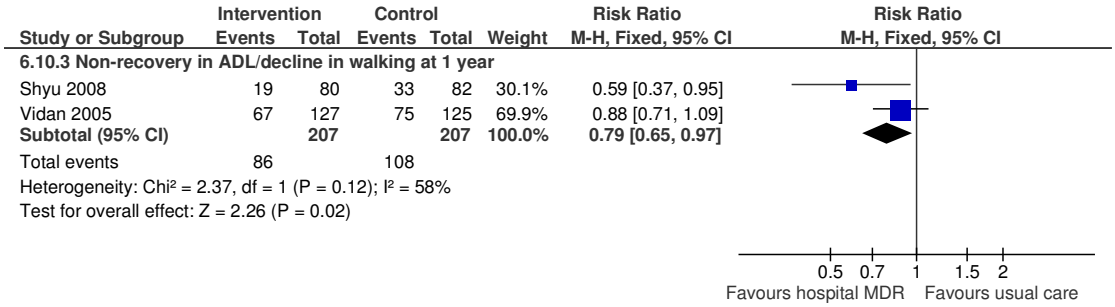


Figure G-146. : Functional outcomes: Barthel scores at long-term follow-up: hip fracture programme versus usual care

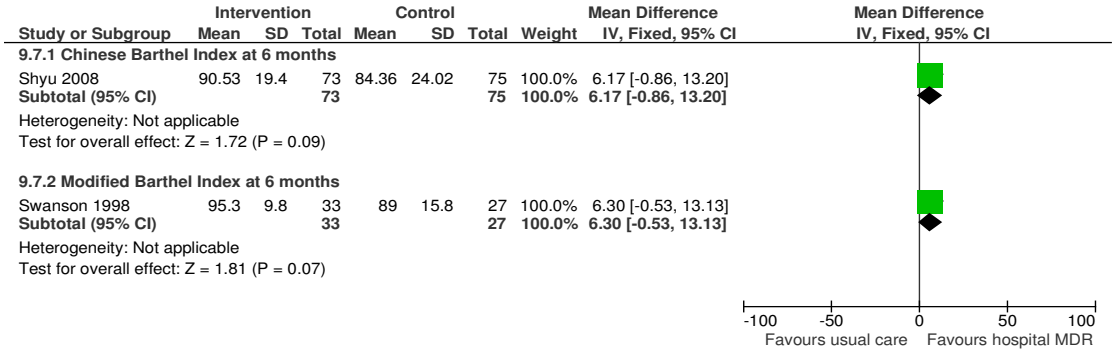


Figure G-147. Complications: hospital MDR versus usual care

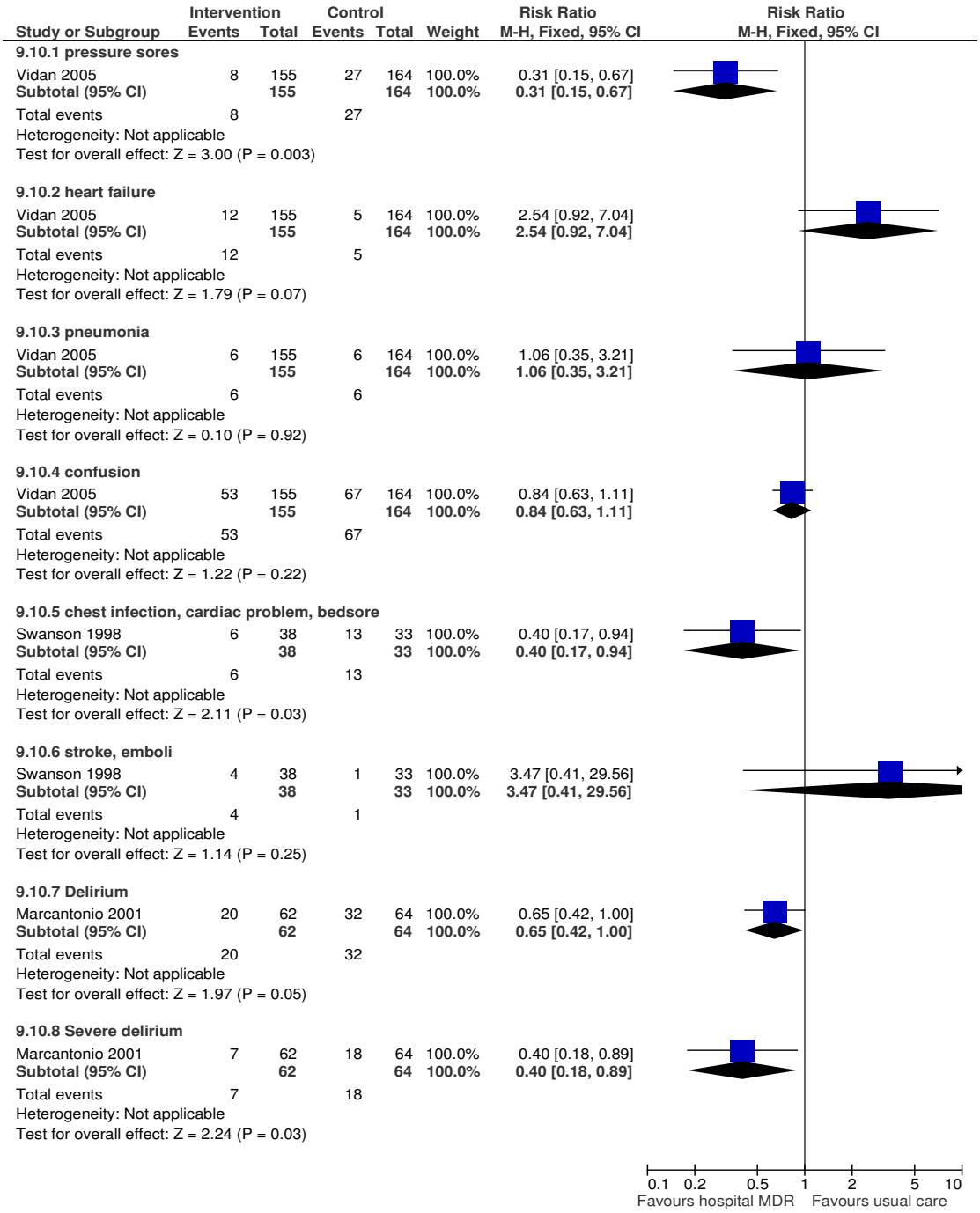


Figure G-148. Length of hospital stay: hospital MDR versus usual care

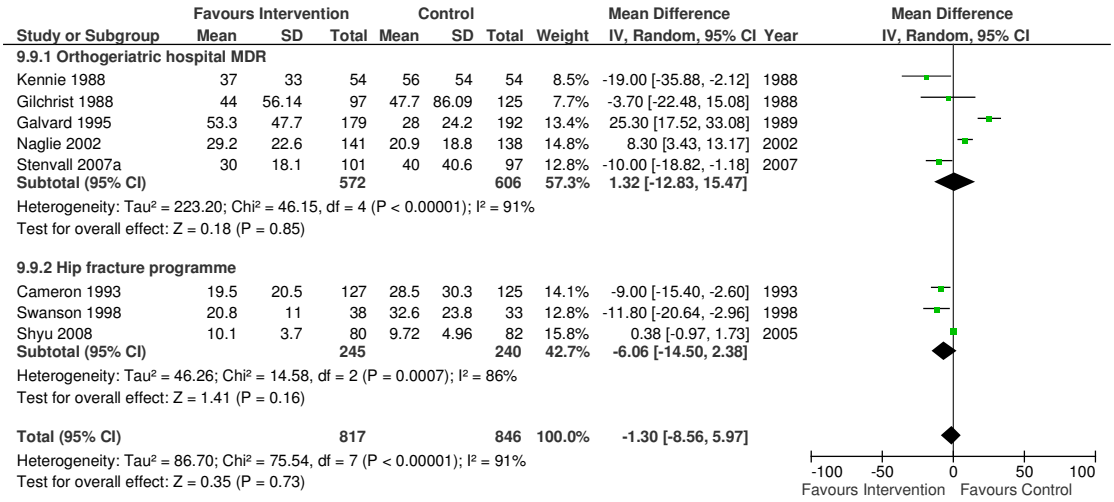
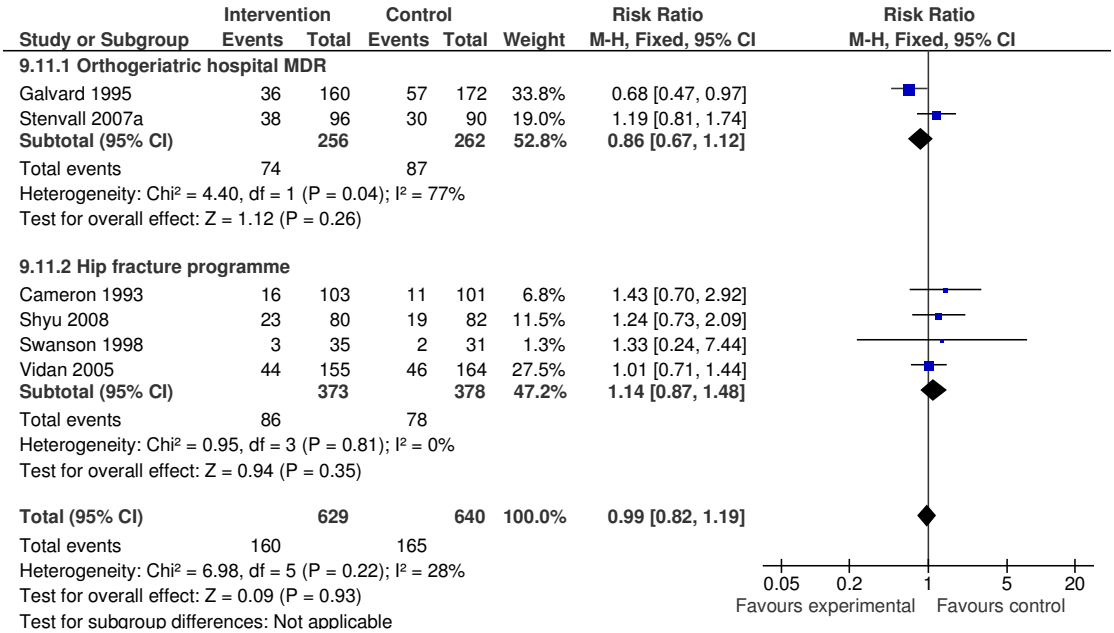


Figure G-149. Readmitted to hospital during follow up: hospital MDR versus usual care



19.9 Home-based MDR versus usual inpatient rehabilitation

Figure G-150. Mortality: Home-based MDR versus usual care

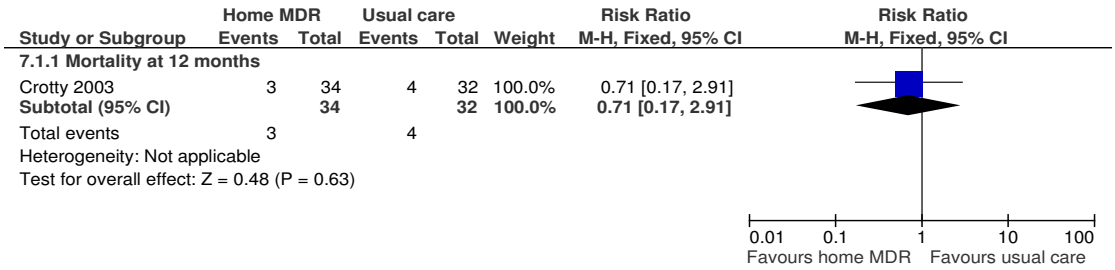


Figure G-151. "Poor outcome" – institutional care and unable to walk: Home-based MDR versus usual care

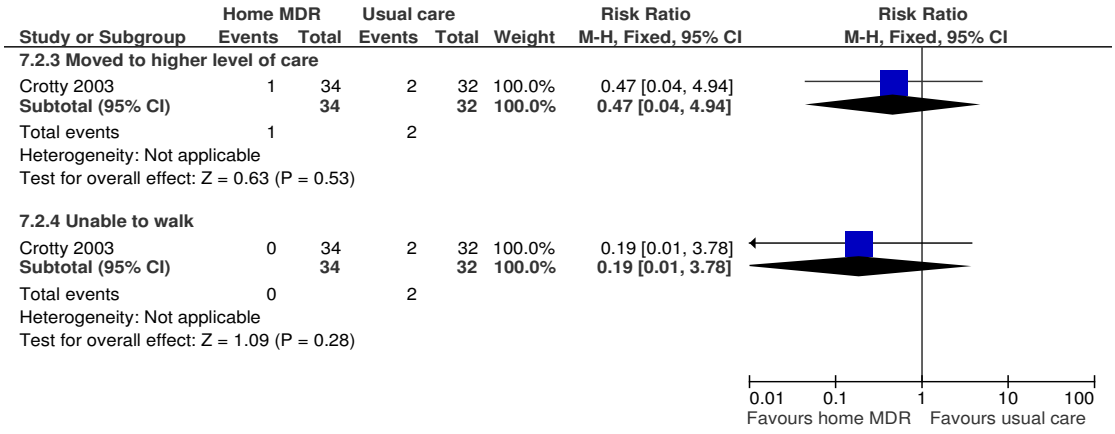


Figure G-152. SF-36 scores at 12 months (0: worst to 100: best): Home-based MDR versus usual care

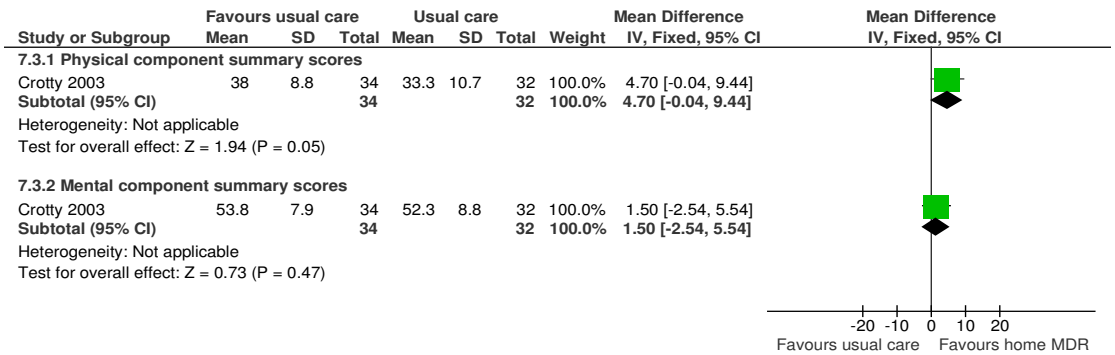


Figure G-153. Lengths of hospital or rehabilitation stays (days): Home-based MDR versus usual care

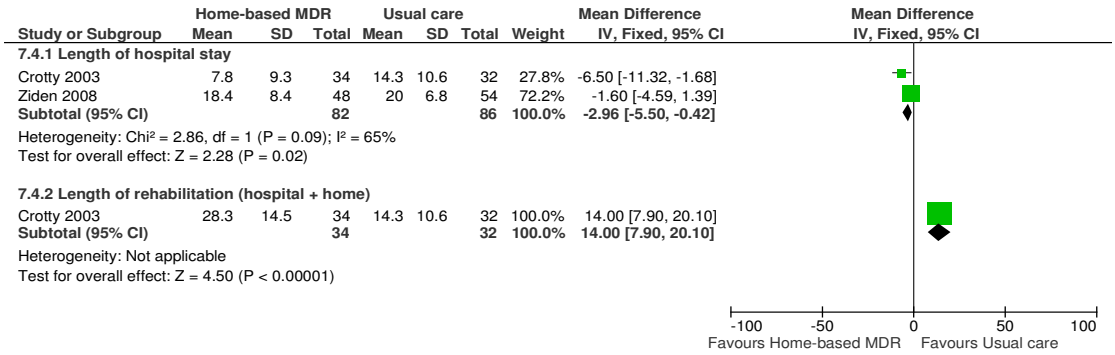


Figure G-154. Readmission to hospital during 4 month follow-up: Home-based MDR versus usual care

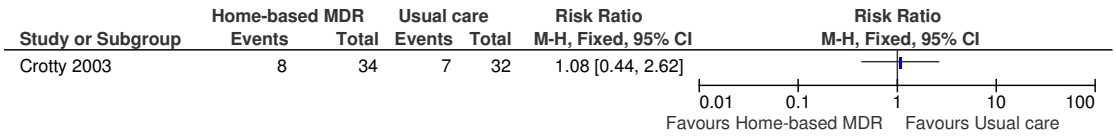


Figure G-155. Degree of independence (Functional Independent Measure): Home-based MDR versus usual care

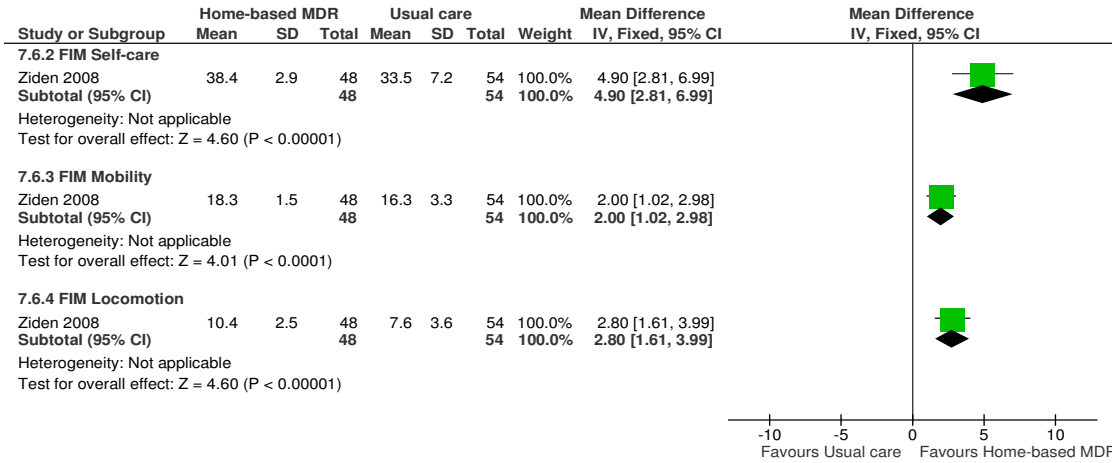
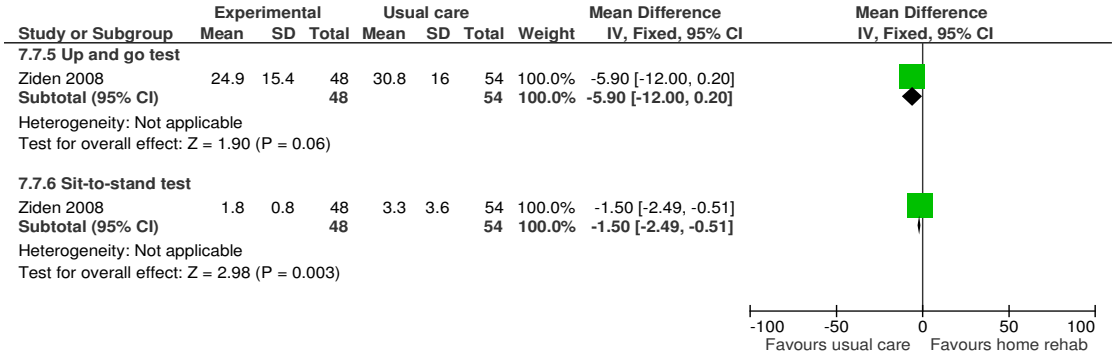


Figure G-156. Mobility and strength tests: Home-based MDR versus usual care



20 Appendix H: Health economic analysis

20.1 Cost analysis of nerve blocks, non-opioid analgesics and opioid analgesics

20.1.1 Nerve block cost analysis

No studies were identified on the cost-effectiveness of nerve blocks compared to systemic analgesia in providing adequate pain relief and reducing side effects and mortality.

As a consequence, we conducted a cost analysis where the different types and level of resources used to administer a nerve block to a patient with a suspected hip fracture are based on the GDG's opinion, summarised in Table 73 below.

Table 73: Cost analysis for nerve block

Resources	Unit price	Source of unit price
Spinal pack (gown and drape) *	£4.50	NHS hospital***
Biogel glove	£1.07	NHS hospital***
Chlorhexidine**	£1.08	NHS hospital***
Vial with Lidocaine 1%	£0.38 (10-mL am)	BNF 58
Vial of 0.5% Levobupivacaine	£3.88 (5mg/mL)	BNF 58

Syringes (10ml)	£0.06	NHS hospital***
Filter needle	£0.23	NHS hospital***
Regional block needle	£5.78	NHS hospital***
Hypodermic needle	£1.35	NHS hospital***
Personnel costs (consultant anaesthetist)	£36.00	PSSRU 2009; GDG estimate (£1.8 per minute*20 minutes)
Total cost	£54.33	

* Most anaesthetists use full aseptic precautions, with a gown and gloves plus a dressing pack
** Chlorhexidine built into swabs are standard practice.
*** Peterborough and Stamford Hospital NHS Foundation Trust

The **personnel costs** can vary depending on the time required to administer a nerve block, which in turn depends on the technique used (nerve stimulator, ultrasound- guided, landmark only) and the block used (3-in-1, femoral nerve only or fascia iliaca block). If a **fascia iliaca** block is administered using a landmark technique only, then the following sequence would be observed:

- Obtaining equipment (needle, disinfectant, gloves, local anaesthetic etc)
- Estimating patient's weight
- Obtaining patient's consent
- Identifying landmark
- Disinfecting skin
- Anaesthetising skin
- Passing needle
- Injecting local anaesthetic
- Maintaining manual pressure distal to injecting site for a minute after injection

The GDG estimates that the whole process would require about 15 - 20min, and that the time required would not change substantially if the block is administered by a consultant anaesthetist or a SAS (staff and associate specialist).

At present, in most emergency departments that do advocate nerve blocks for hip fracture patients, the block would be performed by 'middle grade doctors', i.e. specialist registrars (SpR), senior specialist trainees (ST3-6) or senior clinical fellows. In some departments, junior doctors can also administer the procedure. In operating departments and if asked to do elsewhere anaesthetists will always have a trained assistant with them, usually an ODP, which would increase the total cost for a nerve block to £63.33 (assuming an ODP wage of £27 per hour as that of a senior nurse)

The GDG recognises that there is likely to be a wide variation in practice as far as the administration of nerve blocks is concerned.

1) The nerve block may be administered with a ultrasound-guided technique, which would require the use of ultrasound anaesthetic machines. An average cost of these machines has been estimated at around £34,000 from hospital records supplied by the Peterborough and Stamford Hospital NHS Foundation Trust. The equivalent annual cost would be £5,313, assuming a life expectancy of 7 years and discount rate of 3.5%.

If we assume that the ultrasound machine would be used solely for nerve blocks in the anaesthetic department and that it would be used 7 hours per day every day, including weekends with 4 scans per hour, then the machine costs 52p per scan.

2) Bupivacaine can be used as local anaesthetic instead of Levobupivacaine, but the difference in price would be minimal.

3) A nerve locator could be used when performing the nerve block, but its cost would be minimal (GDG expert's opinion)

20.1.2 Non-opioid analgesics

We assume that patients will take a simple analgesic, such as paracetamol, continuously throughout their inpatient stay. The GDG noted that aspirin would not generally be used as an analgesic for our population, unless it is used as a low dose to prevent strokes. The average cost of these drugs is less than £0.1p per dose (BNF 58).

20.1.3 Opioid analgesics

Table 74: Opioids controlled drugs

Category	Dose cost (source: BNF 58)
Diamorphine hydrochloride	£2.69
Morphine salts	£0.36
Oxycodone hydrochloride	£1.60
Buprenorphine	£0.72
Average cost	£1.34

The opioids reported in table Table 74 are non-controlled drugs and can be administered within existing nurse drug rounds, and therefore there is little extra cost associated with their administration.

Table 75Table 74 summarises the opioids controlled drugs that could be administered to hip fracture patients. This category of analgesics requires an additional round of two trained nurses to administer. The GDG estimates that this would involve approximately 15 minutes per dose, with an extra cost of £10.50 (considering that the cost per hour of a staff nurse is £21 (PSSRU 2009)). Hence, the cost of administering these controlled drugs is £11.84 (nurse time plus drug cost).

Table 74: Opioids controlled drugs

Category	Dose cost (source: BNF 58)
Diamorphine hydrochloride	£2.69
Morphine salts	£0.36
Oxycodone hydrochloride	£1.60
Buprenorphine	£0.72
Average cost	£1.34

The opioids reported in table Table 74 are non-controlled drugs and can be administered within existing nurse drug rounds, and therefore there is little extra cost associated with their administration.

Table 75: Opioids non-controlled drugs

Category	Dose cost (source: BNF 58)
Codeine phosphate	£1.83
Dihydrocodeine Tartrate	£2.58
Tramadol Hydrochoride	£1.47
Average cost	£1.96

The remaining opioid drugs (dipipanone hydrochloride, hydromorphone hydrochloride, meptazinol, methadone hydrochloride, paperetum, pentazocine, pethidine hydrochloride) are very rarely used in our population, as they are highly specialist analgesics for palliative care. Fentanyl is rarely used in acute care, and is therefore not included in the dose cost.

20.2 Hourly wage costs for a planned trauma list

The GDG suggested to consider a general emergency theatre as a likely alternative to a planned trauma list.

A general emergency theatre is one to which multiple specialities have access for unplanned operations. Under these circumstances there will be necessary discussions between the various specialties as to whose patient should go first. With an emergency theatre, there is no start and finish time that can be forecasted in advance and great variation in the professional grade of the personnel involved.

When the hip fracture patient does go to theatre, he will clearly need the same supporting staff of surgeon, anaesthetist, nursing staff, radiographer etc. as for a planned trauma list. Thus, some costs will be common across the two types of lists with the exception that an emergency trauma list is more likely involve more junior staff.

Overall, the GDG has identified the following differences between an emergency and a planned trauma list:

a) Senior responsible staff involved

With a general emergency theatre the involvement of senior staff may be regarded as a covering on-call commitment. With a trauma list it becomes a regular work commitment to which there needs to be programmed activities allocated for both senior responsible anaesthetic and surgical staff. Since the nature of the work is known appropriate scrub staff can be allocated

b) Where necessary a new operating room

Providing trauma cases with the same level of care enjoyed by elective cases may require extra operating theatre space. There have been attempts in many hospitals to use operating theatres for a greater proportion of the 24 hour day to better use that resource. This has in general proved to be difficult; largely because trained staff prefer to have their regular commitments in what would be regarded as normal working hours. Genuine emergency procedures are a small proportion of any theatre workload and these need to be carried out at the necessary time whenever that may be. However, the bulk of procedures are urgent or elective, these should all be given the same advantages of a properly staffed theatre. Should it be necessary for best use of theatre space to utilise evening operating lists it may be preferable that these are occupied by the well prepared elective patients rather than the rapidly prepared often unwell urgent patient. Since this is unlikely to occur more operating space may well be required for daytime lists.

The advantage of a general emergency list is it uses the resources already available, and may run from early in the morning till late in the evening (therefore many operations can be performed sequentially). On the other hand, a planned trauma list needs to be run in parallel with other lists, preferably in the morning. It may be difficult to find a physical space for a planned trauma list to be carried out, in which case a new operating room may be required.

c) Ad-hoc technical resources

A planned trauma list needs a dedicated image intensifier, so it depends upon the other lists running as to whether its availability may be a problem.

d) Type of patients operated

A planned trauma list would only operate trauma patients whereas in a general emergency theatre there would be operations on different types of patients

The table below estimates the cost of one hour of personnel input for a planned trauma list during weekly normal working hours (that is, excluding weekends and public holidays personnel costs).

Personnel input cost for a planned trauma list – weekly normal working hours

Categories of personnel	Cost of hourly wage (source: PSSRU 2009)
Consultant surgeon	£108
Consultant anaesthetist	£108
Scrub nurse (senior staff nurse)	£27
Unscrub nurse (runner – staff nurse)	£21
Radiographer	£25
Anaesthesia assistant [ODP] (as senior staff nurse)	£27
Recovery nurse (staff nurse)	£21
Total personnel costs	**£337**

As for the personnel costs of a general emergency theatre, we assume that it mainly relies on registrars (both surgeons and anaesthetists) rather than consultants, and use a hourly cost for registrars of £38 (per 48 hour week; source: PSSRU 2009[61]). Any emergency theatre also relies on having consultant surgeons and anaesthetist on call, and this cost would also have to be considered in the overall costs for an emergency theatre. Once again we consider the personnel costs during weekly normal working hours, and thus exclude weekends and public holidays personnel costs nor additional personnel costs for out-of-hours operations, which are quite common with a general emergency theatre.

Personnel input cost for an general emergency theatre – weekly normal working hours

Categories of personnel	Cost of hourly wage (source: PSSRU 2009)
Registrar surgeon	£38
Registrar anaesthetist	£38
Consultant surgeon on call*	£23
Consultant anaesthetist on call*	£23
Scrub nurse (senior staff nurse)	£27
Unscrub nurse (runner – staff nurse)	£21

Radiographer	£25
Anaesthesia assistant [ODP] (as senior staff nurse)	£27
Recovery nurse (staff nurse)	£21

Manufacturer	Price for Sliding Hip Screw (for extramedullary fixation) IMP	Price for Short intramedullary nail (for intramedullary fixation)	Price for Long intramedullary nail (for intramedullary fixation)
Stryker	£357	£854	£1384
Biomet	£260.70	£745	£1,090
Zimmer (1)	£175	£826	£1,177
Synthes	£260.35	£796.05	£1,142.85
Smith & Nephew (2)	£245	£823.45	£1,083.16
DePuy	£217	£516	NA

Total personnel costs	**£243**

*= Assumes that the average emergency work undertaken per week for on-call duty is 3 hours. If the amount of this emergency on-call work raises to 6 hours per week, the hourly rate paid to the consultant would be £39. Source: hourly on call salary costs provided by the NICE costing implementation team.

Thus, a planned trauma list has additional personnel cost compared to a general emergency theatre of £94 per hour. It is very important to stress that this estimate does not consider the additional salary costs linked with operations taking place during weekends or public holidays and outside normal working hours.

20.3 Prices for sliding hip screws and short and long intramedullary nails

In the table above we report the prices for sliding hip screws, short intramedullary and long intramedullary nails from quotations received by some of the major manufacturers of implants. All quotations are 2010 prices. All prices include VAT.

Average price	£252.51	£760.08	£1,175.40

Manufacturer	**Price for Sliding Hip Screw (for extramedullary fixation) IMP**	**Price for Short intramedullary nail (for intramedullary fixation)**	**Price for Long intramedullary nail (for intramedullary fixation)**
Stryker	£357	£854	£1384
Biomet	£260.70	£745	£1,090
Zimmer (1)	£175	£826	£1,177
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Smith & Nephew (2)	£245	£823.45	£1,083.16
DePuy	£217	£516	NA
Average price	£252.51	£760.08	£1,175.40

20.4 Cost analysis of the interventions for intensive mobilisation strategies.

Cost analysis of the interventions for intensive mobilisation strategies.

Study	Intervention	Control	Other resources	Unit costs	Incremental cost of intervention over usual care
Hauer et al 2002 [140]	1 hour of physiotherapist for 3 weeks	1 hour of physiotherapist for 3 weeks	Using data provided from a GDG member, the cost of the equipment that would be used in the intervention group was estimated at £49.00 per patient. This estimate is based on a study currently under way, where the costs per person for the exercise equipment was estimated to be £49.00. This cost assumes no re-use of equipment and does not include overhead costs. When appropriately cleand, the equipment could be re-used, in which case, assuming that it is re-used up to four times, the relevant cost per person would be approximately £12.	£23 per hour for physiotherapist input Other costs (for stepping and strength training) are considered as negligible and have not been included in the cost analysis	£12
Karumo 1977A [171]	Physiotherapy performed twice daily – average of 1 hour for 14 days	Average of 30mins physiotherapy per day for 14 days	Crutches	£23 per hour for physiotherapist input (£161 control; £322 intervention)	£180.18

				Cost of crutches: £19.18 (a)	
Moseley et al., 2009[216]	<u>Weight bearing</u> exercise twice daily for a total of 60 minutes per day for 16 weeks. Walking on a tread mill with partial body weight support using a harness (for inpatients) or a walking programme (after hospital discharge). LOS in hospital: 28 days (4 weeks) For 84 days: walking programme with home visits and exercise programme This started as an inpatient programme, followed by home visits and a structured home exercise programme.	Exercise for 30 mins each day for 4 weeks. LOS in hospital: 25 days.	For inpatients: additional inpatients costs Treadmill with partial weight-support	£23 per hour for physiotherapist input £13,029 for Biodex treadmill with body-weight support. Cost per day of a bed (elderly person care: £152 (b)) Assumption: a physiotherapist is present for all the duration of treatment when inpatient Treadmill costs – assumptions: - Treadmill live is 5 years - Treadmill overall use: 4 hours per day for 5 days of the week - Discount rate: 3.5% - Treadmill used for 20 minutes per session - Cost one session of treadmill imputable to the intervention: £0.54. - Cost of treadmill sessions over 4 weeks: 7*4*£0.54= £15.12 **INTERVENTION COSTS:** Bed days cost: £152*28=£4256 Attributable treadmill costs: £15.12 per patient	£827.62 (for the inpatient part of the rehabilitation programme) The costs of the outpatient part of the programme was not calculated as it was not clear from the study what types of resources where used in that part of the rehab programme.

				Physiotherapist costs (intervention): £23*28=£644 **Total inpatient costs of intervention: £4915.12** **CONTROL COSTS:** Physiotherapist costs: £23*0.5*25=£287.5 Bed day costs: £152*25=£3800 **Total cost for control: £4087.5**	

(a) Average cost obtained from the NHS Supply Catalogue 2010 for the following manufacturers: Sunrise Medical Ltd, NHS Supply Chain and Days Healthcare UK Limited

(b): We have estimated the hospital stay using the unit cost per excess day associated with complex elderly patients (that is, the unit cost per day for days exceeding the trim point). Using all the HRG unit costs reported for all Complex Elderly patients (Hospital Episode Statistics for England, Inpatient Statistics, 2007-08) we found a weighted mean of £152.

20.5 Cost-effectiveness analysis of hospital investment versus no hospital investment for early surgery

20.5.1 Introduction

The GDG assigned a high priority in the economic plan for an original economic analysis to the question:

" In patients with hip fractures what is the clinical and cost effectiveness of early surgery (within 24, 36 or 48 hours) on the incidence of complications such as mortality, pneumonia, pressure sores, cognitive dysfunction and increased length of hospital stay?"

A review of the literature was conducted. The literature search and review methods can be found in Chapter 3. No cost-effectiveness analysis was found which addressed our clinical question. As a consequence, the GDG felt that an original decision model was essential in order to inform their recommendations.

The following general principles were adhered to:

- The GDG was consulted during the construction and interpretation of the model.
- When published data was not available, we used hospital records and experts' opinion to populate the model.
- Model assumptions were reported fully and transparently.
- The results were subject to sensitivity analysis and limitations were discussed.
- We followed the methods of the NICE reference case. Therefore costs were calculated from the NHS and PSS perspective. Health gain was measured in terms of quality-adjusted life-years (QALYs) gained. Both future costs and QALYs were discounted at 3.5%.
- The model employed a cost-effectiveness threshold of £20,000 per QALY gained.
- The model was peer-reviewed by another health economist at the NCGC.

20.5.2 Background

There are fundamentally two reasons why a patient with a diagnosed hip fracture is delayed in receiving surgery. First, the patient may be considered to be *unfit* for surgery for medical reasons, and therefore made to wait until the medical team optimises her status. Alternatively, a patient may be deemed to be fit for surgery at the time of admission, but will still incur delays linked with *administrative reasons*, such as lack of space on theatre lists and/or problems with theatre, surgical and anaesthetic staff cover.

In our economic analysis, we focus exclusively on the *administrative reasons* for surgical delay.

This is because, albeit all studies in the clinical review were initially considered for inclusion in the economic model, the GDG concluded that only the subgroup of papers with a population that excluded patients unfit for surgery was appropriate for basing the economic model upon.

In particular, the GDG considered that by removing patients unfit for surgery (defined as those for whom: '*any medical reason when orthopaedic or anaesthetic staff felt that operation should be delayed in order to improve the patient's fitness for surgery'*[308]) from our model, we would be excluding confounding factors from the decision model, thus allowing more confidence in the cost-effectiveness findings.

Those studies that had not excluded patients unfit for surgery from their population would potentially have an imbalance in baseline characteristics which could result in skewing the data in favour of the early surgery group. Even though these studies had used logistic regression to adjust for confounding factors (such as ASA score, sex, age and comorbidities like cardiac problems), the GDG still felt that the subgroup of papers that excluded patients unfit for surgery were more robust.

Overall, three studies which excluded patients unfit for surgery from their population were included in our clinical review: Moran (2005), Siegmeth (2005) and Orosz (2004)[215,250,308]. Of these, only Siegmeth[308] reports data regarding whether patients returned to their original place of residence or whether they changed residence (at 1 year follow up) and this was considered essential information for modelling the different health states in our analysis.

Siegmeth (2005)[308] excluded patients who were delayed for any medical reason when orthopaedic or anaesthetic staff felt that operation should have been delayed in order to improve the patient's fitness for surgery. Reasons for delays included anaemia requiring transfusion, correction of electrolyte imbalance, uncontrolled diabetes and untreated heart failure. The GDG agreed that the study adopted a set of diagnostically objective criteria in deciding which patients were considered fit for surgery, and that no selection bias had been introduced in this process.

Furthermore, Siegmeth[308] is a study set in the UK, and as such was considered to be more applicable to our question than studies set in different countries. As the paper interprets "early surgery" as surgery that took place within 48 hours from admission, we adopt this specific cut-off point in our model.

20.5.3 Population and time horizon

The population for the cost-effectiveness analysis consists of hip fracture patients (male and female) hospitalised for surgery and considered to be fit for surgery. The model spans over a life-time horizon.

20.5.4 Software

The cost-effectiveness analyses were conducted using TreeAge Pro 2008.

20.5.5 Methods

We built a decision tree with Markov states where the expected costs and effectives of two alternatives are evaluated and compared: "investment for early surgery" vs. "no investment for early surgery". As discussed in section 20.5.8, this investment consists of the addition of extra operating lists to the existing weekly number of theatre lists.

As mentioned in section 20.5.2, the health states of the model reflect the outcomes of Siegmeth (2005)[308]**: a**t one year after surgery, patients can be "living in their own home", "living in a residential home", "living in a nursing home", or "dead".

Since patients were followed at 1 year from surgery in Siegmeth (2005)[308], the *cycle length* of the Markov model is supposed to last one year. At the end of each cycle, patients can either stay in the same health state or can transit to the "dead" state (the "absorbing" health state in the model). This is because no data were available from Siegmeth (2005)[308] over the possible transitions of patients between the other health state ("living in own home", "living in residential home" or "living in nursing home"). Hence, we assume that patients' place of residence at 1 year stays the same for the rest of their lifetime. Although this is obviously a simplification, it is unlikely

that the impact of the intervention ("investment for early surgery") will have an effect after 1 year from surgery.

The model starts with a simple decision node, which represent the decision to invest or not in providing extra operating theatre lists. Following the investment, surgery takes place. However, whether surgery will indeed take place "early" (within 48 hours from admission) or "late" is an *uncertain* event. As a consequence, in our decision model we are able to address the question of whether it is cost-effective to invest in extra operating lists (and therefore in extra personnel and all the required resources) in order to increase the *probability* that those patients deemed "fit for surgery" at admission are indeed operated within a certain time target. The probabilities of a patient being in one of the four possible health states in the first cycle depend on whether they have been operated within 48 hours or after 48 hours.

20.5.6 Treatment effects

The proportion of patients in each health state depends on the effectiveness of the treatment (that is, of investment for early surgery), and on the proportion of patients still alive, which falls as the number of cycles and therefore age increases.

Primary data were obtained from a GDG expert advisor regarding the proportion of patients in each health state at 1 year follow up. These data (reported in Table 76 below) have been extracted from the same database used in the Siegmeth[308] study included in our clinical review, and therefore refer to patients who were delayed for surgery not for medical reason but only for administrative reasons.

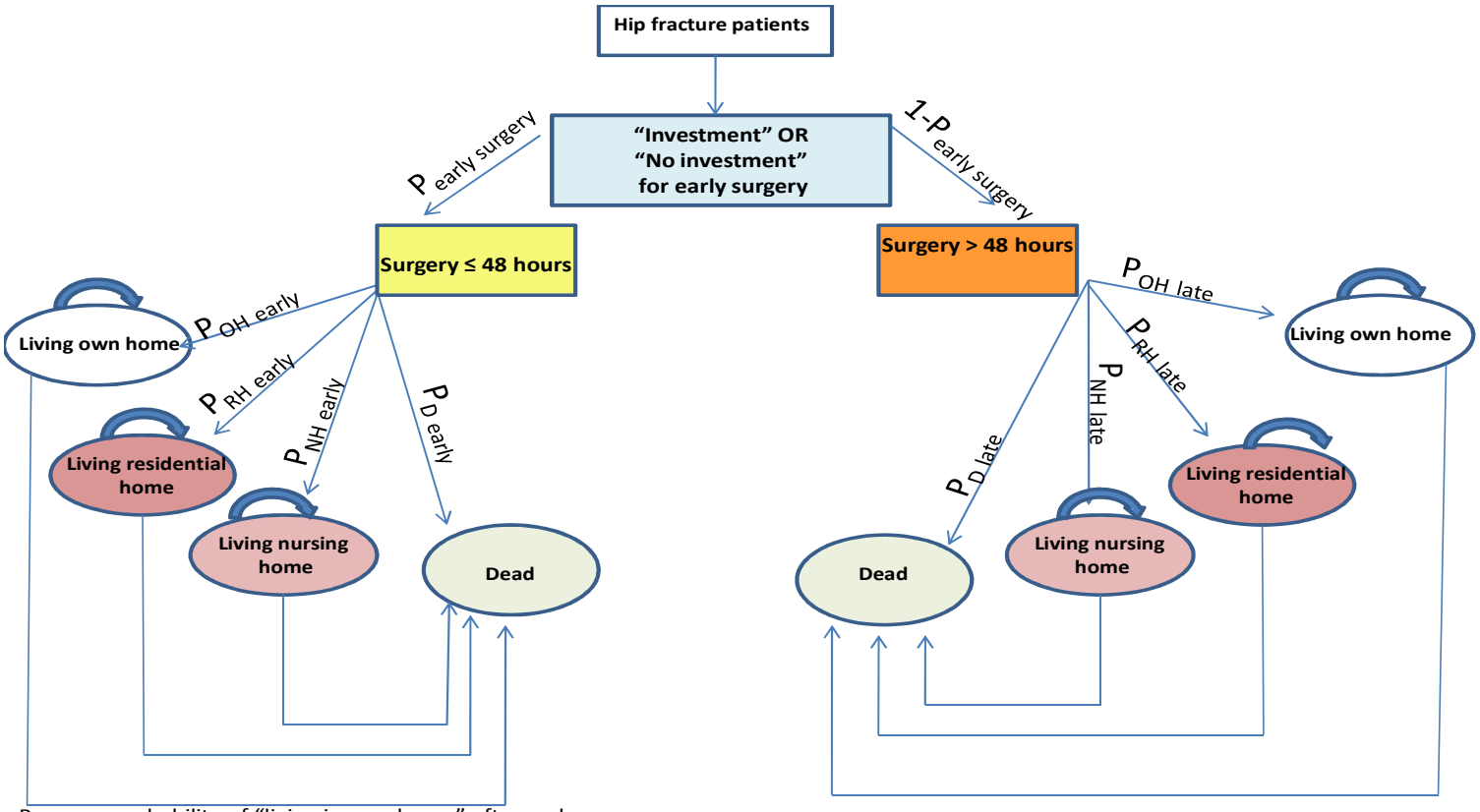


Figure 157: Decision tree with Markov states - investment for early surgery vs. no hospital investment for early surgery

Table 76: Place of residence and mortality at 1 year

	Patients who had surgery ≤ 48 hours	Patients who had surgery > 48 hours	RR (surgery ≤ 48 hours vs. surgery > 48 hours)
Total number of admissions	3445 (0.952%)	175 (0.048%)	
No. patients living in own home at 1 year	1734 (0.503%)	76 (0.434%)	1.16
No. patients living in residential home at 1 year	489 (0.142%)	22 (0.126%)	1.13
No. patients living in nursing home at 1 year	307 (0.089%)	16 (0.091%)	0.97
No. patients dead at 1 year	915 (0.266%)	61 (0.349%)	0.76

It is important to point out that, for the first cycle in our model, the mortality data are based on the information obtained from the database reported in Table 76.

For the long-term mortality, we considered a mean age of 81 for our cohort of patient, as this was the mean age of patients in Siegmeth[308]. Following Parker(1992)[268], the life expectancy after the first cycle was assumed to be the same as that of the general population, and was obtained from the Life Tables for the general population of England and Wales in the year 2005-2007 from the Government Actuary Department:

(http://www.gad.gov.uk/Documents/Demography/EOL/ILT%202005-07/wltewm0507.xls).

This value was then adjusted for the ratio male/female corresponding to the patients characteristics in the study as follows:

Total LE = LE_{female} * %female + LE_{male} * %male

20.5.7 Quality of life

The EQ-5D utility weights for patients living in their own home, in a residential or nursing home used in our model are based on the findings of the paper by Tidermark (2002)[328] and are summarised in Table 77 below.

Table 77: EQ-5D scores for health states

Health state	Utility score
Living in own home (at 1 year from the fracture)	0.64
Living in own home (after 1 year from the fracture)	0.56
Living in an institution	0.35

(a) Source: Tidermark (2002)

We have assumed that patients living in their own home correspond to those "living independently" in Tidermark (2002)[328].

For each strategy, the expected QALYs in each cycle are calculated as follows:

$$\text{Expected QALYs} = \Sigma (U_i \times P_i)$$

Where:

U_i = the utility score for health state i

P_i = the proportion of patients in health state i

and where health state i could be any of the health states reported in table 1.

The overall *lifetime expected QALYs* are given by the sum of QALYs calculated for each cycle. The *incremental QALYs gained* associated with a treatment strategy ("investment for early surgery" in our case) are calculated as the difference between the expected QALYs with that strategy and the expected QALYs with the comparator (that is, "no investment for early surgery").

20.5.8 Cost analysis

20.5.8.1Early surgery implementation costs

The "investments for early surgery" in our model consists of adding extra operating lists aimed at increasing the theatre capacity as a way of reducing the time hip fracture patients have to wait before they receive surgery. The evidence for this strategy refers to hospital records supplied by a GDG member. In 2008, the John Radcliffe hospital in Oxford implemented a policy aimed at increasing the number of patients operated with 48 hours from admissions. This was achieved by adding an extra five half-day operating lists to the weekly number of lists. All the extra lists were added during a normal working week, not during the weekend. Each extra theatre list consisted of four hours of operating time. Table 78 below describes the extra personnel that had to be employed to run these extra lists and the associated costs incurred by the hospital.

Table 78: Personnel costs for extra operating lists

Categories of personnel	Hours per additional list	Cost of hourly wage (source: PSSRU 2009)	Additional personnel costs for the 5 extra lists
Consultant surgeon	4	£108	£2,160
Consultant anaesthetist	4	£108	£2,160
Orthogeriatrician	1	£108	£540
Scrub nurse (as senior staff nurse)	4	£27	£540
Unscrub nurse (runner)	4	£21	£420
Radiographer	4	£25	£500
Anaesthesia assistant [ODP] (as senior staff nurse)	4	£27	£540

Recovery nurse (as staff nurse)	4	£21	£420
Total personnel cost for 5 additional weekly lists			£7,280
Total personnel costs for 5 additional lists over 1 year			£378,560

In addition to the extra personnel costs, we have to consider the *overhead costs* involved with running the operating theatre for the extra five half-day lists. These costs have been estimated on the basis of hospital records obtained from the Peterborough and Stamford District Hospital, and are summarised in the Table 79 below.

Table 79: Overhead costs for the additional operating lists

Resource	Cost per minute (£)
Energy	0.18
Premises maintenance	0.09
Staff uniforms and clothing	0.01
Medical and surgical equipment (including instruments)	0.82
Dressings	0.06
Total overhead costs per minute	£1.16
Total overhead costs for 5 additional weekly lists	£1,392
Total overhead costs for 5 additional over 1 year	£72,384

It follows that the overall total implementation cost for early surgery amounts to £450,944.

Probability of early surgery after hospital investment

The following table summarises the number of patients operated within 48 hours from admissions before the extra operating lists were added (i.e. at baseline, year 2007-08) and for the years following the investment in extra operating lists. These data are also based on hospital records supplied by the John Radcliffe Hospital in Oxford.

Table 80: Patients operated within and after 48 hours from admission - before and after investments in extra operating lists

	2007-8 (baseline)	2008-9 (intervention)	2009-10	2010-2011*
Total cases operated during the year	431	434	441	123
Number of patients fit for surgery within 48 hours during the year	363	347	374	114

Number of patients delayed over 48hrs because unfit for surgery	68	87	67	9
Number of patients fit for surgery and operated within 48 hrs (%)	192 (52.89%)	233 (67.15%)	316 (84.49%)	109 (95.61%)
Number of patients fit for surgery but delayed >48hrs	171 (47.11%)	114 (32.85%)	58 (15.51%)	5 (4.39%)

*data collected up to July 2010.

As Table 80 shows, the addition of the extra operating lists affected the *probability* that patients fit for surgery are operated "early" (in our case, within 48 hours from admission). However, even following this investment, early surgery is still a *random* event which is affected by many other factors beyond the number of operating sessions available. Still, the data in Table 80 shows that there is a clear trend in the increase in the number of patients fit for surgery that are operated within 48 hours. There are several possible reasons for this trend, but they can mostly be seen as the result of a learning process (by all the health care professionals involved in the care of the patients) that produced positive spillover effects and efficiency gains in the years following the implementation of the extra operating lists.

We use the data for 2008-09 as our intervention in the base case analysis. Data referring to other years (2009-10 and 2010-11) are used in a sensitivity analysis.

Incremental cost per patient of implementation costs for extra theatre lists

The extra cost per patient of implementing an early surgery strategy for the first year following the investment (that is, for 2008-09) correspond to £450,944/434 = £1039.04 (where 434 is the total number of patients operated for hip fracture – whether within or after 48 hours from admission – in the intervention year).

20.5.8.2Costing hospital length of stay

In addition to the costs linked with the extra operating lists, we have consider the costs for the length of hospital stay. We assume that the daily cost of a hospital bed in an orthopaedic ward corresponds to £241.69 (which is obtained from a weighted average of the costs of the excess bed days for hip all hip fracture procedures (major, intermediate and minor) with all types of complications). This cost is then multiplied by the length of stay for each group of patients, summarised in Table 81 below and based on the findings of [308]

Table 81: Mean length of hospital stay

	Surgery ≤ 48 hours	**Surgery > 48 hours**	**CI**
Mean hospital stay in days (95% CI)	21.6	36.5	(5.7 – 16) p<0.0001

20.5.8.3Health state costs

Health and social care costs for patients in the "living at own home" health state

We acknowledge that even if a patient is discharged to his own home and returns to an independent living status, he will still incur in a higher level of use of health and domiciliary social care compared to his pre-fracture status, as it is unlikely that he will completely regain his pre-fracture level of independence. The PSSRU (2009)[61] describes five possible "community care packages" for individuals who live in their own home and consume a level of health and domiciliary social care resources that varies according to their specific level of independence in functional status. For our model, we assume that the health and domiciliary social care costs for the patients in the "living in their own home" health state is an average of the cost of the "very low", "low" and "medium" community care packages stated in the report. It follows that the weekly average health care costs for patients living in their own home after the fracture amounts to £9.9, and the weekly domiciliary social care costs to £98.1. While the health care costs are fully funded by the NHS, the domiciliary social care costs will only be partially met by the local authority. We found no published evidence regarding a national average of the percentage of domiciliary social care funded by local authorities[71], [348], [72], [144]. In our base case analysis, we assume that 60% of these costs would be funded by the local authorities, and then test this assumption in a sensitivity analysis.

Health and social care costs for patients in the "living in residential home" and "living in nursing home" health states

For patients living in a residential or in a nursing home, we need to consider the cost of long term care. This is estimated from the unit cost of stay in private nursing homes and in private residential care reported in the PSSRU 2009. The health care costs and fees per permanent residential week are described in Table 82.

Table 82: Weekly health and social care costs for patients living in residential or nursing homes

Place of residence	Weekly health care costs	Weekly fees
Private nursing home	£30.80, of which: • £30 (GP weekly home visit) • £0.80 (community nursing)	£ 678
Private residential care	£26.3, of which: • £19.30 (GP weekly home visit) • £7.00 (community nursing)	£467

Once again, while the NHS fully funds the health care costs, it does not pay towards long-term care for all patients. Moreover, only a proportion of the weekly fees will be met by the local authorities. We found no published evidence regarding a national average of the percentage of long-term care costs funded by local authorities, and as a consequence we assumed that the proportion of the costs of long-term care borne by the NHS and PSS is equal to 60% in the base case analysis, and changed it afterwards in a sensitivity analysis.

20.5.9 Cost-effectiveness analysis

Table 83 below summarised the findings of the cost-effectiveness analysis for the determinist case. We found that, for the first year following the investment in extra operating lists, the

strategy “investment for early surgery” is not cost-effective at a willingness to pay of £20k per QALYs gained.

Table 83: Cost-effectiveness results - deterministic analysis – first year following investment in extra lists

Strategy	Cost	Incremental Cost	Effectiveness	Incremental Effectiveness	Incremental cost-effectiveness (ICER)
No hospital investment for early surgery	£46.4K		2.32		
Hospital investment for early surgery ***(with probability of early surgery =67.15%)***	£47.4K	£1.0K	2.3622	0.0421	**£/QALY 22776**

Table 84: Costs breakdown for "investment" and "no investment" in early surgery reports a breakdown of all the cost categories included in the model for the first year in which the extra operating lists were introduced.

Table 84: Costs breakdown for "investment" and "no investment" in early surgery

Resource item	Investment in extra operating lists	No investment in extra operating lists
Rehab cost	NA	NA
Hospital-related costs (for length of stay and investment in extra operating lists)	7442	6917
Readmission	NA	NA
Community health care (own home)	1664	1630
Community social care (own home)	9892	9690
Community health care (residential and nursing home)	2224	2206
Community social care (residential and nursing home)	26200	26000
Total cost	**£47422**	**£46443**

In order to ascertain how robust the findings of Table 83 are, we ran a series of sensitivity analyses. Deterministic sensitivity analysis showed that the findings of our model are not sensitive to the hospital bed day cost. However, threshold sensitivity analyses found that “investing for early surgery” is the strategy with the highest net benefit in correspondence to a range of values for different variables of the model, as summarised in Table 85 below.

Table 85: Threshold sensitivity analyses

Variable	Threshold values	Strategy with highest net benefit
Probability of being operated within 48 hours when investing for early surgery	>0.68	Investment for early surgery
Probability of living at home at 1 year for early surgery	>0.53	Investment for early surgery
Probability of living in nursing	<0.10	Investment for early surgery

home at 1 year – early surgery		
Probability of living in residential home at 1 year – early surgery	<0.15	Investment for early surgery
Mean length of hospital stay for early surgery patients	<18.47 days	Investment for early surgery
Number of extra operating lists (of 4 hours each)	>4.38	No investment for early surgery
Proportion of social care costs paid by the NHS and local authorities	>0.43	No investment for early surgery
Cost per day in hospital	>£292.50	Investment in early surgery

20.5.9.1 Probabilistic sensitivity analysis

A probabilistic sensitivity analysis was performed to assess the robustness of the model results to plausible variations in the model parameters. Probability distributions were assigned to each model parameter, where there was some measure of parameter variability. We then re-calculated the main results 10000 times, and each time all the model parameters were set simultaneously, selecting from the respective parameter distribution at random. Table 86 summarises the type and properties of distributions used in the probabilistic sensitivity analysis.

Table 86: Description of the type and properties of distributions used in the probabilistic sensitivity analysis

Parameter	Type of distribution	Properties of distribution
Baseline risk	Beta	Bounded on 0 – 1 interval. Derived from sample size, number of patients experiencing events
Cost	Gamma	Bounded at 0, positively skewed. Derived from mean and standard error
Utility	Beta	Bounded on 0 – 1 interval. Derived from mean and sample size
Risk ratio	Lognormal	Bounded at 0. Derived from log (RR) and standard error of log (RR)

Table 87 reports the distribution, parameters and expected values for each variable of the model.

Table 87: Distributions, parameters and expected values for probabilistic sensitivity analysis

Name	Baseline value (deterministic analysis)	Distributions and parameters	Expected value

EQ- 5D "living own home"	0.64	Beta, Real-numbered parameters, alpha = 37.12, beta = 20.88	0.64
EQ - 5D – "living in nursing home" and "living in residential home"	0.35	Beta, Real-numbered parameters, alpha = 2.45, beta = 4.55	0.35
EQ- 5D "living in own home" after 1 year	0.56	Beta, Real-numbered parameters, alpha = 31.92, beta = 25.08	0.56
Cost per hour – consultant (surgeon and anaesthetist)	108	Gamma, alpha = 15.36583528, lambda = 0.142276253	108
Cost per hour (staff nurse)	21	Gamma, alpha = 15.36583528, lambda = 0.731706442	21
Cost per hour - ODP	27	Gamma, alpha = 15.36583528, lambda = 0.56910501	27
Cost per hour -radiographer	25	Gamma, alpha = 15.36583528, lambda = 0.614633411	25
Cost per hour – senior nurse	27	Gamma, alpha = 15.36583528, lambda = 0.56910501	27
Operating time per each extra list (hours)	4	Triangular, Min = 1, Likeliest = 4, Max = 7	4
Initial age	81	None	
Length of hospital stay – early surgery	21.6	Log-Normal, u (mean of logs) = 3.038030773, sigma (std dev of logs) = 0.2632965680	21.6
Length of hospital stay – late surgery	36.5	Log-Normal, u (mean of logs) = 3.562649719, sigma (std dev of logs) = 0.263296568	36.5
No of patients operated in the intervention year (2008-09)	434	Poisson, lambda = 434	434
No of weekly extra operating lists added	5	Triangular, Min = 3, Likeliest = 5, Max = 7	5
Overhead cost per minute	1.16	Gamma, alpha = 15.36583528, lambda = 13.24640973	1.16
Probability of surgery within 48 hours without investments in extra lists	0.5289	Beta, Integer parameters only, n = 363, r = 192	0.5289
Probability of surgery within 48 hours after investments in extra	0.6715	Beta, Integer parameters only, n = 347, r = 233	0.6715

lists			
Proportion of social care costs borne by local authorities	0.6	Triangular, Min = 0.20, Likeliest = 0.60, Max = 1; Expected value: 0.6	0.6
Probability of dead – late surgery	0.349	Beta, Integer parameters only, n = 175, r = 61	0.349
Probability of living in own home – late surgery	0.434	Beta, Integer parameters only, n = 175, r = 76	0.434
Probability of living in nursing home – late surgery	0.092	Beta, Integer parameters only, n = 175, r = 16	0.092
Probability of living in residential home – late surgery	0.125714	Beta, Integer parameters only, n = 175, r = 22	0.125714286
Relative risk of living in nursing home	0.97	Log-Normal, u (mean of logs) = -0.060565609, sigma (std dev of logs) = 0.24538297	0.97
Relative risk of living in own home	1.16	Log-Normal, u (mean of logs) = 0.144607796, sigma (std dev of logs) = 0.08731791	1.16
Relative risk of living in residential home	1.13	Log-Normal, u (mean of logs) = 0.101743909, sigma (std dev of logs) = 0.202354755	1.13
Relative risk mortality	0.76	Log-Normal, u (mean of logs) = -0.280072176, sigma (std dev of logs) = 0.106163367	0.76
Weekly health care costs for patients living in a nursing home	30.8	Gamma, alpha = 15.36583528, lambda = 0.498890756	30.8
Weekly health care costs for patients living in their own home	9.9	Gamma, alpha = 15.36583528, lambda = 1.552104574	9.9
Weekly health care costs for patients living in a retirement home	26.3	Gamma, alpha = 15.36583528, lambda = 0.584252292	26.3
Weekly social care costs for patients living in their own home	98.1	Gamma, alpha = 15.36583528, lambda = 0.156634407	98.1
Weekly social care costs for patients living in a residential home	467	Gamma, alpha = 15.36583528, lambda = 0.032903288	467
Weekly social care costs for patients living in a nursing home	678	Gamma, alpha = 15.36583528, lambda = 0.022663474	678
Daily cost of hospital stay	241.68	Gamma, alpha = 15.36583528,	241.68

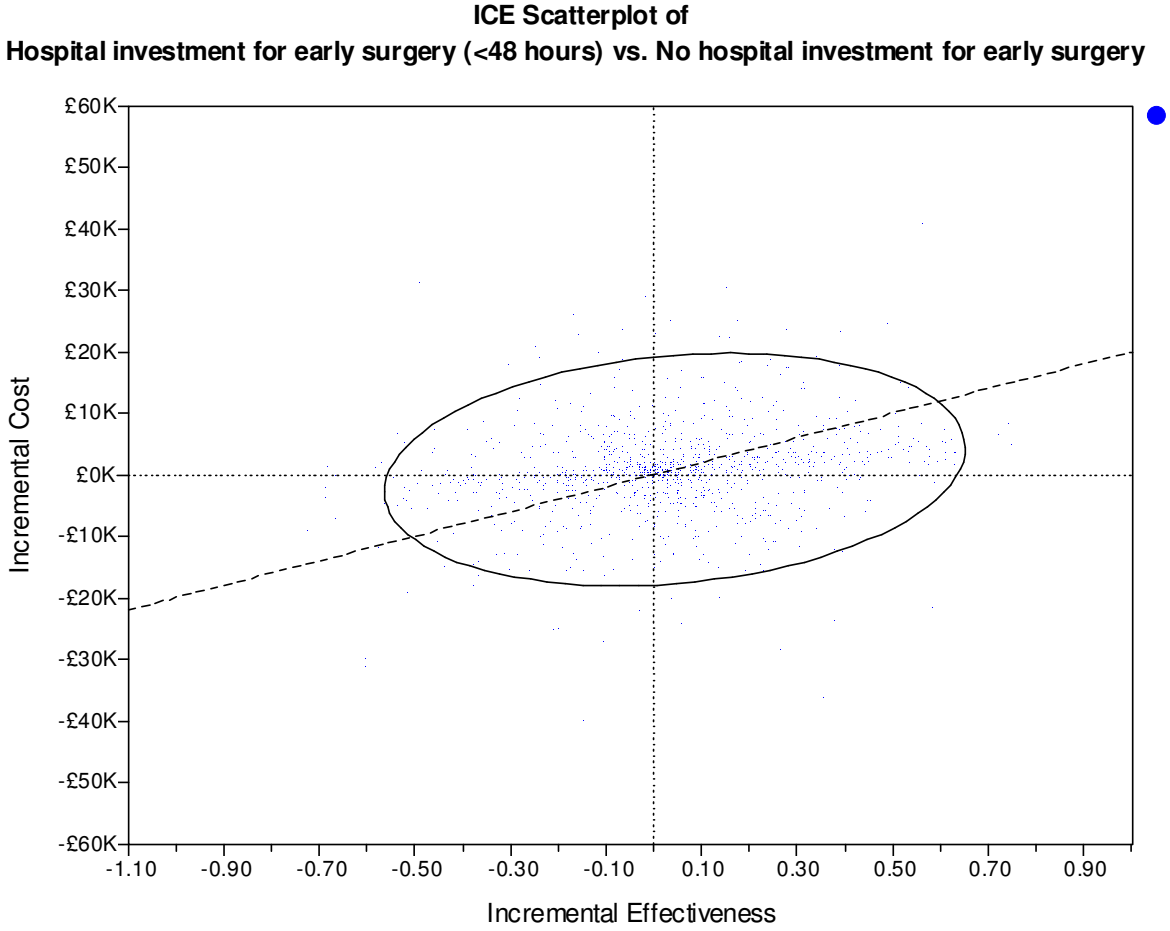
		lambda = 0.063579259	

The conventional way to interpret a cost-effectiveness analysis is to look at the option that is optimal based on mean results from the probabilistic sensitivity analysis. These findings are summarised in Table 88 below:

Table 88: Cost-effectiveness findings from probabilistic sensitivity analysis – first year following investment in extra lists

Strategy	Cost	Incremental Cost	Effectiveness	Incremental ffectiveness	Incremental C/E ratio (ICER)	95% CI
No hospital investment for early surgery	£46.4K		2.3212			
Hospital investment for early surgery (<48 hours)	£47.4K	£1.0K	2.3637	0.0425	£/QALY 22542	Cost saving - dominanted

The PSA shows that there is a high uncertainty as to whether “investment for early surgery” is cost-effective compared to “no investment for early surgery”. This uncertainty can be graphically represented by plotting the results of the incremental analysis for all the 10,000 simulations into a cost-effectiveness plane. Each point on the scatter plot represents the ICER of investment for early surgery versus no investment for early surgery for each simulation. The dotted line represents the £20,000/QALY threshold while the ellipse delimits the 95% confidence interval.



We found that the strategy of "investment in extra operating lists" was cost-effective in 50% of the simulations, both at a willingness to pay of £20,000 per QALY and of 30,000 per QALY.

*20.5.9.2*Scenario analysis: second year following implementation

We now compare the non-investment strategy versus the investment strategy, where for the latter we use data referring to the second year following the introduction of the additional operating lists. The findings of the deterministic and of the probabilistic cost-effectiveness analysis are summarised in Table 89 and Table 90 below.

Table 89: Cost-effectiveness results - deterministic analysis – second year following investment in extra lists

Strategy	Cost	Incremental Cost	Effectiveness	Incremental effectiveness	Incremental Cost-effectiveness ratio (ICER)
No hospital investment for early surgery	£46.4K		2.32		
Hospital investment for early surgery (<48 hours) ***(with probability of early surgery from second year of investment=84.49% and with total number of patients operated in that year = 441)***	£47.3K	£0.8K	2.413	0.093	£/QALY 9070

Table 90: Cost-effectiveness findings from probabilistic sensitivity analysis – first year following investment in extra lists

Strategy	Cost	Incremental Cost	Effectiveness	Incremental effectiveness	Incremental Cost-effectiveness ratio (ICER)
No hospital investment for early surgery	£46.4K		2.321		
Hospital investment for early surgery (<48 hours) ***(with probability of early surgery from second year of investment=84.49% and with total number of patients operated in that year = 441)***	£47.3K	£0.8K	2.415	0.094	£/QALY 8933

The strategy of introducing extra theatre list is therefore cost-effective from the second year of implementing the change aimed at reducing the waiting time to surgery for hip fracture patients.

20.5.10 Discussion

Our analysis showed that adding extra operating lists as a way of undertaking surgery within 48 hours from admission is slightly above the threshold of 20K/QALYs in the first year of implementation, but becomes clearly cost-effective from the second year onwards.

However, our cost-effectiveness estimates are likely to be conservative in that we did not look at the impact of early surgery on the presence of complications. This was because no information on complications was available from Siegmeth (2005)[308], and the other studies from the clinical review that did report data on complications could not be used since they did not exclude patients unfit for surgery from their population.

As resources and treatment effects data are based on information received from two specific hospital settings (John Radcliffe hospital in Oxford and the Peterborough and Stamford Hospital Foundation Trust), our findings may not be generalised to the whole NHS. For example, for some hospitals the addition of extra operating lists may not be feasible if no spare theatre capacity is available for this purpose.

In non-linear models, such as Markov models, there is often a difference between the deterministic and probabilistic results and in such cases the probabilistic results should take precedence. The findings of the PSA reported in section 20.5.9.1 show that there is a high uncertainty as to whether "investment for early surgery" is cost-effective compared to "no investment for early surgery". If we consider a 95% confidence interval the base case results did not reach statistical significance (as reported in table 85). Moreover, we found that the strategy of "investment in extra operating lists" was cost-effective in only 50% of the simulations, both at a willingness to pay of £20,000 per QALY and of 30,000 per QALY.
A possible extension of the model could look at the possibility of introducing extra operating lists during the weekend, which would be more expensive than weekdays, as personnel would have to be paid up to a time and a third more in salary (BMA contract 2003). Patients admitted at weekends or public holidays tend to do worse (Foss 2006)[97]). However, most large hospitals have trauma lists at the weekend, with planned trauma lists built into job plans. The reason why extra lists were introduced during weekdays in the model that we have developed is because it was acknowledged that there are more competing patients for planned trauma lists in those days, for

example patients requiring specialist reconstructions such as pelvic fractures or complex joint injuries.

20.6 Cost-effectiveness analysis of Hospital MDR vs Usual care

20.6.1 Introduction

The GDG identified as a high priority area for economic analysis the multidisciplinary management in hospital for hip fracture patients.

In the economic plan, the clinical question (number 13) linked to this high priority area is the following:

"What is the clinical effectiveness and cost-effectiveness of the following hospital-based multidisciplinary rehabilitation programmes:

- *Hip Fracture Programme (HFP),*
- *Geriatric Orthopaedic Rehabilitation Unit (GORU), and*
- *Mixed Assessment and Rehabilitation Unit (MARU)*

versus each other and versus usual inpatient rehabilitation for hip fracture patients?"

The GDG felt that there were sufficient similarities between the GORU and MARU rehabilitation programmes, and therefore decided to group the evidence for these interventions under the same category of "GORU/MARU". A detailed discussion of the main characteristics of each rehabilitation programme is presented in Chapter 12 of this Guideline, especially in sections 12.1 and 12.2.

A review of the literature was conducted. The literature search and review methods can be found in section 3. Despite some cost-effectiveness studies were identified, none represented a full cost-utility analysis which addressed our clinical question. As a consequence, the GDG felt that an original economic model of the listed interventions was essential in order to inform their recommendations.

The following general principles were adhered to:

- The GDG was consulted during the construction and interpretation of the model.
- When published data was not available we used expert opinion to populate the model.
- Model assumptions were reported fully and transparently.
- The results were subject to sensitivity analysis and limitations were discussed.
- We followed the methods of the NICE reference case. Therefore costs were calculated from a NHS and personal social services perspective. Health gain was measured in terms of quality-adjusted life-years (QALYs) gained. Both future costs and QALYs were discounted at 3.5%.
- The model employed a cost-effectiveness threshold of £20,000 per QALY gained.

- The model was peer-reviewed by another health economist at the NCGC.

20.6.2 Population and time horizon

The population for the cost-effectiveness analysis consists of hip fracture patients (male and female) hospitalised for surgery. The model spans over a life-time horizon.

20.6.3 Software

The cost-effectiveness analyses were conducted using TreeAge Pro 2008.

20.6.4 Structure of the model

20.6.4.1 Model cycles at time 0

We develop a Markov model with a cycle length of 3 months. Thus, all events are calculated on a 3 month basis at the end of which patients are in one of the possible health states. As the time horizon in our model is lifetime, these cycles will keep repeating for the duration of the life expectancy of the population in the studies.

The specific health states of our Markov model have been determined on the basis of the findings of the clinical review. During cycle 0 the health states are determined by the *types of complications* experienced while in hospital (and while undergoing their rehabilitation programme). Using evidence from the clinical review, we assume that during cycle 0, patients can occupy one of the following health states: “not recovered and with no complications”, “not recovered and with pressure sores”, “not recovered and with moderate delirium”, “not recovered and with severe delirium”, and “dead”.

This is a graphic representation of cycle 0 of the Markov model:

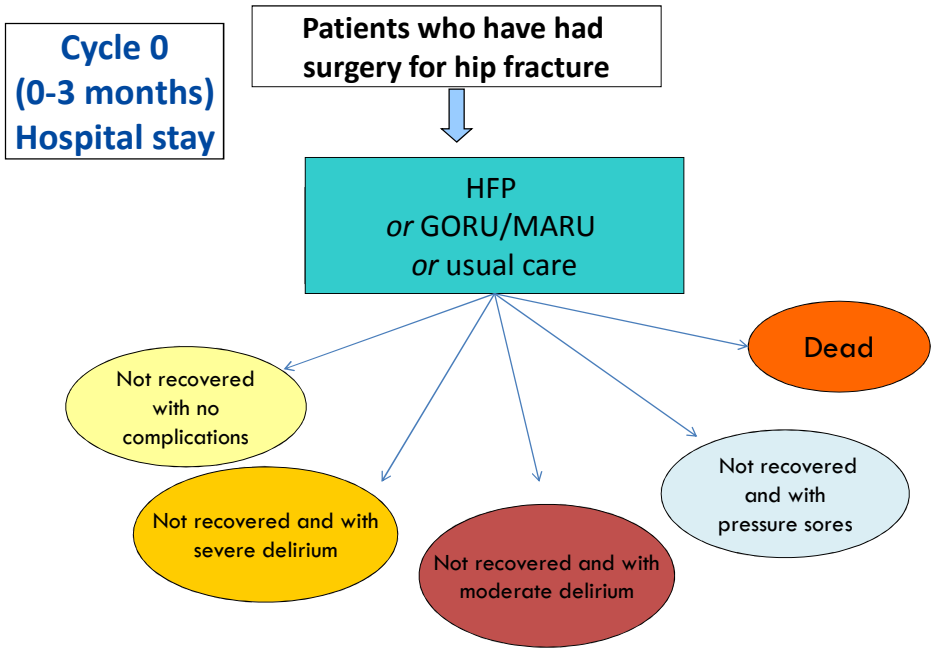


Figure 158: Cycle 0 Markov model

The above diagram illustrates that throughout their hospital stay (and hence, while still undergoing their rehabilitation programme) patients will be considered as "not recovered". Some of these "not recovered" patients will not develop any complications, but others will experience delirium (moderate or severe), or pressure sores.

Evidence and treatment effects on complications – Cycle 0 of the Markov model

The clinical review found evidence of complications only from RCTs of HFP vs usual care. The following complications were identified:

Table 91: Types of complications identified in the clinical review

Type of complication as reported in the clinical review	Source
Pressure sores	Vidan (2005)[344]
Heart failure	Vidan (2005)[344]
Pneumonia	Vidan (2005)[344]
Confusion	Vidan (2005)[344]
Chest infection, cardiac problem, bedsore	Swanson (1998)[325]
Stroke, emboli	Swanson (1998)[325]
Delirium	Marcantonio (2001)[203]

Severe delirium	Marcantonio (2001)[203]

The GDG decided to include the evidence on pressure sores from Vidan (2005)[344] and on delirium from Marcantonio (2001)[203]. This was because of the good quality of the evidence; the reliable ascertainment of these complications, and their well recognised impact on costs of hospital stay.

The findings of Vidan (2005)[344] on "confusion" were not considered in the economic model since they were not statistically significant and because they did not distinguish between "moderate" and "severe" confusion, so it was not possible to use these findings alongside those of Marcantonio (2001)[203] on delirium.

The evidence on complications from Swanson (1998)[325] was not included in the economic model since the paper only provided a composite figure for chest infections, cardiac problems and bedsores and did not distinguish among the different types of complications. As a consequence, it was not possible to determine the loss in health-related Quality of Life (QoL) due to each complication and the associated costs.

The evidence on pneumonia (Vidan 2005)[344] was also not included in the economic model, because it showed no difference between the intervention and control group.

The GDG decided to exclude the remaining complications (heart failure, and stroke) due to the weaker evidence of effectiveness in prevention and the unreliable ascertainment of the conditions. In particular, it was pointed out that 'heart failure' is very difficult to define and diagnose clinically, and that 'stroke' is a whole series of different conditions with hugely differing origins and outcomes. It should also be noted that it is unlikely that we have introduced a bias in our model because of the exclusion of these specific outcomes. In fact, despite the clinical review reported that the relative risk for heart failure and stroke was large and in favour of usual care, it was also true that they had wide confidence intervals, which meant that the difference was not statistically significant. Moreover, the GDG agreed that the lower event numbers associated with usual care was due to the fact that people had been less intensively monitored compared to the intervention arms of the studies, so that some events may have been missed in the control arm.

As a consequence, the model only looked at the following complications: pressure sores (from Vidan 2005)[344], moderate delirium and severe delirium (Marcantonio 2001)[203].

The clinical review did not find evidence of complications for GORU/MARU vs usual care. The GDG decided to consider the sample complications from the HFP (pressure sores, moderate and severe delirium) and assume that there was no difference between the intervention and usual care (and hence to consider a RR equal to 1). This assumption was subject to a sensitivity analysis. Table 91 below reports the transition probabilities for cycle 0 of the Markov model.

Table 92: Transition probabilities - cycle 0 of the Markov model

Transition Probability	Usual care	HFP	GORU
Probability moderate delirium*	22.0%	20.9% (RR 0.95)	22% (RR 1.00)
Probability severe delirium*	28.12%	11.25% (RR 0.4)	28.12% (RR 1.00)

Probability pressure sores**	16.46%	5.10 % (RR 0.31)	16.46% (RR 1.00)

*= source: Marcantonio (2001)[203].

**= source: Vidan (2005)[344]

*20.6.4.2*Cycles 1 – onwards

As for the health states for cycle 1 – onwards, we again used the findings of the clinical review and assume that, after their hospital discharge (and therefore, after their hospital-based MDR or their usual care has been completed), patients can transit between the following health states: "recovered", "not recovered", and "dead".

Vidan (2005)[344], Stenvall (2007)[320] and Shyu (2008)[305] report findings regarding the effectiveness of hospital MDR programmes versus usual care to help patients recover their pre-fracture Activities of Daily Living (ADL) levels. The "recovered" health state in our model refers therefore to the case in which patients have gone back to their pre-fracture ADL levels.

This is a graphic representation of cycles 1 to 3 of Markov model, following hospital discharge:

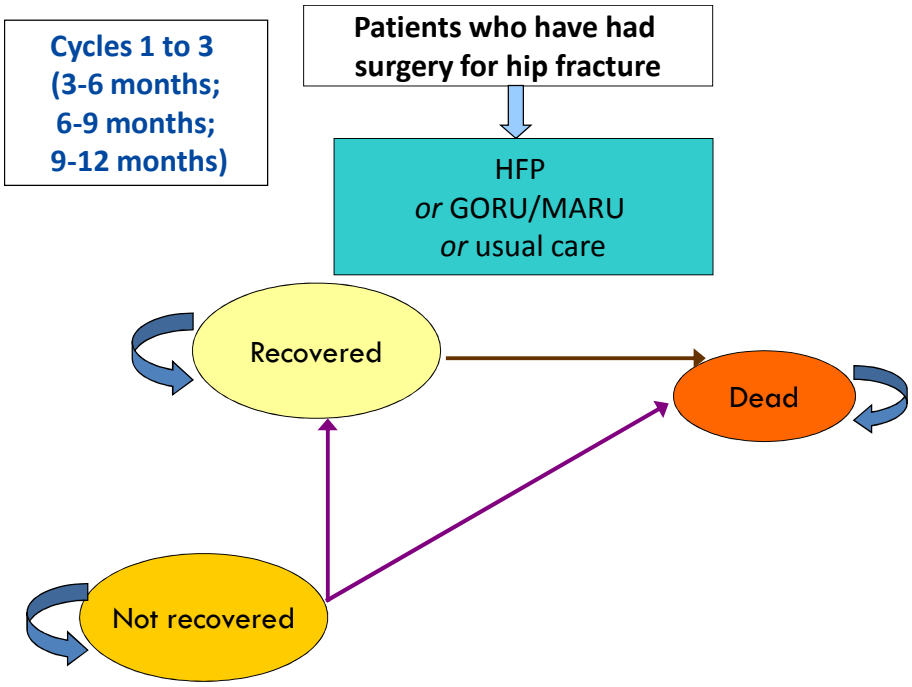


Figure 159: Cycles 1 to 3 of the Markov model

The above diagram illustrates that, up until 12 months, patients who are in the "recovered" health state can stay in the same state in the following cycles, or can transit to the "dead" health state.

However, patients in the "not recovered" health state can stay in the same state at the end of each cycle, or transit to the "recovered" or "dead" states. This is because, from the clinical review, we only have data regarding the transition of patients from the "not recovered" to the

"recovered" health state, and these data are only available up until 12 months follow up period. No clinical data are available regarding the possible transition of the "recovered" patients to the "not recovered health state".

From 12 months onwards, we assume that patients will no longer transit from the "not recovered" to the "recovered" health state, and that patients can only remain in the state they are in or transit to the "dead" state. This is because no clinical data are available from the clinical review after that point. Hence, the relevant transitions between health states after 12 months will be:

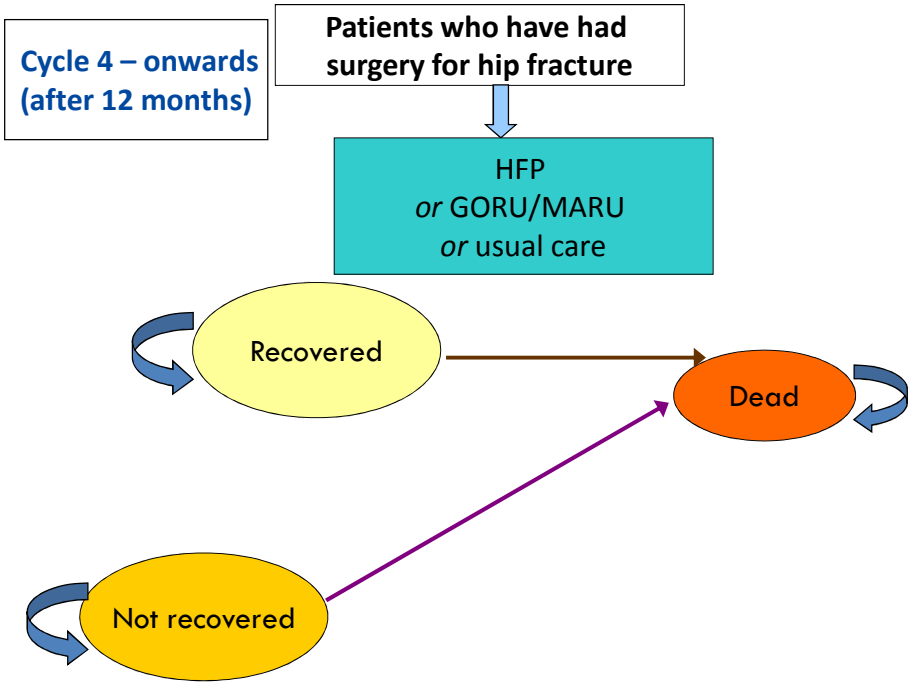


Figure 160: Cycle 4 - onwards of the Markov model

That is, from cycle 4 onwards, patients who are in the "recovered" health state will stay in that state or transit to the "dead" state. Similarly, patients in the "not recovered" health state will remain in that state or transit to the "dead" state. The GDG noted that the assumption that people remain in the same health state from 12 months onwards is clinically reasonable, as from that time patients' health state will no longer be influenced by their hip fracture. All possible events after this time (e.g. death, falls, needs for care home etc) will take place at rates that are consistent and in line with those of the general population and that therefore will no longer be a consequence of the hip fracture nor of the specific rehabilitation programme received.

Whether they are "recovered" or "not recovered", the place of residence at hospital discharge for patients will also be affected by whether they received usual care, HFP or GORU/MARU as a form of rehabilitation programme. This circumstance is represented in Figure Figure 161: Place of residence at discharge below:

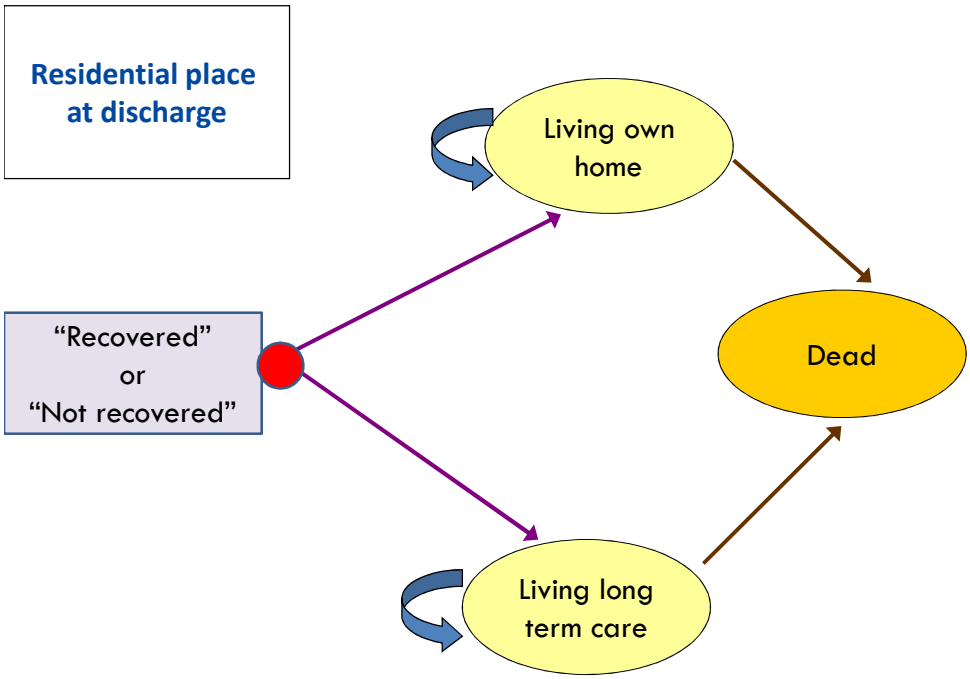


Figure 161: Place of residence at discharge

No evidence is available from the clinical review regarding whether patients discharged to their own home would then transit to the "living in long term care" setting in subsequent cycles of the model, and vice versa. Hence, we make the assumption that patients will keep living in the same place of residence they had when they were discharged from hospital, and that they can only transit to the "dead" state in the following cycles.

Evidence and treatment effects on recovery of ADL levels and on place of residence at discharge

Table 93 reports the levels of the transition probabilities used in the model

Table 93: Transition probability of Not Recovery of ADL pre-fracture levels

Transition probability of Not Recovery of ADL pre-fracture levels	Usual care	HFP	GORU/MARU
At 3 months[(1)]	0.73	0.5767 (RR=0.79)	0.5694 (RR=0.78)
At 6 months[(1)]	0.67	0.5293 (RR=0.79)	0.5226 (RR=0.78)
At 9 months[(2)]	0.63	0.4977 (RR=0.79)	0.4914 (RR=0.78)
At 12 months[(3)]	0.59	0.4661 (RR=0.79)	0.4602 (RR=0.78)

[(1)]Data at 3 and 6 months from Vidan[344]

[(2)]Data at 9 months obtained with a linear extrapolation from the transition probabilities in Vidan[344]

[(3)]Data at 12 months pooled from Vidan, Shyu and Stenvall[305,320,344]

As for the place of residence following hospital discharge, we use the following treatment effects in our model:

	Usual care	HFP	GORU/MARU
Probability of returning to own home*	0.71	0.8094 (RR=1.14)	0.7881 (RR=1.11)

*source: NCGC meta-analysis of clinical trials

20.6.5 Evidence and treatment effects on mortality

In our model we distinguished two types of mortality: short-term mortality (within 12 months from the start of the rehab programme) and long-term mortality (after 12 months).

SHORT-TERM MORTALITY

In order to take into account the difference in mortality due to the intervention, we used the data from the RCTs included in our meta-analysis to estimate mortality. The data available from the RCTs can be found in Table Table 93.

Table 94: Proportion of patients dead at different time points

	6 months	12 months
Usual care[1]	16.73%	21.38%
HFP[2]	NA	17.32% (RR 0.81)
GORU/MARU[2]	13.22% (RR 0.79)	20.31% (RR 0.95)

1 Data pooled from the usual care arms of RCTs in the clinical review

2 RR calculated compared to usual care

Data were available for usual care and GORU at 6 and 12 months from randomisation. Only 12 month data were available for the HFP intervention.

When more than one time points was available (i.e. for the usual care and GORU/MARU arms), the probability of dying was calculated from the data reported in Table 4 as follows:

Prob_die_y to x = (% dead time x - % dead time y)/(1 - % dead time y)

Where:

Prob_die_y to x is the probability of dying from time y to the following time x

- "% dead time x" is the proportion of patients dead at time x
- " % dead time y" is the proportion of patients dead at time y

To convert probabilities into a 3-month transition probability, which is the cycle length of the model, we used the formula:

1 - exp((ln(1- Prob_die_y to x))/((x-y)/3)

Where x and y are the initial and final time points of the interval considered, exp(a)=exponential of a; and ln(a)=natural log of a.

LONG-TERM MORTALITY

The mean age of the patients when entering the model was 81 as this was the mean age of patients in the RCTs.

Life expectancy in people who were alive one year after a hip fracture was assumed to be the same as the general population in England and Wales, as reported in a study (Parker1992, citing Elmerson1988)[268]. The remaining life expectancy for the participants of the RCTs was obtained from the Life Tables for the general population of England and Wales in the year 2005-2007 from the Government Actuary Department (http://www.gad.gov.uk/Documents/Demography/EOL/ILT%202005-07/wltewm0507.xls).

The value was adjusted for the ratio male/female corresponding to the patients characteristics in the RCTs as follows:

Total LE = LE_{female} * %female + LE_{male} * %male

20.6.6 Utilities data

20.6.6.1 Utilities for cycle 0 (0-3 months)

Utilities indicate the preference for health states on a scale from 0 (death) to 1 (perfect health). Quality of life values are attached to all health states.

Stage 0 of the model refers to the first three months of the Markov model. They capture the time that the patients spend in hospital, during which they undergo a surgical treatment of the fracture, following which the rehabilitation process starts.

The utility weights for the health states in cycle 0 are summarised in Table 94.

Table 95: Utility weights for cycle 0

Table 5: Utility weights for cycle 0**Health state**	**Base case value**	**Source**
"Not recovered, no complications"	0.314	ADL levels from Kennie (1988)[176]; EQ-5D scores from Tidermark (2002)[328]
"Not recovered and with pressure sores"	0.19	Essex (2009)[86]
"Not recovered and with moderate delirium"	0.314	ADL levels from Kennie (1988)[176]; EQ-5D scores from Tidermark (2002)[328]
"Not recovered and with severe delirium"	0.25	NICE clinical guideline on Delirium[224]

We assume that the utility for the "not recovered, no complication" health state in the first three months is the same as that of the "Not recovered" health state after the hospital discharge (i.e. after the first cycle). The following paragraph explains how the utility for the "not recovered, no complication" health state is obtained.

The NICE guideline on Delirium[224] reports utility weights for patients with moderate and severe delirium using the finding of Ekman (2007)[76] on patients with dementia. Ekman (2007)[76] estimates that the mean utility score for mild, moderate and severe dementia correspond to 0.62, 0.40 and 0.25 respectively. As for pressure sores, Essex (2009)[86] reports an EQ-5D score of 0.19 for patients experiencing this complication. EQ-5D scores were obtained from a survey of a sample of 6 patients with pressure ulcers.

We proceeded by selecting the *lowest* EQ-5D score between the "not recovered with no complication" health state and the EQ-5D linked with that particular complication (moderate delirium, severe delirium or pressure sores). Thus, being the utility for "moderate delirium" 0.4, and being this utility higher than the one of the "not recovered with no complication" health state (0.4 vs 0.314), we selected the latter also for the "not recovered and with moderate delirium" health state.

However, the utility score for patients with severe delirium identified in the literature was lower than then the score for the "not recovered, no complications" health state (0.25 vs 0.314). Similarly, the utility score for pressure sores identified in the literature was lower than the one of the "not recovered, no complications" health state (0.19 vs 0.314). Hence, we used the EQ-5D score for those specific complications (severe delirium, pressure sores) in our model.

*20.6.6.2*Utilities for cycles 1 – onwards (3 months – onwards)

In order to assign an utility level to each of the health states for the model in cycles 1-onwards (that is, "recovered" and "not recovered"), we proceeded by using the RCT included in our clinical review by Kennie et al (1988)[176] which reports the number of patients (in the treatment and control group) classified according to their level of independence in activities of daily living *before admission* (i.e. before the hip fracture) and *at entry into study* (i.e. before the rehabilitation program has started). This information is summarised in Table 95 and Table 96 below.

Table 96: ADL levels before admission for treatment and control group (source: Kennie et al 1988)[176]

Independence in activities of daily living before admission (Katz index)	***Treatment group (n=54)***	***Control group (n=54)***
A	*21*	*28*
B	*14*	*11*
C	*6*	*6*
D	*3*	*3*
E	*2*	*1*
F	*2*	*1*
G	*1*	*1*
Not classified	*5*	*3*

Table 97: ADL levels at entry into study for treatment and control group (source: Kennie et al 1988)[176]

Independence in activities of daily living at entry into study (Katz index)	Treatment group (n=54)	Control group (n=54)
A	0	0
B	1	0
C	1	0
D	2	3
E	18	19
F	23	16
G	7	15
Not classified	2	1

Source: Kennie et al (1988)[176]

We use the data for the "independence in ADL before admission" to calculate the proportion of independent and dependent patients that are in the "recovered" health state. Similarly, we use the information on ADL for patients at entry into study to calculate the proportion of independent and dependent patients that are in the "not recovered" health state.

As a consequence, we have:

- *% of patients with A-B score in the "recovered" state:*
  (21+14) (from the treatment group) + (28+11) (from the control group)/100 = 74%

- *% of patients with A-B score in the "not recovered" state:*
  1/100 = 1%

Hence, in the "recovered" health state, 74% of patients have an ADL score of A-B, and 26% of patients in the same state have an ADL score of C-G. On the other hand, in the "not recovered" health state, only 1% of patients have ADL score of A-B, the rest having an ADL score of C-F.

For each of these two states we calculated the *composite utility*, that is the utility for the "independent" and for the "dependent" patients. Tidermark (2002)[328] reports EQ-5D scores associated with ADL scores of A-B and C-F for hip fracture patients at 4 months after the fracture. These weights correspond to: 0.68 for ADLs of A-B, and to 0.31 for ADLs of C-G.

Using the proportion of patients who were reported as independent and as dependent before admission for the "recovered" health state we have:

74% * 0.68 = 0.053

26% * 0.31= 0.081

Thus, the utility weight for "recovered" health state corresponds to 0.584

As for the "Not recovered" health state we have:

1% *0.68 = 0.0068

99%*0.31 = 0.307

Thus, the utility weight for "not recovered" health state is: 0.314. We summarise these findings in Table 98:

Table 98: Utility weights for health states in cycles 1 -onwards

Health state	EQ-5D	Source
"Recovered"	0.584	ADL levels from Kennie (1988)[176]; EQ-5D scores from Tidermark (2002)[328]
"Not recovered"	0.314	ADL levels from Kennie (1988)[176]; EQ-5D scores from Tidermark (2002)[328]

20.6.7 Calculating QALYs gained

For each strategy (HFP, GORU/MARU and usual inpatient rehabilitation), the expected QALYs in

each cycle are calculated as follows:

$$\textbf{Expected QALYs} = \Sigma (U_i \times P_i)$$

where

U_i = the utility score for health state i

P_i = the proportion of patients in health state i

and where health state i could be any of the health states reported in the Figures 147 and 148.

The proportion of patients in each health state depends on the effectiveness of the treatment, and on the proportion of patients still alive, which falls as the number of cycles and therefore age increases.

The overall *lifetime expected QALYs* are given by the sum of QALYs calculated for each cycle. The *incremental QALYs gained* associated with a treatment strategy are calculated as the difference between the expected QALYs with that strategy and the expected QALYs with the comparator.

20.6.8 Cost data

20.6.8.1Cost data: cycle 0 (hospital stay)

During hospital stay, the costs will depend on the rehabilitation programme, the length of hospital stay and health state related costs. We analyse each category in turn.

Cost of the rehabilitation programme

The NICE "Guide to the methods of technology appraisal" points out that national data based on healthcare resource groups (HRGs), such as the Payment by Results tariff, are a valuable source of information for resource use and costs and should be considered for use whey they are appropriate and available ("Guide to the methods of technology appraisal", 2008, page 40). However, data based on HRGs may not be appropriate in all circumstances, especially when the definition of the HRG is broad or the mean cost probably does not reflect resource use in relation to the interventions we are evaluating.

In our case, we would be using the HRG4 as the source to cost our rehab programmes. In the document: "Casemix Service HRG4 - Guide to unbundling" it is pointed out that the HRG4 refers to cases of **Discrete Rehab** services:

"[..] only discrete rehabilitation activity and costs should be reported using the rehabilitation HRG4 categories, for the reference costs collection."

And the 2007 document on Collection Guidance on Reference Costs for 2006-07 specifies that:

"Rehabilitation HRGs are only generated where care is identified as taking place under a specialist rehabilitation consultation or within a discrete rehabilitation ward or unit. [..] Where a patient is not admitted specifically to a rehabilitation unit or where rehabilitation treatment is undertaken without transfer to a specialist consultant, or without transfer to a rehabilitation unit, this should not be reported as discrete rehabilitation".

It would therefore seem that whilst this definition could apply to the GORU/MARU model (where a patient is discharged from the orthopaedic unit and admitted to a separate geriatric orthopaedic unit to receive the rehabilitation), it could not reflect the case of a HFP, where a patient is not usually discharged to the care of a specialist rehabilitation consultant.

Thus, whilst we could use the HRG4 to cost a GORU and a MARU programme, we would not be able to use it to cost a HFP.

As a consequence, the GDG decided to evaluate the cost of the different rehabilitation programmes using the level of resources specified in the different RCTs included in the clinical review. When necessary, such levels have been adjusted by expert opinion to reflect a pattern of care closer to the UK health care setting (see below).

The resources used in the different RCTs have been reported as *incremental* resources used with respect to the usual care arm of the study. Using information on unit costs for NHS personnel provided by the PSSRU 2009, we were then able to estimate the *incremental cost* of both HFP and GORU/MARU with respect to usual care.

Moreover, it is important to note that the level of resources used in the two hospital-based MDR programmes are calculated in such a way to reflect the length of hospital stay of the patients in our model. Thus, we use the length of stay for the HFP to calculate the incremental resources and costs for that programme, as follows. Similarly, we use the length of stay for GORU/MARU to calculate the incremental resources and costs for that rehab programme.

Tables 9 – 11 summarise the incremental resources used in the HFP and the GORU/MARU programme, compared to usual care.

Table 99: Incremental resource use for GORU/MARU programme versus usual care

Staff resources	Incremental resources used, based on a LOS of 32.88 days	Source	Unit cost (source: PSSRU 2008/09), £ per hour	Incremental cost
Orthogeriatrician	Two consultant ward rounds (0.25/hour per patient each) and one weekly conference (0.25/hour = **0.75 hour per week per patient 0.75*4.6 weeks = 3.45 hours per patients**	Kennie et al (1988)[176]	£108	£372.6
Physiotherapist	8.5 hours per patient	Naglie 2002[222]	£23	£195.5
Occupational therapist	5 hr/patient	GDG adjustment from the 7.5 hr/pt reported in Naglie[222]	£23	£115
Nurse	Initial assessment within 72 hours (0.5 hour per patient) and twice weekly assessment afterwards (0.25*2)/hour per patient 0.5+0.5*4.6 weeks= 2.8 hours per patient	Naglie 2002[222]	Nurse team leader: £27 Nurse day ward: £21	£75.6 £58.8
Social worker	-0.4 hour per patient	Naglie 2002[222]	£29 (from community data)	-£11.6
Dietician	-0.4 hour per patient	Naglie 2002[222]	£23/	-£9.2
Total incremental cost for GORU/MARU over usual care:				**£721 (with generic nurse, Band 5); £738 (with team leader nurse, Band 6)**

Table 100: Incremental resource use and incremental cost for HFP over usual care

Staff resources	Incremental resources used based on a LOS of 25.5 days	Source	Incremental cost (using PSSRU 2008/09 unit costs)
Orthogeriatrician	Initial assessment 0.5 hour per patient, and subsequently 0.25 hour per day: **0.50 + 0.25*24.5 =6.625 hour per patient**	Cameron (1993)[44]; Shyu (2008)[305]; Marcantonio[203]	£108*6.625=£715.50
Physiotherapist or nurse	0.5 hour per patient per day: **0.50*25.5=12.75 hours**	Cameron (1993)[44]	£23*12.75=£293.25
Total incremental cost of HFP over usual care: £1009			

Hence, the incremental cost for HFP over usual care is £1009, while for the GORU/MARU programme it is £721 (with generic nurse) or £738 (with team leader nurse).

Health state related costs in cycle 0

To calculate the health state costs during the hospital stay, we used the NHS reference cost for excess bed days reported in table 28 below. The excess bed day cost is the cost per day for days exceeding the trimpoint, a cut-off that determines patients with exceptionally long stay, and as such usually estimates the cost of care without the cost of procedures (i.e. without the cost of the surgery. These costs reflect the presence of complications experienced by hip fracture patients during their entire hospital stay. Moreover, they distinguish between "major" and "intermediate" complications, thus allowing users to take into account the different degrees of resource use.

Table 101: National Schedule of Reference Costs Year : '2008-09' - NHS Trusts and PCTs combined Non-Elective Inpatient (Long Stay) Excess Bed Day HRG Data for hip procedures

Currency Code	Currency Description	Activity	National Average Unit Cost
HA11A	Major Hip Procedures Category 2 for Trauma with Major CC	360	£243
HA11B	Major Hip Procedures Category 2 for Trauma with Intermediate CC	620	£242
HA11C	Major Hip Procedures Category 2 for Trauma without CC	162	£220
HA12B	Major Hip Procedures Category 1 for Trauma with CC	9,760	£237
HA12C	Major Hip Procedures Category 1 for Trauma without CC	1,230	£226
HA13A	Intermediate Hip Procedures for Trauma with	14,891	£240

	Major CC		
HA13B	Intermediate Hip Procedures for Trauma with Intermediate CC	12,856	£249
HA13C	Intermediate Hip Procedures for Trauma without CC	2,972	£223
HA14A	Minor Hip Procedures for Trauma with Major CC	5,195	£234
HA14B	Minor Hip Procedures for Trauma with Intermediate CC	5,808	£245

The GDG decided to calculate a weighted average cost of the different categories of hip fractures taking into account the level of activity associated with each procedure.

To cost the health state "not recovered with pressure sores" we use evidence from Bennett (2004)[17] regarding the cost of pressure ulcer treatment in the UK. The paper calculates the daily cost of treating pressure ulcers looking at resources such as nurse time (dressing changes, patient repositioning and risk assessment) dressings, antibiotics, diagnostic tests, and support surfaces. These costs do not include inpatient costs, but assume that the patients are cared for in an institutional setting (hospital or long-term care).

Pressure ulcers can have a different "grade", ranging from 1 to 4 as their complexity increases. However, the GDG emphasised that the published evidence on the incidence of the different types of pressure sores in hip fracture patients reports many contradictory findings from which it is difficult to draw definitive conclusions when it comes to costs. We followed the evidence in Rademakers (2007)[278] and assumed that 97% of the pressure ulcers were of grade 2, and 3% of grade 3 or 4.

Bennett (2004)[17] reports a daily cost for grade 2 pressure sores of £42, and of £50 for grade 3 and 4. These daily costs refer to patients who do not develop any further complications linked to the pressure sores (such as critical colonisation, cellulites, or osteomyelitis), as no evidence on such conditions was available from the RCTs included in our clinical review. Table 102 reports the total daily cost for the "not recovered with pressure sores" health state.

Table 102: Total daily hospital cost for patients with pressure sores

Category of cost	Level of cost
Daily inpatient hospital cost without complications	£220.07
Daily cost of grade 2 pressure sore	0.97*£45
Daily cost for grade 3 and 4 pressure sore	0.03*£50
Total daily cost for patients with pressure sores	**£265.22**

For the cost of the health state "not recovered with moderate delirium" we used the mean weighted average cost for minor complications (£237), and for the cost of the health state "not recovered with severe delirium", we used the mean weighted average cost for major and intermediate complications (£242.89). One limit with this approach is that all patients with moderate delirium are assumed to have undergone a Major Hip Procedures Category 1 for

Trauma. Even if the difference between the two cost figures is quite low (£5.89) we test the impact of this assumption on the base case findings in a sensitivity analysis.

It has to be emphasised that this approach to calculate the health state costs in cycle 0 is necessary in that only figures regarding the *total* length of hospital stay are available from the evidence included in our clinical review. Ideally, we would have needed information regarding the *additional* length of hospital stay for the patients experiencing a particular complication, both for the control and for the intervention groups, but this information was not available from the clinical review. Moreover, even if Marcantonio (2001)[203] reports the hospital days of delirium per episode, it does not distinguish between the two types of delirium (moderate and severe) that correspond to our health states in cycle 0 of the Markov model, and only gives an overall figure for all types of delirium.

Table 103: Daily inpatient average cost for health states in cycle 0

Health state	Average daily cost	Source
Not recovered and with no complications	£220.07	Mean weighted average of excess bed days costs – NHS reference costs 2008-08 Major, Intermediate and Minor Hip procedures *with no complications*
Not recovered and with pressure sores	£265.22	See Table 29
Not recovered and with moderate delirium	£237	Mean weighted average of excess bed days costs – NHS reference costs 2008-08. Major, Intermediate and Minor Hip procedures *with minor complications*
Not recovered and with severe delirium	£242.89	Mean weighted average of excess bed days costs – NHS reference costs 2008-08. Major, Intermediate and minor hip procedures *with intermediate and major complications*

Evidence and treatment effects on length of hospital stay

The studies included in the clinical review comparing the GORU/MARU programme vs usual care only reported the *total* length of hospital stay for patients in the intervention arm of the study. Hence, no information was available to evaluate the number of days patients spent in the orthopaedic ward and the number of days they spent in the orthogeriatric rehabilitation hospital ward.

To calculate the length of stay at baseline (i.e. the usual care arm of the model), we pooled the data for the usual care arm from all RCTs included in the clinical review. Table 104 reports the relevant values for hospital length of stay used in the model:

Table 104: Mean length of hospital stay

Mean length of stay - usual care (days)	**31.56**

Mean difference length of stay - HFP (days)	-6.06
Mean difference length of stay - GORU/MARU (days)	1.32

*20.6.8.2*Cost data: cycle 1 - onwards

From cycle 1 – onwards, the costs for our model will depend on the place of discharge (whether own home or residential or nursing home), which in turn will affect the level of health care services and social care used, and on the probability of hospital readmissions.

Hospital readmissions

The RCTs on HFP versus usual care included in the clinical review did not report any information over the reasons for hospital readmissions nor the associated length of stay.

Two RCTs on GORU/MARU versus usual care (Galvard 1995 and Stenvall 2007)[107,320] reported data on length of stay following readmission available from two RCTs on GORU/MARU. However, the reasons for readmissions (whether orthopaedic-related or any other medical reason) were only given in Galvard (1995)[107].

Given the lack of data from the clinical review, the GDG decided to assume that readmissions were composed by an equal proportion of patients are readmitted for surgery, medicine and rehabilitation reasons. This assumption was also supported by unpublished data on readmissions following hip fracture obtained from a GDG member and based on hospital records from Peterborough and Stamford NHS Foundation Trust.

As for the length of stay following a hospital readmission, we followed the most recent clinical paper (Stenvall 2007)[320] and assumed a LOS for readmission for usual care is 11 days and in the intervention (whether GORU/MARU or HFP) is 7 days.

The cost data for the hospital readmissions were obtained from Czoski-Murray (2007)[63], which reports the unit costs for inpatient stay (at 2002 prices) for surgery (£381), medicine (£282) and rehabilitation (£188). These costs are based on Netten et al (2002)[241]. The mean unit cost for inpatient stay for readmissions (at 2009 prices) was estimated at £367.00. This price has been obtained using the annual percentage increases for prices of hospital and community health services (HCHS) for 2002/03 – 2008/09 reported in the PSSRU 2009 report[61].

Community care costs for the "recovered" and "not recovered" health states when discharged to own home

To analyse the costs associated with the "recovered" and the "not recovered" health states we need to take in to consideration whether patients are discharged to a long-term care setting or to their own home.

The GDG decided that in determining the level of community (that is, health care and social care) resources used after the hip fracture and after the rehabilitation programme it was important to reflect the level of "*dependency*" and "*independency*" in activities of daily living of patients in each of the health state.

The PSSRU 2009 identifies five different "packages" of community care provided in the home setting of the patient (also known as "domiciliary care"), according to the different level of

dependency in the activities of daily living of the recipients. These packages of care are summarised in Table 105 below.

Table 105: Weekly costs of community care packages – excluding accommodation and living expenses. Source PSSRU 2009.

Community care package	Description of the level of functional ability of the recipient of care	Weekly cost (excluding accommodation, living expenses and independently provided home care)	Average weekly cost of social care services	Average weekly cost of health care services
"Very low cost"	Mrs A. had problems with three activities of daily living: stairs, getting around outside, and bathing. Her problems stemmed from a previous stroke.	£49	**£41.3** (£18.10 of home care (one hour of weekly local authority-organised home care)) and £23.20 of meals on wheals)	**£7.70** for a 11.7 minutes of GP surgery visit (one every four weeks)
"Low cost"	Mrs B. had problems with three activities of daily living: stairs, getting around outside and bathing. Her problems stemmed from arthritic conditions and cardiovascular disease.	£87(1)	**£72** of home care (4 hours of local authority-organised home care)	**£14.3** (of which £6.60 of community nurse (one visit per month) and £7.70 of one GP visit (one every four weeks))
"Median cost"	Mrs C. had problems with four activities of daily living: stairs, getting around outside, dressing and bathing.	£188	**£181** of home care (10 hours of weekly local authority-organised home care)	**£7.70** for a 11.7 minutes of GP surgery visit (one every four weeks)
"High cost"	Mr D. had problems with seven activities of daily living: stairs, getting around outside and inside the house, using the toilet, transferring between	£273	**£216** (of which £181 of home care (10 hours of weekly local authority-organised home care) and £35 for a	**£58** £26 of community nurse (once a week); £24 for two monthly OT visits; £7.70 for a 11.7 minutes of GP

	chair and bed, dressing and bathing. His problems stemmed from arthritic conditions and a previous stroke.		day centre attended once a week)	surgery visit (one every four weeks)
"Very high cost"	Mrs E suffered from dementia and needed help with nine activities of daily living: stairs, getting around outside and inside the house, using the toilet, transferring between chair and bed, dressing, bathing, washing and feeding.	£576	**£542** of home care (30 hours of weekly local authority-organised home care)	**£34** £26 of community nurse (once a week); £7.70 for a 11.7 minutes of GP surgery visit (one every four weeks)

(1) Please note that the cost figure reported in the PSSRU 2009 for "low cost" is not correct (£129) as the cost for the independently provided health care has not been subtracted (£42). The correct figure should be £87.

We used the data from Kennie (1988)[176] to determine the proportion of patients with level of independence from A to G to attribute the community care costs to the "recovered" and "not recovered" health state.

For both health states ("recovered" and "not recovered"), we assume that patients with ADL score A or B do not incur in any domiciliary care cost. However, we assume that the same type of patients will each visit the GP once weekly.

The weekly health and social care costs are calculated by multiplying the weekly unit cost of the different type of care (as obtained from the PSSRU 2009) times the proportion of patients with the corresponding ADL score in the specific health state and times the level of resources used (which depend on the level of dependency). The health and social care costs for the "recovered" and "not recovered" health states are described in Table 106 and in Table 107 below.

Table 106: Health and social care costs for patients in the "recovered" health state discharged at their own home

ADL	% ADL in recovered state	Unit health care costs	Health cost for recovered state	Unit social care costs	Social care costs for recovered state
A	0.454	7.7	3.4958	N/A	N/A
B	0.231	7.7	1.7787	N/A	N/A
C	0.112	7.7	0.8624	41.3	4.6256
D	0.056	7.7	0.4312	41.3	2.3128
E	0.028	14.3	0.4004	72	2.016
F	0.028	7.7	0.2156	181	5.068

G	0.018	58	1.044	216	3.888
NC	0.073	34	2.482	542	39.566
		Total	10.7101	Total	57.4764
		Annual health care cost	**556.925**	**Annual social care cost**	**2988.77**

Table 107: Health and social care costs for patients in the "not recovered" health state discharged at their own home

ADL	% ADL in not recovered state	Unit health care costs (£)	Health cost for recovered state (£)	Unit social care costs (£)	Social care costs for recovered state (£)
A	0	0	0	N/A	N/A
B	0.009	7.7	0.0693	N/A	N/A
C	0.009	7.7	0.0693	41.3	0.3717
D	0.046	7.7	0.3542	41.3	1.8998
E	0.342	14.3	4.8906	72	24.624
F	0.362	7.7	2.7874	181	65.522
G	0.204	58	11.832	216	44.064
NC	0.028	34	0.952	542	15.176
			20.9548		151.658
		Annual health care cost	**1089.65**	**Annual social care cost**	**7886.19**

Hence, the annual health and social care costs for the "recovered" and the "not recovered" health state are:

Table 108: Annual health and social care costs for the "recovered" and the "not recovered" health state

Annual health care costs	**£557**	**£2989**
Annual social care costs	£1090	£7886
Total community care costs	**£1647**	**£10875**

While the health care costs will be fully funded by the NHS, the social care costs will only be generally partially funded by the local councils[71], [348], [72], [144]. It was not possible to identify a national average for the social care costs funded by local authorities in the published literature, and as a consequence an assumption had to be made regarding the proportion of this care that was publicly funded. In the base case analysis, we assume that 60% of social care costs are funded by the local authorities, and are therefore includable in the model, and we then test this assumption in a sensitivity analysis.

Community care costs for the "recovered" and "not recovered" health states when discharged to long term care

The cost of long term care used in the model was estimated from the unit cost of stay in private nursing homes, private residential care, voluntary residential care and local authority residential care facility for older people. The care package costs per permanent residential week are described in Table 109.

Table 109: Weekly long term care costs for patients not discharged to their own home. (Source: PSSRU 2009).

Type of long term care	Weekly health care costs	Weekly fees (minus living expences)
Private nursing home	**£30.80** £30.00 (GP weekly home visit) £0.80 (community nursing)	£678
Private residential care	**£26.3** £19.30 (GP weekly home visit) £7.00 (community nursing)	£467
Voluntary residential care	**£28.7** £19.30 (GP weekly home visit) £9.40 (community nursing)	£470
Local authority residential care	**£20.9** £10.60 (GP weekly surgery visit) £10.30 (community nursing)	£902

These unit costs include the cost of external services such as community nursing, GP services as well as personal living expenses. They also include capital costs for the local authority residential care, and fees for the private and voluntary residential care. We subtracted £9.20, the cost of personal living expenses per week, from each unit cost and estimated **£717.05**, the weighted average of £708.80, £493.80, £489.80 and £913.80, to be the weekly unit cost of long term care. By also subtracting the health care costs, we get: **£557.64 as the weekly fees** for long term care (£28997 per year). The (weighted) **health cost per week is £27** (£1404 per year).

The weighting is based on the distribution of residents, 65 years and older, in care homes in 1996. It was reported that in nursing homes, local authority, private and voluntary residential homes the number of residents were 5746, 5476, 2791 and 3664 respectively (Netten et al 1998)[240]. A similar approach is also followed in the cost-effectiveness analysis conducted in the NICE Delirium Guideline[224].

It is important to note that, contrary to the community care packages for domiciliary care, we could not distinguish the level of long-term residential care according to the level of "dependency" in ADL of the patients in the different health state. Hence, the same figure for community costs had to be used both for the "recovered" and "not recovered" health states if not discharged at their own home.

As with the domiciliary care, the health care costs in table 18 will be fully funded by the NHS, but the residential fees for long term care will only be generally partially funded by the local councils. Moreover, only a very small proportion of patients (about 2%) qualifies for fully funded NHS care

(the so called "continuing care")[71, 348, 72, 144]. It was not possible to identify a national average for this figure in the published literature, and as a consequence an assumption had to be made regarding the proportion of residential costs in long term care paid by local authorities. In the base case analysis, we assume that 60% of residential fees costs are funded by the local authorities, and then change this assumption in a sensitivity analysis.

20.6.9 Cost-effectiveness findings for base-case analysis

In the base case analysis, HFP is the dominant strategy (more effective, less costly) than both GORU/MARU and usual care.

Table 110: Cost-effectiveness findings from the deterministic base case analysis

Strategy	Cost (£000)	Incremental Cost* (£000)	Effectiveness (QALYs)	Incremental Effectiveness* (QALYs)	Incremental cost-effectiveness
HFP	£34		3.75		
GORU/MARU	£36	£2	3.62	-0.13	(Dominated by HFP)
Usual care	£59	£26	2.73	-1.02	(Dominated by HFP)

*Compared with HFP

Table 110 below shows the breakdown of the different cost categories for the three strategies of the deterministic base case

Table 111: Cost breakdown for usual care, HFP and GORU/MARU

Resource item	Usual Care	HFP	GORU
Rehab cost (initial costs)*	-	1009	729
Complications*	-	-548	217
Readmission	969.5	762.2	535.3
Health care **costs – living in own home**	9178	4032	3738
Social care **costs – living in** own home	14,000	5,000	5,000
Health care **costs – residential and nursing home**	2,615	1,801	1930
Social care **costs (fees) - residential and nursing home**	32,000	22,000	24,000
Total cost	**58762.50**	**33595.2**	**35203.3**

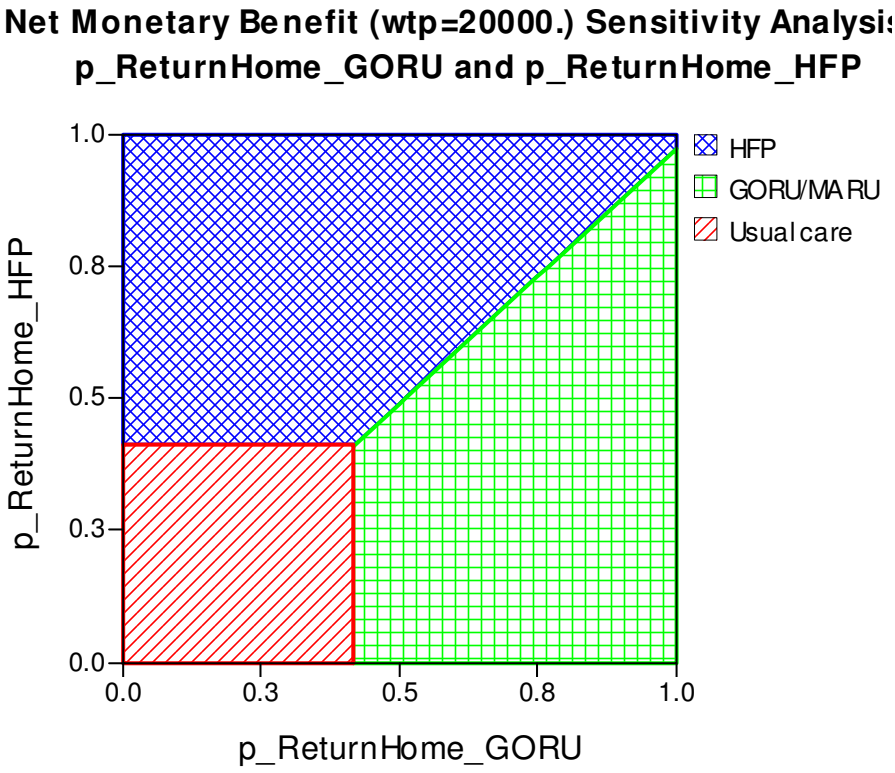
* calculated incrementally vs usual care

20.6.9.1 Sensitivity analyses

In order to check how robust the findings in the deterministic base case analysis reported in table 109 are, we ran a series of sensitivity analyses.

The results were not sensitive to changes in several parameters (length of hospitals stay, cost of long-term care, proportion of long-term care borne by the NHS and PSS).

However, the results were sensitive to changes in the probability of returning home for both HFP and GORU/MARU. In the base case analysis, the probability of returning home for the HFP is 0.81 (RR of HFP vs usual care: 1.14), and for GORU/MARU it is 0.79 (RR of GORU/MARU vs usual care: 1.11). The findings of a two-way sensitivity analysis on such probabilities are reported in the graph below.



A threshold sensitivity analysis shows that:

a) If the probability of returning home for HFP <0.77 (it is 0.81 in the base case scenario), then GORU/MARU is the most cost-effective option at a willingness to pay threshold of £20,000 per QALY.
b) If probability of returning home for GORU/MARU <0.83 (it is 0.79 in the base case scenario), then HFP is the most cost-effective option at a willingness to pay threshold of £20,000 per QALY.

A two-way sensitivity analysis on a) the proportion of social care costs borne by the NHS and PSS for patients living in their own home and b) the proportion of social care costs borne by the NHS and PSS for patients living in a residential or nursing accommodation found that HFP is always the most cost-effective option.

*20.6.9.2*Probabilistic sensitivity analysis

A probabilistic sensitivity analysis was performed to assess the robustness of the model results to plausible variations in the model parameters.

Probability distributions were assigned to each model parameter, where there was some measure of parameter variability. We then re-calculated the main results 10,000 times, and each time all the model parameters were set simultaneously, selecting from the respective parameter distribution at random. Table 112 describes the type and properties of the distributions used in the probabilistic sensitivity analysis.

Table 112: Description of the type and properties of distributions used in the probabilistic sensitivity analysis

Parameter	Type of distribution	Properties of distribution
Baseline risk	Beta	Bounded on 0 – 1 interval. Derived from sample size, number of patients experiencing events
Cost	Gamma	Bounded at 0, positively skewed. Derived from mean and standard error
Utility	Beta	Bounded on 0 – 1 interval. Derived from mean and sample size
Risk ratio, length of stay	Lognormal	Bounded at 0. Derived from log and standard error of log
Mean differences (e.g. in length of stay, time of therapies, etc.)	Normal	Derived from mean and standard deviation

Table 113 summarises the distribution, parameters and expected values for each variable of the model.

Table 113: Probabilistic sensitivity analysis: formulas and expected value

Variable name	Formula	Expected value	Deterministic value
Cost per hospital bed day (patients with moderate delirium)	Gamma alpha = 15.366, lambda = 0.0648;	237.13	237
Cost per hospital bed day (patients with no complications)	Gamma alpha = 15.366, lambda =	220.14	220.07

	0.0698;		
Cost per hospital bed day (patients with pressure sores)	Gamma alpha = 15.366, lambda = 0.057984;	265.00	265.22
Cost per hospital bed day (patients with severe delirium)	Gamma alpha = 15.366, lambda = 0.0633;	242.75	242.89
Annual health care costs – "not recovered" patients living in their own home	Gamma alpha = 15.366, lambda = 0.005141;	2988.91	2989
Annual health care costs for "recovered" patients living in their own home	Gamma alpha = 15.366, lambda = 0.0275;	558.76	557
Annual social care costs for "not recovered" patients living in their own home	Gamma alpha = 15.366, lambda = 0.001948;	7888.09	7886
Annual social care costs for "recovered" patients living in their own home	Gamma alpha = 15.366, lambda = 0.014;	1097.57	1090
Annual cost for fees in long term care – "not recovered" patients	Gamma alpha = 15.366, lambda = 0.00053;	28992.45	28997
Annual cost for fees in long term care – "recovered" patients	Gamma alpha = 15.366, lambda = 0.00053;	28992.45	28997
Annual health care costs for "not recovered" patients in long term care	Gamma alpha = 15.366, lambda = 0.0109;	1409.72	1404
Annual health care costs for "recovered" patients in long term care	Gamma alpha = 15.366, lambda = 0.0109;	1409.72	1404
Cost of hospital bed day for readmissions	Gamma alpha = 15.366, lambda = 0.0474;	324.18	324.01
Cost per hour of day ward nurse	Gamma alpha = 15.366, lambda = 0.7317;	21	21
Cost per hour of a dietician	Gamma alpha = 15.366, lambda = 0.668;	23	23
Cost per hour of a geriatrician	Gamma alpha = 15.366, lambda = 0.1423;	108	108
Cost per hour of an occupational therapist	Gamma alpha = 15.366, lambda = 0.668;	23	23
Cost per hour of a physiotherapist	Gamma alpha = 15.366, lambda = 0.668;	23	23

Cost per hour of a social worker	Gamma alpha = 15.366, lambda = 0.5298;	29	29
Cost per hour of a team lead nurse	Gamma alpha = 15.366, lambda = 0.5691;	27	27
Initial age	None – from meta analysis of RCTs	81	81
Length of stay (days) – usual care	Log-Normal, u (mean of logs) = 3.439942259 sigma (std dev of logs) = 0.154584841;	31.56	31.56
Length of stay (days) – mean difference – GORU/MARU	Normal, Mean = 1.32, Std Dev = 0.03322; Expected value: 1.32	1.32	1.32
Length of stay (days) – mean difference – HFP	Normal, Mean = -6.06, Std Dev = 0.3593	-6.06	-6.06
Length of stay for hospital readmissions – GORU/MARU	Triangular, Min = 4, Likeliest = 7, Max = 10;	7	7
Length of stay for hospital readmissions – HFP	Triangular, Min = 4, Likeliest = 7, Max = 10;	7	7
Length of stay for hospital readmissions – usual care	Triangular, Min = 7, Likeliest = 11, Max = 15;	11	11
Proportion of patients with ADL scores C-G in the "not recovered" health state	Beta Integer parameters only, n = 108, r = 107;	0.99	0.99
Proportion of patients with ADL scores C-G in the "recovered" health state	Beta Integer parameters only, n = 108, r = 34;	0.31	0.31
Probability moderate delirium – usual care	Beta Integer parameters only, n = 64 , r = 14;	0.22	0.22
Probability pressure sores –usual care	Beta Integer parameters only, n = 164, r = 27;	0.1646	0.1646
Probability die at 12 months – usual care	Beta Integer parameters only, n = 870 , r = 186;	0.2138	0.2138
Probability die at 6 months – usual care	Beta Integer parameters only, n = 263, r = 44 ;	0.1673	0.1673
Probability die 6 to 12 months – usual care	Beta Integer parameters only, n = 219, r = 12;	0.0548	0.0558
Probability of hospital readmission at 12 months – usual care	Beta Integer parameters only, n = 640 , r = 165;	0.2578	0.26

Probability of not recovery of pre-fracture ADL levels at 12 months – usual care	Beta Integer parameters only, n = 283 , r = 167;	0.59	0.59
Probability of not recovery of pre-fracture ADL levels at 3 months – usual care	Beta Integer parameters only, n = 125, r = 91;	0.728	0.73
Probability of not recovery of pre-fracture ADL levels at 6 months – usual care	Beta, Integer parameters only, n = 125, r = 84;	0.672	0.67
Proportion of social care costs funded by the NHS or local authorities – patients living in their own home	Triangular, Min = 0.3, Likeliest = 0.6, Max = 0.9;	0.6	0.6
Proportion of long term fee costs funded by the NHS or local authorities – patients living in long term care	Triangular, Min = 0.3, Likeliest = 0.6, Max = 0.9;	0.6	0.6
Probability severe delirium – usual care	Beta Integer parameters only, n = 64 , r = 18;	0.28125	0.28125
Proportion of men - HFR and GORU/MARU	None – from meta analysis of RCTs		0.76
Proportion of men - usual care	None – from meta analysis of RCTs		0.79
Relative risk of die – 12 months – GORU/MARU	Log-Normal, u (mean of logs) = -0.05969, sigma (std dev of logs) = 0.129622261;	0.95	0.95
Relative risk of die – 12 months – HFP	Log-Normal, u (mean of logs) = -0.22022, sigma (std dev of logs) = 0.140960518;	0.81	0.81
Relative risk of die – 6 months – GORU/MARU	Log-Normal, u (mean of logs) = -0.26001, sigma (std dev of logs) = 0.220399212;	0.79	0.79
Relative risk – moderate delirium - HFP	Log-Normal, u (mean of logs) = -0.10966, sigma (std dev of logs) = 0.341655183;	0.95	0.95
Relative risk – not recovery – GORU/MARU	Log-Normal, u (mean of logs) = -0.25423, sigma (std dev of logs) = 0.107452415;	0.78	0.78
Relative risk – not recovery – HFP	Log-Normal, u (mean of logs) = -0.24094, sigma (std dev of logs) = 0.102123395;	0.79	0.78
Relative risk pressure sores – HFP	Log-Normal u (mean of logs) = -	0.31	0.31

	1.24407, sigma (std dev of logs) = 0.381796535;		
Relative risk of readmissions – GORU/MARU	Log-Normal u (mean of logs) = -0.15941, sigma (std dev of logs) = 0.131073023;	0.86	0.86
Relative risk of readmissions - HFP	Log-Normal u (mean of logs) = 0.121843, sigma (std dev of logs) = 0.135536774;	1.14	1.14
Relative risk of returning to own home – GORU/MARU	Log-Normal u (mean of logs) = 0.103769, sigma (std dev of logs) = 0.0347056;	1.11	1.11
Relative risk of returning to own home – HFP	Log-Normal u (mean of logs) = 0.129321, sigma (std dev of logs) = 0.058435349;	1.14	1.14
Relative risk – severe delirium – HFP	Log-Normal u (mean of logs) = -0.99941, sigma (std dev of logs) = 0.407720564;	0.4	0.4
Time input of dietician (incremental over usual care) – GORU/MARU	Normal Mean = -0.4, Std Dev = 0.0332;	-0.4	-0.4
Time input of nurse - (incremental over usual care) – GORU/MARU	Normal Mean = 2.8, Std Dev = 0.358;	2.8	2.8
Time input of occupational therapist - (incremental over usual care) – GORU/MARU	Normal Mean = 5, Std Dev = 0.64;	5	5
Time input of physiotherapist (incremental over usual care) – GORU/MARU	Normal Mean = 8.5, Std Dev = 1.09;	8.5	8.5
Time input of social worker - (incremental over usual care) – GORU/MARU	Normal Mean = -0.4, Std Dev = 0.32;	-0.4	-0.4
Transition probability from "not recovered" to "recovered" health state – 0 to 3 months	Beta Integer parameters only, n = 125, r = 34;	0.272	0.27
Transition probability from "not recovered" to "recovered" health state – 3 to 6 months	Beta Integer parameters only, n = 91, r = 7;	0.076923077	0.082192
Transition probability from "not recovered" to "recovered" health state – 6 to 12 months	Beta Integer parameters only, n = 499212, r = 60837	0.121866061	0.119403
EQ-5D score for "Recovered" health state	Beta Real-numbered	0.68	0.68

	parameters, alpha = 35.36, beta = 16.64;		
EQ-5D score for "Not recovered with no complications" health state	Beta Real-numbered parameters, alpha = 3.72, beta = 8.28;	0.31	0.31
EQ-5D score for "Not recovered with pressure sores" health state	Beta Real-numbered parameters, alpha = 0.952227, beta = 4.059492;	0.19	0.19
EQ-5D score for "Not recovered with severe delirium" health state	Beta Real-numbered parameters, alpha = 293, beta = 880;	0.25	0.25

The conventional way to identify the most cost-effective strategy is to look at the option that is optimal based on the mean costs and mean QALYs averaged across all of the probabilistic simulations. These findings are summarised in Table 114.

Table 114: Cost-effectiveness analysis from probabilistic analysis

Strategy	Cost	Incremental Cost	Effectiveness	Incremental effectiveness	Incremental C/E (ICER)
HFP	£34K		3.74		
GORU/MARU	£36K	£2K	3.61	-0.13	(Dominated)
Usual care	£59K	£25K	2.73	-1.01	(Dominated)

The probabilistic results are very similar to the deterministic ones indicating that HFP is dominant (has lower cost and more QALYs) compared with the two alternatives.

These findings are described in Figures 162, 163 and 164. Each point on the second scatter plot represents the incremental cost and QALYs gained for HFP vs GORU for one simulation. The dotted line represents the £20,000/QALY threshold and the ellipse delimits the 95% confidence space.

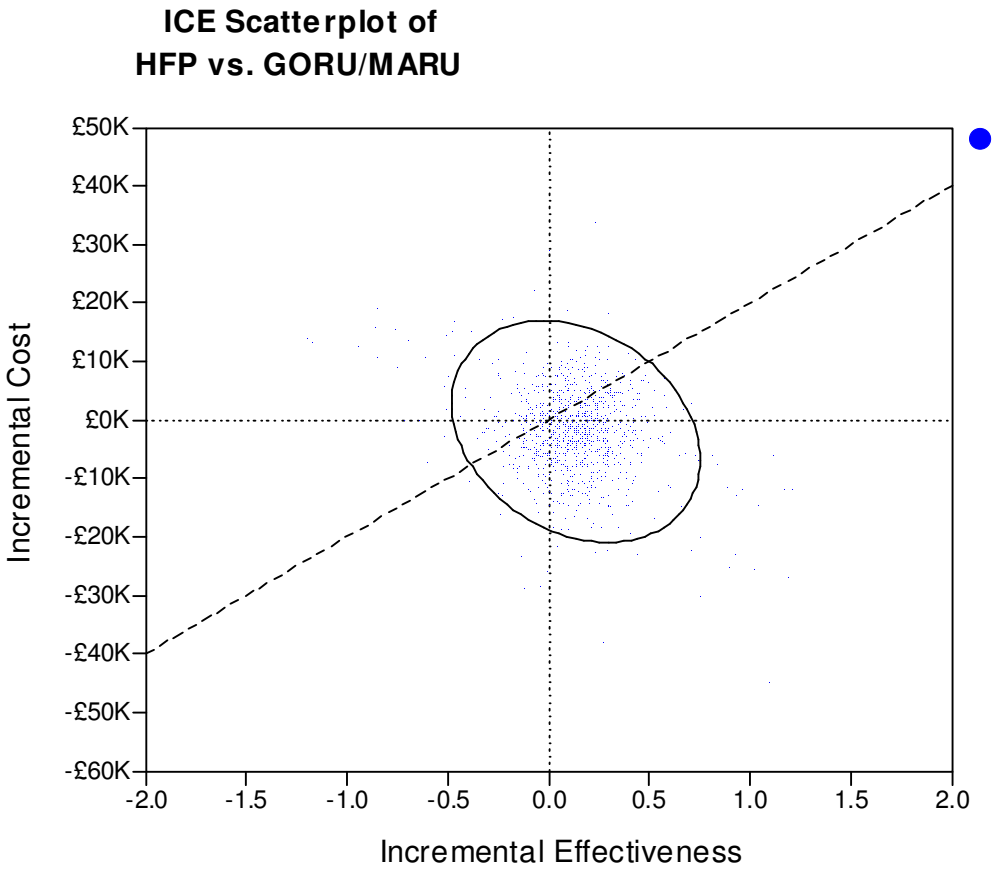


Figure 162: Incremental cost-effectiveness scatter plot: HFP vs GORU/MARU

The scatter plot of HFP vs usual care shows the high certainty of HFP being cost-effective as all the dots in the 95% confidence ellipse are below the £20,000/QALY threshold and more than 95% are cost saving.

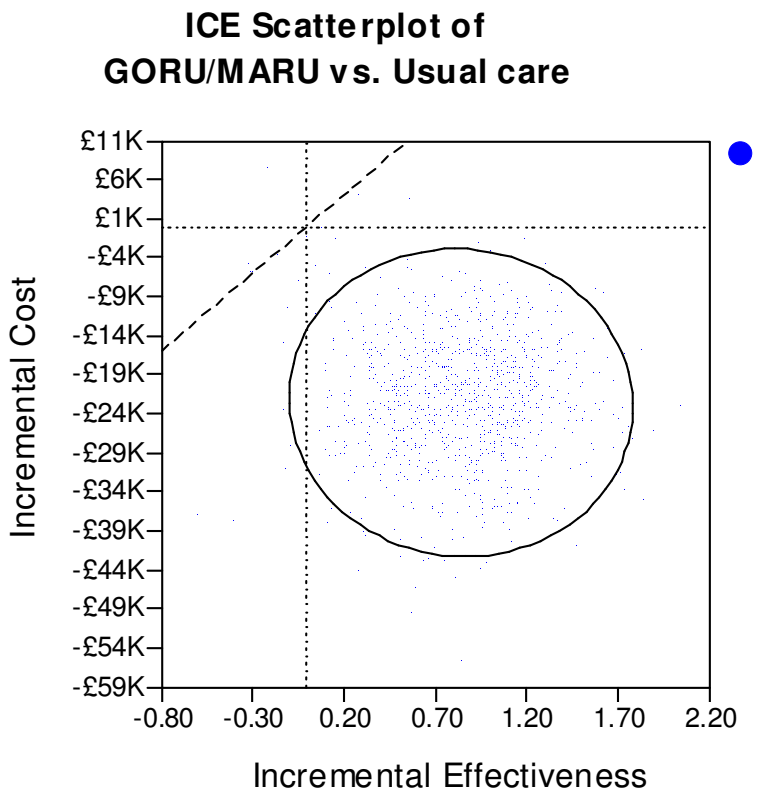


Figure 163: Incremental cost-effectiveness scatter plot: GORU/MARU vs. usual care

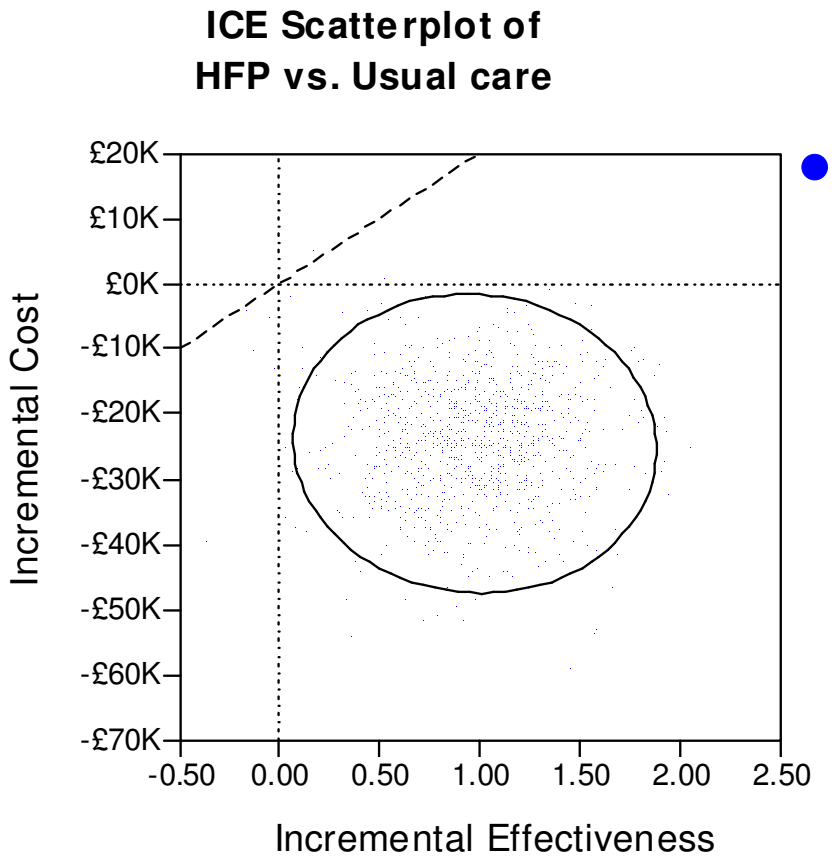


Figure 164: Incremental cost-effectiveness scatter plot - HFP vs usual care

However, when we compared HFP with GORU the 95% CI showed a greater uncertainty as HFP was dominant in the lower bound and GORU was dominant in the upper bound. The uncertainty can be graphically represented by plotting the results of the incremental analysis for all the 10,000 simulations into a cost-effectiveness plane.

We also found that, at a willingness to pay equal to £20,000 per QALY, HFP was the optimal strategy in 70% of the simulations; GORU/MARU was the most cost-effective intervention in 30% of simulations, and usual care was never the optimal strategy. These findings are summarised in table 42 below:

Table 42: Probability most cost-effective intervention at a willingness to pay of £20,000 and £30,000 per QALY

Strategy	Probability most cost-effective intervention at a WTP of £20,000 per QALY	Probability most cost-effective intervention at a WTP of £30,000 per QALY
HFP	0.70	0.80
GORU/MARU	0.30	0.20
Usual care	0	0

20.6.10 Discussion

The optimal strategy in a cost-effectiveness analysis is the one with the highest incremental net benefit averaged across all the probabilistic simulations. This was HFP.

The model showed that usual care was clearly not the optimal strategy.

However, there was some uncertainty about which strategy was the most cost-effective between HFP and GORU/MARU. In particular the results were sensitive to the proportion of patients returning home after their rehabilitation: if the probability of returning home after undergoing a GORU/MARU programme was 83% (instead of 79% in the base case) then GORU is the optimal strategy.

Our analysis had to rely on several assumptions.

Firstly, no evidence was available which compared directly HFP vs GORU/MARU. As a consequence, only an *indirect comparison* between the two hospital MDR programmes was possible. This meant that findings had to be pooled in the usual care arm of the different RCTs included in our clinical review, thus assuming that "usual care arms" in all such studies were sufficiently similar. However, the GDG agreed that the population included in the RCTs on HFP and the population included in the RCTs on GORU were sufficiently similar and that therefore our findings were not affected by counfounding factors.

Secondly, no data were available regarding the presence and incidence of complications in the GORU/MARU programme versus usual care. The assumption that in this case the relative risk for that rehab programme was equal to 1 implies that we may have underestimated the efficacy of GORU/MARU in reducing the presence of postoperative complications, and as a consequence, that we may have overestimated its costs and decrement in quality of life compared to HFP. However, when we changed the probabilities of complications for GORU/MARU in a one-way sensitivity analysis, the findings of the cost-effectiveness analysis did not change, and HFP was still the dominant strategy.

Finally, the finding of the meta-analysis of clinical trials regarding the length of stay showed a longer length of stay for the GORU/MARU programme versus usual care (mean difference (days): 1.32). However, the inclusion of the study by Galvard (1995)[107] in the meta-analysis may have biased this finding. This is because Galvard (1995)[107] reports a mean length of stay of 53.3 days for the intervention (GORU) group and of 28 days for usual care. This finding, according to the authors, was due to the fact that GORU was a new rehabilitation programme that had just been implemented in their hospital, and the hospital staff was not yet experienced in the management of the programme, which could have resulted in a longer length of stay for patients in the intervention group. As a consequence, we may have overestimated the costs of hospital stay for GORU/MARU. However, when we changed the length of hospital stay for the GORU/MARU programme in a one-way sensitivity analysis, the findings of the cost-effectiveness analysis did not change, and HFP was still the dominant strategy.

20.7 Cost-effectiveness analysis of Community MDR vs Usual care

20.7.1 Introduction

The GDG identified the multidisciplinary management in the community for hip fracture patients as a high priority area for economic analysis.

The clinical question linked to this high priority area is the following:

What is the comparative effectiveness of community -based multidisciplinary rehabilitation models versus usual care?

A review of the literature was conducted followed by economic modelling of the cost-effectiveness of the listed interventions in England and Wales. The literature search and review methods can be Chapter 3. Despite some cost-effectiveness studies were identified, none represented a full cost-utility analysis which addressed our clinical question. As a consequence, the GDG felt that an original economic model was essential in order to support their recommendations.

The following general principles were adhered to:

- The GDG was consulted during the construction and interpretation of the model.
- When published data was not available we used expert opinion to populate the model.
- Model assumptions were reported fully and transparently.
- The results were subject to sensitivity analysis and limitations were discussed.
- We followed the methods of the NICE reference case. Therefore costs were calculated from the UK NHS and PSS perspective. Health gains were measured in terms of quality-adjusted life-years (QALYs) gained.
- The model employed a cost-effectiveness threshold of £20,000 per QALY gained.
- The model was peer-reviewed by another health economist at the NCGC.

20.7.2 Population and time horizon

The population for the cost-effectiveness analysis consists of hip fracture patients (male and female) hospitalised for surgery. The model spans over a life-time horizon.

20.7.3 Software

The cost-effectiveness analyses were conducted using TreeAge Pro 2008.

20.7.4 Economic evaluation type

We conduct a cost-utility analysis, where health outcomes are measured as Quality-Adjusted Life-Years (QALYs). The cost effectiveness outcome of the model is measured as cost per QALY gained.

20.7.5 Time horizon and discount rates used

The model spans over a life-time horizon. All costs considered in the model were calculated at on the basis of a four-months follow-up time and hence were not discounted. However, we used a discount rate of 3.5% for the health gains, as these were calculated throughout the remaining life of the cohort of patients.

20.7.6 Structure of the model

The structure of our model reflects the findings of the RCT by Crotty et al (2002)[60]. The paper reports SF-36 scores for surviving patients, both in the community MDR and in the usual care arm of the study, at a 4 months follow up.

We develop a decision tree with Markov states, where a hip fracture patients can either receive a community based MDR programme or usual inpatient rehabilitation. Following this decision node, a chance node determines whether patients survive or die following their specific rehabilitation programme. The probability associated to this chance node is derived from Crotty et al (2002)[60] at a 4 months follow up. Subsequently, patients who are alive after the 4-months follow up period transit in a Markov state, "alive after follow up". Patients will then either stay in that state or transit to the "dead" state in the following cycles.

The structure of the model is the following:

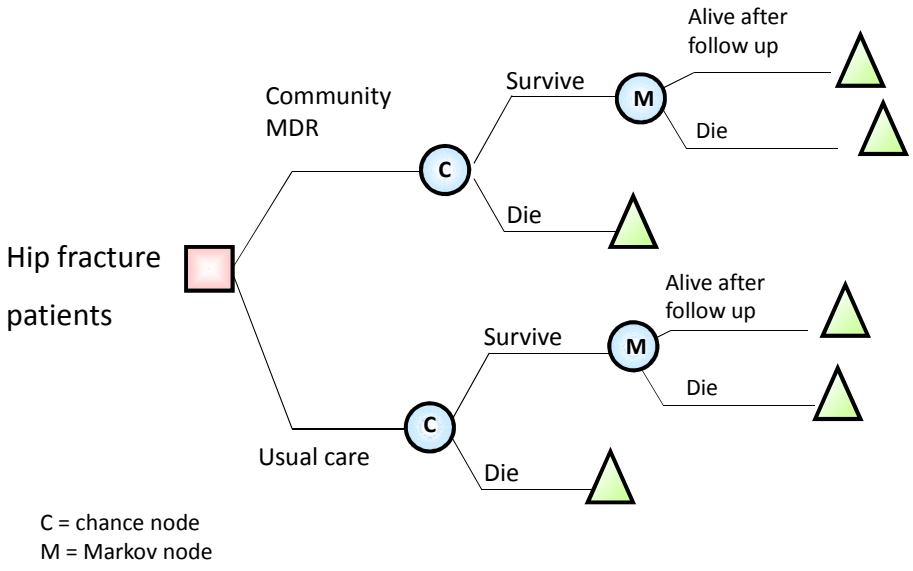


Figure 165: Model structure - community MDR vs usual care

20.7.7 Utility data

Utility weights are calculated using SF-36 scores obtained from Crotty et al (2002)[60]. The paper only reports total scores for the physical and mental components. Following personal communications with the authors, we were able to access individual SF-36 scores, reported in Table 115 below:

Table 115: SF-36 scores based on Crotty et al (2002)[60].

SF-36 domain, Mean (SD)	Conventional Care, n=29	Early Discharge, n=30
Physical functioning	28.8 (25.2)	41.2 (26.6)
Social functioning	62.1 (40.0)	72.5 (32.4)
Role-physical	61.2 (41.0)	53.3 (40.9)
Role-emotional	83.9 (31.6)	77.8 (38.5)
Mental health	77.9 (14.2)	80.1 (19.8)
Vitality	45.0 (21.9)	54.2 (24.3)
Bodily pain	61.4 (30.9)	65.1 (24.4)
General health	61.8 (30.1)	69.3 (24.1)

Source: primary data supplied by the authors of Crotty et al (2002)[60]

Using the Ara-Brazier method[7], we mapped the individual SF-36 scores in EQ-5D utility weights. We found that the EQ-5D weight for patients undergoing community MDR is 0.732, and for patients undergoing usual inpatient rehabilitation is 0.643. As the effectiveness data refer to findings at 4 months [60], we used these utility weights for cycle 0 only. For cycle 1-onwards we assume that there is no difference in the utility score of the two groups of patients, and use the EQ-5D score of the control group also for patients in the community MDR arm of the model.

20.7.8 Mortality

The mortality rates for the community MDR and usual care patients have been adjusted to take into account the baseline characteristics of the two groups, which were very different in the two arms of Crotty et al (2002)[60], since 62% of patients were female in the COMMUNITY MDR versus 75% in the usual care group, and the median age for COMMUNITY MDR patients was 81.6 versus 83.5 years in the usual care arm.

First, we have calculated the age and gender-adjusted mortality rate (AMR) for the general UK population as per characteristics in usual care arm and the same for community MDR arm. Then, we have calculated the Standardised Mortality Rate (SMR) as = MR/AMR, both the usual care and the community MDR arm. We have then assumed that the average age for the overall population in the model was 80 years of age, and we have determined the probability of death using the formula: SMR*pDeath[80].

We have found that that probability of death at 4 months for the patients in the usual care arm corresponds to 0.07239, and for patients in the community MDR group is equal to 0.067. The relative risk of the mortality rate for community MDR compared to usual care is 0.925.

20.7.9 Calculating QALYs gained

For each strategy (community MDR and usual inpatient rehabilitation), the expected QALYs in the "survived" health state at each cycle are calculated as follows:

$$\textbf{Expected QALYs} = \Sigma (U_{survived} \times P_{survived})$$

where: $U_{survived}$ = the utility score for the patients who are still alive and $P_{survived}$ = the proportion of alive patients

The proportion of patients in the "alive" health state depends on the effectiveness of the treatment, and on the proportion of patients still alive, which falls as the number of cycles and therefore age increases.

The overall *lifetime expected QALYs* are given by the sum of QALYs calculated for each cycle. The *incremental QALYs gained* associated with a treatment strategy are calculated as the difference between the expected QALYs with that strategy and the expected QALYs with the comparator.

20.7.10 Cost analysis

20.7.10.1Cost for the community MDR and inpatient rehabilitation programmes.

While in hospital, we assume that there is no difference in the level and type of resources used by patients in the two groups, as no evidence of the contrary was found in the literature. Moreover, as patients receive their inpatients rehabilitation services without being discharged to a different ward, they will still be under the same HRG recorded at admission. Thus, the rehabilitation that patients receive while in hospital is not a type of discrete rehabilitation service, that is, a service that can be cost using its own HRG, since: *"rehabilitation HRGs are only generated where care is identified as taking place under a specialist rehabilitation consultation or within a discrete rehabilitation ward or unit. [..] Where a patient is not admitted specifically to a rehabilitation unit or where rehabilitation treatment is undertaken without transfer to a specialist consultant, or without transfer to a rehabilitation unit, this should not be reported as discrete rehabilitation" (*Collection Guidance on Reference Costs for 2006-07[70]).

As a consequence, we use the reference cost for excess bed days reported in the National Schedule of Reference Costs Year: '2008-09' - NHS Trusts and PCTs combined Non-Elective Inpatient (Long Stay).

Crotty et al (2002)[60] report evidence on the presence of complications experienced by hip fracture patients in the two groups while in acute care. None of these complications were statistically significant different between usual care and community MDR (the complications were: pneumonia, pressure sores, confusion, wound infection and urinary tract infection). Moreover, no additional information was provided in the paper as to whether those complications resulted in a prolonged length of hospital stay for patients in the community MDR scheme. Thus, we used the weighted average NHS reference cost for excess bed days for major, intermediate and minor hip procedures with all types of complications, amounting to £241.68 per day.

As for the daily cost of the community MDR scheme, we use the NHS reference cost (2008-09) reported for "Hospital at Home/ Early Discharge Schemes - Fractured Neck of Femur", which corresponds to £94 per day.

We conduct a sensitivity analysis on these values in section 32.1 of this chapter.

20.7.10.2Length of stay

Crotty et al (2002)[60] reports the following findings for the length of stay for the community MDR and the usual inpatient rehabilitation:

Table 116: Length of stay in hospital and in own home

Length of stay community MDR (at home stay)	**20.3 (mean, days)**
Length of stay community MDR (at home stay) (in	7.8 (mean, days)

hospital stay)	
Length of stay usual care (in hospital stay)	14.3 (mean, days)

20.7.10.3 Hospital readmissions and related length of stay

Crotty et al (2002)[60] gives information about the levels of readmissions during the four months follow up of the study. The paper distinguishes between related readmissions and unrelated readmissions, and gives the length of stay for both cases. However what these related and unrelated admissions were was not clear in the paper. We consider surgery and the rehabilitation admissions to be the "related" readmissions, and we consider the cost of a bed day in medicine for the cost of not-related admissions.

These unit bed day costs are based on Czoski-Murray (2007)[63], which reports the cost per day for hospital stay in an orthopaedic, rehabilitation or general medicine ward at 2002 prices. We assume that the "related readmissions" take place either for orthopaedic or for rehabilitation reasons, and that the "unrelated readmission" are those in the generic medicine ward.

Taking into account of the inflation index, the cost per day of hospital stay for a related readmission corresponds to £367.85 (assuming that half of these readmissions took place for surgery and half for rehabilitation reasons) and to £364.61 for unrelated readmission.

Table 117: Evidence on readmissions (Crotty et al, 2002)[60]

Number of not related readmission for usual care	**0.43**
Mean difference for unrelated readmissions	0.38
Number of related readmission for usual care	0.27
Mean difference for related readmissions	-0.05
Length of hospital stay for not related readmissions (usual care)	4.9
Mean difference for length of hospital stay for unrelated readmissions	-0.3
Length of hospital stay for related readmissions (usual care)	3.6
Mean difference for length of hospital stay for related readmissions	0.1

20.7.10.4 Social services costs

For community services, Crotty et al (2002)[60] intended any of the following: outpatient rehabilitation; private therapy, district nursing, day care, respite care, employment rehabilitation training, carer time off work and Meals on Wheels. As we do not have data regarding the exact amount of resources for each of the above categories that were actually used by patients in the

two arms of the study, we assume that the weekly cost of social care is given by a weighted average of the five categories of packages of care reported in the PSSRU 2009[61] and discussed in section 18.2.2 of the hospital MDR model. We assume that an equal proportion of patients used each type of social care package. However, in a sensitivity analysis we look at the case in which all patients used a "very low cost" type of social care package and when all of them used a "very high cost" package of care.

Only a proportion of the social care costs will generally be funded by local authorities[71], [348], [72], [144]. It was not possible to identify a national average for the social care costs funded by local authorities in the published literature, and as a consequence an assumption had to be made regarding the proportion of this care that was publicly funded. In the base case analysis, we assume that 60% of social care costs are borne by local authorities, and are therefore includable in the model, and we then test this assumption in a sensitivity analysis.

As no further data were given regarding the use of social care services after the 4 months follow up, we adopted a conservative approach and assumed that after that period there was no difference in the use of social services that could be due to the different rehabilitation scheme used.

20.7.10.5 Primary care costs

Crotty et al (2002)[60] point out that: *"[..] patients [in the community MDR scheme] tended to call the GPs if problems arose and this invariably meant a visit to the home for the GP"* (Crotty et al 2002, page 11[60]). On the other hand, no details were provided regarding whether *all* GP visits to patients in the community MDR scheme took in fact place in the patients' own home. Similarly, no information was given regarding where GP visit took place for patients in the usual care arm. As a consequence, we have assumed that the unit cost for a GP visit for patients in the usual care scheme is the average between the cost of a GP visit at the patient's own home (£117) and a GP surgery visit (£76) as reported in the PSSRU 2009[61], and corresponds to £96.5.

As no further data were given regarding the use of primary care services after the 4 months follow up, we adopted a conservative approach and assumed that after that period there was no difference in the use of GP services that could be ascribed to the different rehabilitation scheme used.

Table 118: Evidence on GP visits (Crotty et al, 2002)

Number of GP visits (usual care)	**4.5**
Number of GP visits (community MDR)	3.3 (mean difference: -1.2)

20.7.11 Cost effectiveness findings

The cost-effectiveness findings for the deterministic base case analysis is presented in Table 119: Cost-effectiveness analysis - deterministic base case below:

Table 119: Cost-effectiveness analysis - deterministic base case

Strategy	Cost	Incremental	Effectiveness	Incremental	Incremental cost-

		Cost		Effectiveness	effectiveness ratio
Usual care	£6469.1		3.0827 QALYs		
Community MDR	£6903.2	£434.1	3.1283 QALYs	0.0456 QALYs	9521 £/QALYs

Hence, the community MDR scheme is a cost-effective treatment for the rehabilitation of hip fracture patients in the deterministic case scenario. **Table 120** reports a breakdown of costs for the relevant resources used in the community MDR and in the usual care group.

Table 120: Cost breakdown for community MDR and usual care

Resource item	Usual Care	Community MDR
Rehab cost	3456	**3793**
Readmission	1124	**1657**
Domiciliary social care	1453	**1133**
GP visits	434	**318**
Total cost	**£6467**	**£6901**

20.7.11.1Sensitivity analysis

We now proceed by investigating how robust the findings of the deterministic analysis are by conducting a series of sensitivity analysis.

To begin with we note that the model is not sensitive to changes in the level of social services paid by the NHS (from 0 to 100%), as community MDR is still cost-effective.

Moreover, when the cost per week of social services is varied between the minimum (£41 per week) and the maximum (£542) the option with the highest net benefit is still community MDR.

However, our findings are sensitive to the length of hospital stay (both for community MDR and for usual care patients) and on the length of rehabilitation programme at home, as well as on the daily cost of hospital stay following surgery and on the daily cost of the community MDR programme. These findings are summarized in Table 121 below.

Table 121: Threshold sensitivity analysis

Variable	Values	Strategy with the highest net benefit
Length of stay in hospital for community MDR patients	≥ 9.78 (days)	Usual care
	‹ 9.78 (days)	Community MDR
Length of stay at home for community MDR patients	≥ 25.38 (days)	Usual care
	‹ 25.38 (days)	Community MDR
Length of stay in hospital for usual care patients	≥ 12.32 (days)	Community MDR
	‹ 12.32 (days)	Usual care
Daily cost for hospital stay	> £168.18	Community MDR

Daily cost for community MDR rehab programme	< £ 117.53	Community MDR

Our cost-effectiveness findings are not sensitive to changes in the cost per day in hospital of the related readmissions and to changes in the proportion of social care costs borne by local authorities.

The following figure summarise the findings of a two-ways sensitivity analysis on the length of stay in hospital and at home (the vertical axe reports the length of stay at home for community MDR patients and the horizontal axe the length of stay in hospital for usual care).

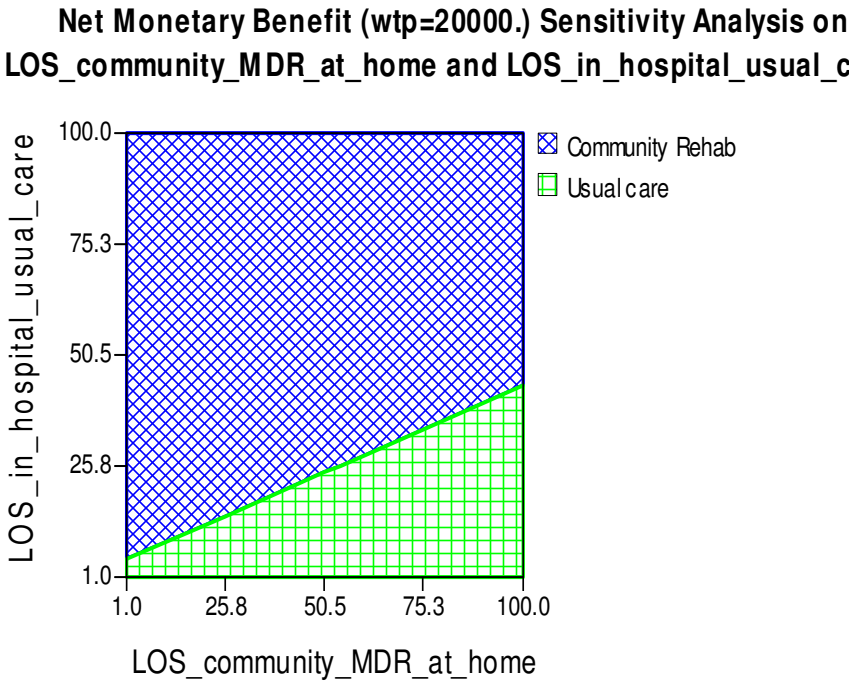


Figure 166: Two-way sensitivity analysis on length of stay at home and in hospital

20.7.11.2Probabilistic sensitivity analysis

A probabilistic sensitivity analysis was performed to assess the robustness of the model results to plausible variations in the model parameters.

Probability distributions were assigned to each model parameter, where there was some measure of parameter variability. We then re-calculated the main results 10000 times, and each time all the model parameters were set simultaneously, selecting from the respective parameter distribution at random.

Table 122: Description of the type and properties of distributions used in the probabilistic sensitivity analysis

Parameter	Type of distribution	Properties of distribution

Baseline risk	Beta	Bounded on 0 – 1 interval. Derived from sample size, number of patients experiencing events
Cost	Gamma	Bounded at 0, positively skewed. Derived from mean and standard error
Utility	Beta	Bounded on 0 – 1 interval. Derived from mean and sample size
Risk ratio, length of stay	Lognormal	Bounded at 0. Derived from log and standard error of log
Mean differences (e.g. in length of stay, time of therapies, etc.)	Normal	Derived from mean and standard deviation

Table 123 summarises the expected values of the variables in our model from the different distributions used in the PSA.

Table 123: Distribution and parameters - probabilistic sensitivity analysis

Name	Baseline value	Expected value	Distribution and parameters
Probability use of community services for usual care	0.72	0.7187	Beta, Integer parameters only, n = 32, r = 23
Weekly social care unit cost for "high need" patients (£)	216	216	Gamma, alpha = 15.36583528, lambda = 0.071138126
Weekly social care unit cost for "low need" patients	72	72	Gamma, alpha = 15.36583528, lambda = 0.213414379
Weekly social care unit cost for "median need" patients (£)	180	180	Gamma, alpha = 15.36583528, lambda = 0.085365752
Weekly social care unit cost for "very high need" patients (£)	542	542	Gamma, alpha = 15.36583528, lambda = 0.02835025
Weekly social care unit cost for "very low need" patients (£)	41	41	Gamma, alpha = 15.36583528, lambda = 0.37477647
NHS reference costs for community MDR (£; daily)	94	94	Gamma, alpha = 15.36583528, lambda = 0.163466333
NHS reference cost for usual care	240	240	Gamma, alpha = 15.36583528, lambda = 0.064024314
Mean difference in GP visits for community MDR	-1.2	-1.2	Normal, Mean = -1.2, Std Dev = 0.0957

Number of GP visits for usual care	4.5	4.5	Normal, Mean = 4.5, Std Dev = 0.646
Length of stay (days) at own home for community MDR programme	20.3	20.3	Log-Normal, u (mean of logs) = 3.006198781, sigma (std dev of logs) = 0.094043657
Length of stay (days) in hospital for community MDR patients	7.8	7.8	Log-Normal, u (mean of logs) = 2.028128367, sigma (std dev of logs) = 0.228014764
Length of stay (days) unrelated readmissions	4.9	4.9	Log-Normal, u (mean of logs) = 1.264935055, sigma (std dev of logs) = 0.80535725
Length of stay (days) related readmissions	3.6	3.6	Log-Normal, u (mean of logs) = 1.061775585, sigma (std dev of logs) = 0.662054772
Length of stay (days) in hospital – usual care	14.3	14.3	Log-Normal, u (mean of logs) = 2.650611207, sigma (std dev of logs) = 0.138912419
Probability mortality – community MDR	0.067	0.067	Beta, Real-numbered parameters, alpha = 2.278, beta = 31.722
Probability mortality usual care	0.0724	0.0724	Beta, Real-numbered parameters, alpha = 2.31648, beta = 29.68352
Proportion of patients with "very low"/"low"/ "median"/"high"/"very high" social care costs	0.2	0.2	Dirichlet; Alpha list (proportion of patients with very low social care costs; proportion of patients with low social care costs; proportion of patients with median social care costs; proportion of patients with high social care costs; proportion of patients with very high social care costs)
Proportion of social care costs funded by the NHS	0.6	0.6	Triangular, Min = 0.30, Likeliest = 0.60, Max = 0.90;
EQ-5D score (community MDR)	0.732	0.732	Beta, Real-numbered parameters, alpha = 24.888, beta = 9.112
EQ-5D score (usual care)	0.643	0.643	Beta, Real-numbered parameters, alpha = 20.576, beta = 11.424
Number of not related	0.43	0.43	Normal, Mean = 0.43, Std Dev =

readmission for usual care			0.0617
Number of related readmission for usual care	0.27	0.27	Normal, Mean = 0.27, Std Dev = 0.387
Mean difference for length of hospital stay for related readmissions	0.1	0.1	Normal, Mean = 0.1, Std Dev = 0.0145
Mean difference for related readmissions	-0.05	-0.05	Normal, Mean = -0.05, Std Dev = 0.04
Mean difference for length of hospital stay for unrelated readmissions	-0.3	-0.3	Normal, Mean = -0.3, Std Dev = 0.03442
Mean difference for unrelated readmissions	0.38	0.38	Normal, Mean = 0.38, Std Dev = 0.545;
Relative Risk use of community service	0.78	0.78	Log-Normal, u (mean of logs) = -0.265778098, sigma (std dev of logs) = 0.186100721
Unit cost for a GP visit	76	76	Gamma, alpha = 15.36583528, lambda = 0.202182043
Unit cost for related readmissions	352	352	Gamma, alpha = 15.36583528, lambda = 0.043652941
Unit cost for unrelated readmissions	249	249	Gamma, alpha = 15.36583528, lambda = 0.061710182

The cost-effectiveness findings of the PSA are summarized in Table 124 below:

Table 124: cost-effectiveness finding from probabilistic sensitivity analysis

Strategy	Cost	Incr Cost	Eff	Incr Eff	Incremental cost-effectiveness ratio	95% CI on ICERs
Usual care	£6466.6		3.0827 QALYs			
Community Rehab	£6901.2	£434.6	3.1283 QALYs	0.0456 QALYs	9533 £/QALYs	Cost saving - dominated

The PSA shows that there is a high uncertainty as to whether community MDR is cost-effective compared to usual care. This uncertainty can be graphically represented by plotting the results of the incremental analysis for all the 10,000 simulations into a cost-effectiveness plane. Each point on the scatter plot represents the ICER of community MDR versus usual care for each simulation.

The dotted line represents the £20,000/QALY threshold while the ellipse delimits the 95% confidence interval.

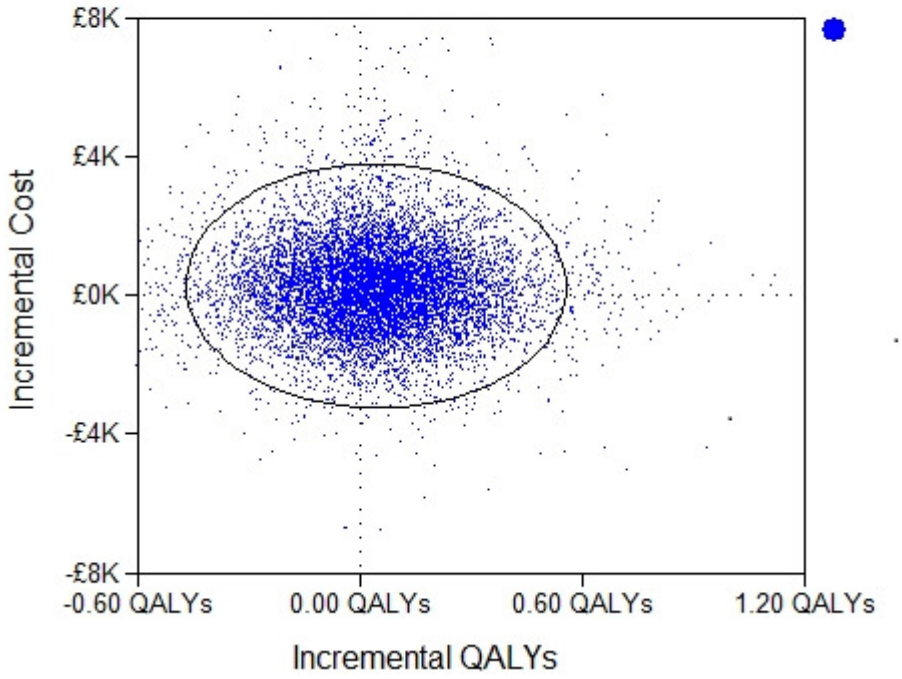


Figure 167: Incremental cost-effectiveness scatter plot - Community MDR vs usual care

From the simulations conducted for the PSA, we found that at a willingness to pay equal to £20,000 per QALY, community MDR was the optimal strategy in 50% of the simulations. At a willingness to pay of £30,000 per QALY, community MDR was the optimal strategy in 60% of the simulations.

Table 125: Probability most cost-effective intervention at a willingness to pay of £20,000 and 30,000 per QALY

Strategy	Probability most cost-effective intervention at a WTP of £20,000 per QALY	Probability most cost-effective intervention at a WTP of £30,000 per QALY
Community MDR	0.50	0.60
Usual care	0.50	0.40

20.7.12 Discussion

The model shows that community MDR is cost-effective in the rehabilitation of patients after a hip fracture. However, this finding is rather sensitive to variations in the length of stay, both in hospital and at home. Moreover, a PSA has shown that there is high uncertainty over the cost-effectiveness of community MDR compared to usual care.

The model has several limitations, such as the fact that it is based on the clinical evidence derived from only one RCT)[60] based in Australia. Moreover, the evidence on treatment effects[60] was available only up to 4 months follow up. No information was available regarding the impact of community MDR after that time point.

20.8 Cost analysis of cemented vs. uncemented implants (newer designs of arthroplasty)

In order to conduct a cost analysis for the cemented and uncemented implants, we need to consider the following cost components: implants cost; accessories costs; length of stay; re-operation and theatre costs.

a) Cost of implants

The National Joint Registry (NJRv7) was accessed on February 11th 2011, in order to find out the five most commonly used types of both cemented (stems with no head) and uncemented implants in the UK. Furthermore, the NHS Supply catalogue 2011 was searched in order to obtain the most recent price for each of these items. All this information is reported in **Table 126** below:

Table 126: Price of new design cemented and uncemented stems most commonly used in the UK

Cemented implants – stems with no head **(from most common to less common)**	**Price per item (£)**	**Uncemented implants** **(from most common to less common)**	**Price per item (£)**
Exeter	410.53	Corail	893.47
C-Stem	347.37	Taperloc	Could not retrieve price on NHS supply catalogue
CPT	393.68	JRI Furlong	789.47
Stanmore	Could not retrieve price on NHS supply catalogue	Accolade	684.21
Charnely	Could not retrieve price on NHS supply catalogue	SL-Plus	789.47
Average price for most common cemented implants	**383.86**	**Average price for most common uncemented implants**	**789.15**

b) Accessories costs for the cemented group of patients

The price for accessorises used when new design cemented stems are implanted are presented in **Table 127** below.

Table 127: Prices for accessorises used with new design cemented stems

Resources	Unit price	Source of unit price
Pulse Lavage	£27.86	NHS Supply Chain catalogue 2011
Biogel glove	£1.07	NHS hospital*
Cement	£45	Data supplied by GDG member
Cement mixing kit	£35	Data supplied by GDG member
Cement Restrictor (size 16/18/20mm)	£35.88	Smith & Nephews**
Femoral canal brush (NW 12.5/19MM)	£64.48	Smith & Nephews**
MIXOR femoral pressurizer (large/medium/small)	£14.70	Smith & Nephews**
Sterilzed tray	£25	NHS hospital record***
Total cost for accessories	£248.99	

*Peterborough and Stamford Hospital NHS Trust

**Price list available online at: http://browse.uk-plc.net/Companies/SMITH__NEPHEW/products/CEMENT_ACCESSORIES.htm (accessed 21st February 2011)

***Data from John Radcliffe NHS Hosptial Trust.

It is important to note that the cost of the sterilized tray could vary from £25 to £50 (source: John Radcliffe NHS Hosptial Trust) depending on the number of instruments contained in the tray. It is also relevant to point out that our cost calculation for the accessorises used with the new design of cemented stems is very similar to the cost reported in Unnanuntana et al (2009)[335], which calculates the cost of accessorises used for a third-generation cement technique. They considered two 40-g bags of bone cement without antibiotics, a vacuum mixing cartridge, cement pressurizer, canal plug and distal cement centralizer, canal brush and cement scrapers. The average total cost for the two 40-g batches of bone cement and all accessories used to achieve a third-generation cement technique was estimated to be $386 (range, $351-$407) (January 2008 prices), which correspond to £252 (range, £229 - £266) (converted using 2008 purchasing power parity).
The GDG noted that the accessorises costs determined in table 126 represent a through end of the spectrum; at the "lower end" of the spectrum, the only accessories costs to consider would be those for the cement, cement mixing kit, restrictor and sterilized tray, for an overall cost of £**140.88**.

c) Cost of length of stay in hospital

To calculate the health state costs during the hospital stay, we use the NHS reference cost for excess bed days reported in Table 128 below. The excess bed day cost is the cost per day for days exceeding the trimpoint, a cut-off that determines patients with exceptionally long stay, and as such usually estimates the cost of care without the cost of procedures (i.e. without the cost of the surgery. These costs reflect the presence of complications experienced by hip fracture patients during their entire hospital stay. Moreover, they distinguish between "major" and "intermediate" complications, thus allowing users to take into account the different degrees of resource use.

Table 128: National Schedule of Reference Costs Year : '2008-09' - NHS Trusts and PCTs combined Non-Elective Inpatient (Long Stay) Excess Bed Day HRG Data for hip procedures

Currency Code	Currency Description	Activity	National Average Unit Cost
HA11A	Major Hip Procedures Category 2 for Trauma with Major CC	360	£243
HA11B	Major Hip Procedures Category 2 for Trauma with Intermediate CC	620	£242
HA11C	Major Hip Procedures Category 2 for Trauma without CC	162	£220
HA12B	Major Hip Procedures Category 1 for Trauma with CC	9,760	£237
HA12C	Major Hip Procedures Category 1 for Trauma without CC	1,230	£226
HA13A	Intermediate Hip Procedures for Trauma with Major CC	14,891	£240
HA13B	Intermediate Hip Procedures for Trauma with Intermediate CC	12,856	£249
HA13C	Intermediate Hip Procedures for Trauma without CC	2,972	£223
HA14A	Minor Hip Procedures for Trauma with Major CC	5,195	£234
HA14B	Minor Hip Procedures for Trauma with Intermediate CC	5,808	£245
Mean weighted average of excess bed days costs – NHS reference costs 2008-08 Major, Intermediate and Minor Hip procedures with all types of complications			£240

Using the evidence reported in Figved (2009)[94], the mean LOS in hospital for patients in the cemented group was 7.8 days and in the uncemented group 8.4 ($p<0.52$). This implies that the LOS costs for the cemented group correspond to £1872 and for the uncemented group to £2016.

d) Re-operation costs

The cost of the re-operations in the two groups of patients is calculated by using the weighted average of the NHS reference cost for non-elective inpatient short stay data for NHS Trusts and PCTs combined. The different HRGs and unit costs associated with each type of surgical procedure and possible presence of complications are summarised in **Table 129** below.

Table 129: National Schedule of Reference Costs Year : '2008-09' - NHS Trusts and PCTs combined Non-Elective Inpatient (Short Stay) HRG Data

Currency Code	Currency Description	Activity	National Average Unit Cost
HB11A	Major Hip Procedures for non Trauma Category 2 with Major CC	4	£1,793
HB11B	Major Hip Procedures for non Trauma Category 2 with CC	5	£2,001
HB11C	Major Hip Procedures for non Trauma Category 2 without CC	3	£1,765
HB12A	Major Hip Procedures for non Trauma Category 1 with Major CC	16	£1,811
HB12B	Major Hip Procedures for non Trauma Category 1 with CC	89	£2,097
HB12C	Major Hip Procedures for non Trauma Category 1 without CC	88	£1,611
HB13Z	Intermediate Hip Procedures for non Trauma Category 2	51	£2,771
HB14B	Intermediate Hip Procedures for non Trauma Category 1 with CC	746	£1,671
HB14C	Intermediate Hip Procedures for non Trauma Category 1 without CC	529	£1,785
HB15D	Minor Hip Procedures for non Trauma Category 2 19 years and over with CC	213	£912
HB15E	Minor Hip Procedures for non Trauma Category 2 19 years and over without CC	124	£1,028
HB15F	Minor Hip Procedures for non Trauma Category 2 18 years and under with CC	8	£779
HB15G	Minor Hip Procedures for non Trauma Category 2 18 years and under without CC	73	£1,304
HB16B	Minor Hip Procedures for non Trauma Category 1 with CC	141	£2,057
HB16C	Minor Hip Procedures for non Trauma Category 1 without CC	111	£833
Mean weighted average of short-stay non-elective NHS reference costs 2009-10 Major, Intermediate and Minor Hip procedures *with all types of complications*			£1,598.39

Figved (2009)[94] reports a re-operation rate of 6.3% for the cemented group and of 7.4% for the uncemented group. The re-operation costs therefore correspond to £100.70 in the cemented group and to £118.28 for the uncemented group.

e) Theatre time costs

Figved (2009)[94] reports the duration of the operation for the cemented group which was 12.4 minutes longer than for the uncemented group. Using a cost per minute for the theatre use of £20.50 (from Peterborough and Stamford NHS Trust accountant data), the higher theatre costs for the cemented group correspond to: £254.2

Summary of costs components

	Patients who received cemented	Patients who received

	implants	uncemented implants
Cost categories:		
a) Implants	£383.86	£789.15
b) Accessories costs for cemented implants	£248.99	-
c) LOS	£1872	£2016
d) Re-operations	£100.70	£118.28
e) Incremental theatre costs for cemented group	£254.2	-
Total costs	£2859.75	£2923.43

It follows that the overall incremental cost of the newer design of uncemented implants over the cemented ones £63.68. When the lower estimate for accessories costs is used (£140.88) the total costs for the cemented group corresponds to £2751.64, and the incremental cost of the uncemented implants to £171.79. These cost does not include the additional pain relief required by patients in the uncemented group. However, the unit costs for analgesics is relatively low, as showed in Appendix H section 20.1.

21 Appendix I: High Priority Research Recommendations

21.1 Imaging options in occult hip fracture

Research question: In patients with a continuing suspicion of a hip fracture but whose radiographs are normal, what is the clinical and cost effectiveness of computed tomography (CT) compared to magnetic resonance imaging (MRI), in confirming or excluding the fracture?

Why this is important:

The GDG's consensus decision to recommend CT over a radionuclide bone scan as an alternative to MRI to detect occult hip fractures reflects current NHS practice but assumes that advances in technology have made the reliability of CT comparable with that of MRI. If modern CT can be shown to have similar reliability and accuracy to MRI, then this has considerable implications because of its widespread availability out of hours and lower cost. It is therefore a high priority to confirm or refute this assumption by direct randomised comparison. The study design would need to retain MRI as the 'gold standard' for cases of uncertainty and to standardise the criteria, expertise and procedures for radiological assessment. Numbers required would depend on the degree of sensitivity/specificity (the key outcome criteria) set as target requirement for comparability, but need not necessarily be very large.

Criteria for selecting high-priority research recommendations:

PICO question Each research recommendation should be formulated as an answerable question or a set of closely related questions. This should use the PICO framework (patient, intervention, comparison and outcome)	In patients with a continuing suspicion of a hip fracture but whose radiographs are normal, what is the clinical and cost effectiveness of computed tomography compared to magnetic resonance imaging, in confirming or excluding the fracture? Patient: patients with a continuing suspicion of a hip fracture but whose radiographs are normal Intervention: Modern Computed Tomography techniques e.g. 64-slice scanners with three dimensional capabilities and spiral multidetector CT (MDCT) Comparison: Magnetic resonance imaging Outcomes: Diagnostic accuracy including sensitivity and specificity
Importance to patients or the population. What would be the impact of any new or altered guidance on the population (for example, acceptability to patients, quality of life, morbidity or disease prevalence, severity of disease or mortality)?	The altered guidance would ensure the availability of accurate diagnosis out of hours and thus promote the benefits of prompt, accurate surgery to all patients in this group – prompt pain relief, lower mortality, enhanced return to independent living, fewer complications and shorter hospital stay.
Relevance to NICE guidance How would the answer to this question change future NICE guidance (that is, generate new knowledge and/or evidence)?	Demonstration of comparable sensitivity and specificity with MRI would enable CT techniques to be recommended as investigation of first choice in these circumstances.
Relevance to the NHS What would be the impact on the NHS and (where relevant) the public sector of any new or altered guidance (for example, financial advantage, effect on staff, impact on strategic planning or service delivery)?	Avoiding delay to surgery in hip fracture is cost-effective. The altered guidance would support this objective. CT is in addition available at lower NHS cost than MRI.

National priorities Is the question relevant to a national priority area (such as a national service framework or white paper)? The relevant document should be specified.	The question has a direct bearing on the Department of Health Best Practice Tariff initiative to achieve time-to-surgery not exceeding 36 hours.
Current evidence base What is the current evidence base? What are the problems with the current evidence base? (that is, why is further research required?) Reference should be made to the section of the full guideline that describes the current evidence base, including details of trials and systematic reviews. The date on which the final literature search was undertaken should be specified.	There have been no studies comparing the sensitivity and specificity of modern multi-detector CT techniques with the current gold standard (MRI) in the diagnosis of hip fracture. See Section 5.5.1 of the Full Guideline.
Equality Does the research recommendation address equality issues? For example, does it focus on groups that need special consideration, or focus on an intervention that is not available for use by people with certain disabilities?	No specific equality issues.
Study design It should also specify the most appropriate study design to address the proposed question(s). Primary research or secondary research (for example, systematic reviews) can be recommended.	The research design of choice would be a two-stage design comprising (1) an initial small-scale prospective randomised trial to test an agreed minimum percentage variability between methods followed (subject to outcome) by (2) a prospective cohort study using CT alone.
Feasibility Can the proposed research be carried out in a realistic timescale and at an acceptable cost? As part of cost-effectiveness analysis, formal value-of-information methods may also sometimes be used to estimate the value for money of additional research. Are there any ethical or technical issues?	It should be possible to undertake both elements in a realistic timescale and at reasonable cost. This would not be the case if a full-scale Phase 3 trial (as distinct from a prospective cohort) were considered essential. It would be ethically necessary to retain the availability of MRI as opt-out gold standard throughout both studies.
Other comments Any other important issues should be mentioned, such as potential funders or outcomes of previous attempts to address this issue or methodological problems. However,	The ideal study would compare both CT and MRI in the same patients. This is, however, impractical. The proposed research design has some limitations, but does have the potential to provide useful evidence. The alternative of awaiting an “evolutionary” approach to progress in this area is less acceptable.

this is not a research protocol.	
<u>Importance</u> How important is the question to the overall guideline? The research recommendation should be categorised into one of the following categories of importance: • High: the research is essential to inform future updates of key recommendations in the guideline • Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates • Low: the research is of interest and will fill existing evidence gaps.	The research is of high priority, since its findings have the potential to alter future guidance on the diagnosis of occult hip fracture.

21.2 Anaesthesia

Research question: What is the clinical and cost effectiveness of regional versus general anaesthesia on postoperative morbidity in patients with hip fracture?

Why this is important

No recent randomised controlled trials were identified that fully address this question. The evidence is old and does not reflect current practice. In addition, in most of the studies the patients are sedated before regional anaesthesia is administered, and this is not taken into account when analysing the results. The study design for the proposed research would be best addressed by a randomised controlled trial. This would ideally be a multi-centre trial including 3000 participants in each arm. This is achievable given that there are about 70,000 to 75,000 hip fractures a year in the UK. The study should have three arms that look at spinal anaesthesia versus spinal anaesthesia plus sedation versus general anaesthesia; this would separate those with regional anaesthesia from those with regional anaesthesia plus sedation. The study would also need to control for surgery, especially type of fracture, prosthesis and grade of surgeon. A qualitative research component would also be helpful to study on patient preference for type of anaesthesia.

This needs to be multicentre and could be conducted in one year in the U.K.Sample size, may need to have 3,000 in each limb which is achievable if one considers that there are 80, 000 hip fractures a year in the UK.

Criteria for selecting high-priority research recommendations:

PICO question Each research recommendation should be formulated as an answerable question or a set of closely related questions. This should use the PICO framework (patient, intervention, comparison and outcome)	What is the clinical and cost effectiveness of regional versus general anaesthesia on postoperative morbidity in patients with hip fracture? Patient: patients undergoing surgical repair for hip fractures Intervention: regional anaesthesia Comparison: general anaesthesia Outcome: postoperative morbidity
Importance to patients or the population. What would be the impact of any new or altered guidance on the population? (for example, acceptability to patients, quality of life, morbidity or disease prevalence, severity of disease or mortality).	Improved survival following hip fracture. Improved analgesia following surgery. Reduced complications such as acute delirium, nausea and vomiting.
Relevance to NICE guidance How would the answer to this question change future NICE guidance (that is, generate new knowledge and/or evidence)?	The study may give the evidence to give better guidance to anaesthetists. There have been no studies comparing modern anaesthesia techniques in this group of patients. The current evidence is old and unreliable. The hip fracture population is now older and has more comorbidities than the population in which the historical studies were conducted.

	The studies are also important to help patients and their carers make informed decisions about the form of anaesthesia most appropriate for them. Importance : High
Relevance to the NHS What would be the impact on the NHS and (where relevant) the public sector of any new or altered guidance (for example, financial advantage, effect on staff, impact on strategic planning or service delivery)?	There may be a reduction in length of stay in patients receiving spinal anaesthesia, without sedation. Postoperative recovery should be quicker.
National priorities Is the question relevant to a national priority area (such as a national service framework or white paper)? The relevant document should be specified.	SIGN recommend spinal but without any evidence base. The evidence for benefit is weak and was conducted over 30 years ago.
Current evidence base What is the current evidence base? What are the problems with the current evidence base? (that is, why is further research required?) Reference should be made to the section of the full guideline that describes the current evidence base, including details of trials and systematic reviews. The date on which the final literature search was undertaken should be specified.	No trial evidence was identified
Equality Does the research recommendation address equality issues? For example, does it focus on groups that need special consideration, or focus on an intervention that is not available for use by people with certain disabilities?	This recommendation does not exclude any patient group. However, special consideration should be given to very frail older people with a high prevalence of cognitive impairment.
Study design It should also specify the most appropriate study design to address the proposed question(s). Primary research or secondary research (for example, systematic reviews) can be recommended.	The study design for the proposed research would be best addressed by an RCT. This would ideally have three arms (3000 participants each) which looks at spinal versus spinal plus sedation versus general anaesthsia, this would separate those with regional anaesthesia from those with regional anaesthesia plus sedation. The study would also need to control for surgery, especially type of fracture, prosthesis and grade of surgeon. A qualitative research component would also be helpful to study on patient preference for

	type of anaesthesia.
Feasibility Can the proposed research be carried out in a realistic timescale and at an acceptable cost? As part of cost-effectiveness analysis, formal value-of-information methods may also sometimes be used to estimate the value for money of additional research. Are there any ethical or technical issues?	Although the number of participants suggested is relatively high, it is worth considering that there are over 80,000 patients admitted with hip fractures each year. This should be feasible by conducting a multi-centre RCT.
Other comments Any other important issues should be mentioned, such as potential funders or outcomes of previous attempts to address this issue or methodological problems. However, this is not a research protocol.	Potential funders include : The National Institute for Health Research (NIHR), ASTRA foundation.
Importance How important is the question to the overall guideline? The research recommendation should be categorised into one of the following categories of importance: • High: the research is essential to inform future updates of key recommendations in the guideline • Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates • Low: the research is of interest and will fill existing evidence gaps.	High. The research is essential to inform future updates of key recommendations in the guideline.

21.3 Displaced intracapsular hip fractures

Research question:

What is the clinical and cost effectiveness of large head total hip replacement versus hemiarthroplasty on functional status, reoperations and quality of life in patients with displaced intracapsular hip fracture?

Why this is important:

Large-head total hip replacement is a development of traditional total hip replacement, where a larger head makes the joint more stable and hence reduces the risks of dislocation. Three small trials have shown traditional small-head total hip replacement to have better outcomes and function, albeit with an increased dislocation rate in selected groups of patients. The drawback with large-head arthroplasty is the additional implant cost and theatre time. This cost can account for up to 20% of current NHS tariff (up to £2000) and the study aims to address whether this translates to improved patient outcome. The study design for the proposed research would be best addressed by a randomised controlled trial. This would have two arms to compare current standard care (using hemiarthroplasty) with using large-head total hip replacement for patients sustaining displaced intracapsular hip fractures. The primary outcome would be patient mobility at 1 year and secondary outcomes would include functional outcomes, quality of life and cost effectiveness of the intervention.

It would be expected that a sample size of approximately 500 patients would be required to show a significant difference in the mobility, hip function and quality of life (assuming 80% power, $p < 0.05$). By recruiting through a trauma research network it is estimated that 10 centres would be able to recruit 20 patients per month (from 45 eligible patients) giving a recruitment period of 25 months.

Criteria for selecting high-priority research recommendations:

PICO question Each research recommendation should be formulated as an answerable question or a set of closely related questions. This should use the PICO framework (patient, intervention, comparison and outcome)	Question: What is the clinical and cost effectiveness of large head total hip replacement versus hemiarthroplasty on functional status, reoperations and quality of life in patients with displaced intracapsular hip fracture? *Patients*: Patients sustaining displaced intracapsular hip fractures *Intervention*: Arthroplasty *Comparison*: Either hemiarthroplasty (half a hip replacement) or total hip replacement with a large head *Outcome*: Timely functional status, cost effectiveness,re-operations and quality of life at one year

Importance to patients or the population. What would be the impact of any new or altered guidance on the population? (for example, acceptability to patients, quality of life, morbidity or disease prevalence, severity of disease or mortality).	Presently there are over 30,000 who sustain a displaced intracapsular hip fracture per year in the United Kingdom. Whilst there is evidence that total hip replacement with a small femoral head gives some advantages in specific groups (3 small RCTs) the concern has been the risk of dislocations. The technology has advanced and it is now possible to perform large head (>36mm) total hip replacement which significantly reduces the risk of dislocation and may improve function. The drawback is the increased cost (between £1000 - £2000 or >10-20% of the tariff)
Relevance to NICE guidance How would the answer to this question change future NICE guidance (that is, generate new knowledge and/or evidence)?	Presently the NICE recommendations recommend replacement arthroplasty and is only specific about a defined group of cognitively unimpaired, previously mobile and with no significant comorbidities. There is currently widespread practice in arthroplasty and there is an increase use of more expensive prosthesis. Surgeons are beginning to adopt large head technology without evidence of effectiveness, cost benefit or consideration of complication rates. This recommendation is considered high by the NICE Hip Fracture Development Group as the results of this study would advise NICE on future recommendations for the large and vulnerable group of patients
Relevance to the NHS What would be the impact on the NHS and (where relevant) the public sector of any new or altered guidance (for example, financial advantage, effect on staff, impact on strategic planning or service delivery)?	The NHS would be in a better position to focus resources on those in most need. Better function of the large head total hip replacement may reduce care costs in both the acute setting and rehabilitation.
National priorities Is the question relevant to a national priority area (such as a national service framework or white paper)? The relevant document should be specified.	Improving the care of those suffering fragility fractures is a NHS priority. Hip fractures are the largest cost of this group and account for two thirds of all hospital days due to fractures and 87% of the costs (£385million 2007).
Current evidence base What is the current evidence base? What are	One cohort study has been presented on large head total hip replacement and three previous RCTs on small head total hip replacements have

the problems with the current evidence base? (that is, why is further research required?) Reference should be made to the section of the full guideline that describes the current evidence base, including details of trials and systematic reviews. The date on which the final literature search was undertaken should be specified.	been published
Equality Does the research recommendation address equality issues? For example, does it focus on groups that need special consideration, or focus on an intervention that is not available for use by people with certain disabilities?	Yes, very frail older people with a high prevalence of cognitive impairment.
Study design It should also specify the most appropriate study design to address the proposed question(s). Primary research or secondary research (for example, systematic reviews) can be recommended.	*Design*: A randomised controlled trial of displaced intracapsular fractures in previously mobile patients between hemiarthroplasty and large head total hip replacement. *Outcome*: Does large head arthroplasty improve recovery of mobility one year after surgical management of displaced intracapsular hip fracture
Feasibility Can the proposed research be carried out in a realistic timescale and at an acceptable cost? As part of cost-effectiveness analysis, formal value-of-information methods may also sometimes be used to estimate the value for money of additional research. Are there any ethical or technical issues?	The research would be ethically and technically feasible. The research costs would need to be considered in the context that participants would still need treatment if outside a trial which would set the research costs into proper context and perspective.
Other comments Any other important issues should be mentioned, such as potential funders or outcomes of previous attempts to address this issue or methodological problems. However, this is not a research protocol.	The National Institute for Health Research (NIHR) would be an appropriate funding source. Industry support would off lay excess implant costs
Importance How important is the question to the overall guideline? The research recommendation should be categorised into one of the following categories of importance: • High: the research is essential to inform future updates of key recommendations in the guideline	High. The research is essential to inform future updates of key recommendations in the guideline.

• Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates • Low: the research is of interest and will fill existing evidence gaps.	

21.4 Intensive rehabilitation therapies after hip fracture

Research question:

What is the clinical and cost effectiveness of additional intensive physiotherapy and/or occupational therapy (for example progressive resistance training) after hip fracture?

Why this is important:

The rapid restoration of physical and self care functions is critical to recovery from hip fracture, particularly where the goal is to return to the patient to preoperative levels of function and residence. Approaches that are worthy of future development and investigation include progressive resistance training, progressive balance and gait training, supported treadmill gait re-training, dual task training, and activities of daily living training. The optimal time point at which these interventions should be started requires clarification.

The ideal study design is a randomised controlled trial. Initial studies may have to focus on proof of concept and be mindful of costs. A phase III randomised controlled trial is required to determine clinical effectiveness and cost-effectiveness. The ideal sample size will be around, 400 to 500 patients, and the primary outcome should be physical function and health related quality of life. Outcomes should also include falls. A formal sample size calculation will need to be undertaken. Outcomes should be followed over a minimum of 1 year, and compare if possible, either the recovery curve for restoration of function or time to attainment of functional goals.

Criteria for selecting high-priority research recommendations:

PICO question Each research recommendation should be formulated as an answerable question or a set of closely related questions. This should use the PICO framework (patient, intervention, comparison and outcome)	*Question*: What is the clinical and cost effectiveness of additional intensive physiotherapy and/or occupational therapy (for example progressive, resistance training) after hip fracture? *Patients*: All patients who have a fracture, studies should consider all forms of surgical treatment. Separate studies maybe needed for those with severe cognitive impairment and those without (depending on specifics of the intervention) *Intervention*: Progressive therapy protocols *Comparison*: Usual care therapy *Outcome*: Restoration of mobility, health related quality of life, falls, residence, ADL /IADL abilities, linked geriatric syndromes, resource use.
Importance to patients or the population. What would be the impact of any new or altered guidance on the population? (for	Patients and their families value mobility very highly. The ability to walk even short distances, can mean the difference between being able

example, acceptability to patients, quality of life, morbidity or disease prevalence, severity of disease or mortality).	to live at home, or not. The step between being able to walk outside and inside is greater still. The same can be said for key skills like dressing and bathing. The impact of improved mobility, strength, balance and function would have a substantial impact on the patient and their family, as well as the requirement for long term residential or at home care.
Relevance to NICE guidance How would the answer to this question change future NICE guidance (that is, generate new knowledge and/or evidence)?	It would enable NICE to come to a decision on whether to recommend more intensive physiotherapy and/or occupational therapy, by generating new evidence on clinical and cost effectiveness. This is very important to the guideline – at the moment we have made several statements about volume (frequency of therapy) but not of content. The guideline would be strengthened considerably with this additional information. The level would be high.
Relevance to the NHS What would be the impact on the NHS and (where relevant) the public sector of any new or altered guidance (for example, financial advantage, effect on staff, impact on strategic planning or service delivery)?	There would possibly be an increase in the amount of therapy time that is needed, and this would incur impacts on strategic planning and service delivery.
National priorities Is the question relevant to a national priority area (such as a national service framework or white paper)? The relevant document should be specified.	Yes the national service framework for older people.
Current evidence base What is the current evidence base? What are the problems with the current evidence base? (that is, why is further research required?) Reference should be made to the section of the full guideline that describes the current evidence base, including details of trials and systematic reviews. The date on which the final literature search was undertaken should be specified.	Very limited trial evidence, and no trial evidence for some interventions.
Equality Does the research recommendation address	Yes these are vulnerable older adults who need special consideration, particularly if they have cognitive impairment or frailty. These

equality issues? For example, does it focus on groups that need special consideration, or focus on an intervention that is not available for use by people with certain disabilities?	types of services are not currently provided to many hip fracture patients, and certainly not those with cognitive impairments
Study design It should also specify the most appropriate study design to address the proposed question(s). Primary research or secondary research (for example, systematic reviews) can be recommended.	*Design*: A randomised controlled trial of intensive therapy (to be specified) versus usual care therapy *Outcome*: Mobility, function, health related quality of life, resource use, and costs (health and social care)
Feasibility Can the proposed research be carried out in a realistic timescale and at an acceptable cost? As part of cost-effectiveness analysis, formal value-of-information methods may also sometimes be used to estimate the value for money of additional research. Are there any ethical or technical issues?	The research would be ethically and technically feasible. The outcome and research question is sufficiently important to merit a large scale randomised controlled trial
Other comments Any other important issues should be mentioned, such as potential funders or outcomes of previous attempts to address this issue or methodological problems. However, this is not a research protocol.	The National Institute for Health Research (NIHR) HTA would be an appropriate funding source.
Importance How important is the question to the overall guideline? The research recommendation should be categorised into one of the following categories of importance: • High: the research is essential to inform future updates of key recommendations in the guideline • Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates • Low: the research is of interest and will fill existing evidence gaps.	High. The research is essential to inform future updates of key recommendations in the guideline.

21.5 Early Supported Discharge in Care Home patients

Research question:

What is the clinical and cost effectiveness of early supported discharge on mortality, quality of life and functional status in patients with hip fracture who are admitted from a care home?

Why this is important:

Residents of care and nursing homes account for about 30% of all patients with hip fracture admitted to hospital. Two-thirds of these come from care homes and the remainder from nursing homes. These patients are frailer, more functionally dependent and have a higher prevalence of cognitive impairment than patients admitted from their own homes. One-third of those admitted from a care home are discharged to a nursing home and one-fifth are readmitted to hospital within 3 months. There are no clinical trials to define the optimal rehabilitation pathway following hip fracture for these patients and therefore represent a discrete cohort where the existing meta-analyses do not apply. As a consequence, many patients are denied structured rehabilitation and are discharged back to their care home or nursing home with very little or no rehabilitation input.

Given the patient frailty and comorbidities, rehabilitation may have no effect on clinical outcomes for this group. However, the fact that they already live in a home where they are supported by trained care staff, clearly provides an opportunity for a systematic approach to rehabilitation. Early multidisciplinary rehabilitation based in care homes or nursing homes would take advantage of the day-to-day care arrangements already in place and provide additional NHS support to deliver naturalistic rehabilitation, where problems are tackled in the patient's residential.

Early supported multidisciplinary rehabilitation could reduce hospital stay, improve early return to function, and affect both readmission rates and the level of NHS-funded nursing care required.

The research would follow a two-stage design: (1) an initial feasibility study to refine the selection criteria and process for reliable identification and characterisation of those considered most likely to benefit, together with the intervention package and measures for collaboration between the Hip Fracture Programme team, care-home staff and other community-based professionals, and (2) a cluster randomized controlled comparison (with two or more intervention units and matched control units) set against agreed outcome criteria. The latter should include those specified above, together with measures of the impact on care-home staff activity and cost, as well as qualitative data from patients on relevant quality-of-life variables.

Criteria for selecting high-priority research recommendations:

PICO question Each research recommendation should be formulated as an answerable question or a set of closely related questions. This should use the PICO framework (patient, intervention, comparison and outcome).	*Patients*: Elderly hip fracture patients admitted from a care/nursing home *Intervention*: Structured multidisciplinary rehabilitation *Comparison*: Standard care *Outcome*: Reduction in hospital LOS, short and long-term functional improvement, reduction in readmission to hospital, reduction in upgrade from care to nursing home dependency.
Importance to patients or the population. What would be the impact of any new or altered guidance on the population? (for example, acceptability to patients, quality of life, morbidity or disease prevalence, severity of disease or mortality).	Reduced dependency
Relevance to NICE guidance How would the answer to this question change future NICE guidance (that is, generate new knowledge and/or evidence)?	The answer to this question is key to guidance on early supported discharge in hip fracture patients admitted from care home, who represent a significant proportion of patients With this information available NICE would be in a position to recommend early supported discharge in this group of patients. Importance : High
Relevance to the NHS What would be the impact on the NHS and (where relevant) the public sector of any new or altered guidance (for example, financial advantage, effect on staff, impact on strategic planning or service delivery)?	Reduction in hospital LOS will allow greater efficiency with respect to usage of trauma beds. Reduction in re-admissions, upgraded dependency to nursing homes represent significant cost savings
National priorities Is the question relevant to a national priority area (such as a national service framework or white paper)? The relevant document should be specified.	A number of national guidelines now recommend the need for research in care home patients following hip fracture (SIGN, Orthopaedic Blue Book, NIHR HTA review, Cochrane review).
Current evidence base What is the current evidence base? What are the problems with the current evidence base? (that is, why is further research	No trial evidence was identified.

required?) Reference should be made to the section of the full guideline that describes the current evidence base, including details of trials and systematic reviews. The date on which the final literature search was undertaken should be specified.	
Equality Does the research recommendation address equality issues? For example, does it focus on groups that need special consideration, or focus on an intervention that is not available for use by people with certain disabilities?	Yes, very frail older people with a high prevalence of cognitive impairment.
Study design It should also specify the most appropriate study design to address the proposed question(s). Primary research or secondary research (for example, systematic reviews) can be recommended.	This will comprise: a systematic literature review, focusing on rehabilitation in care homes; a qualitative interview study with care home residents, their families, care home staff, allied health professionals and inpatient orthopaedic staff regarding discharge planning and rehabilitation for these patients; and an evaluation of a pilot early supported multidisciplinary rehabilitation service compared to usual care.
Feasibility Can the proposed research be carried out in a realistic timescale and at an acceptable cost? As part of cost-effectiveness analysis, formal value-of-information methods may also sometimes be used to estimate the value for money of additional research. Are there any ethical or technical issues?	The research would be ethically and technically feasible, at an acceptable level of cost.
Other comments Any other important issues should be mentioned, such as potential funders or outcomes of previous attempts to address this issue or methodological problems. However, this is not a research protocol.	Potential funders include :The National Institute for Health Research (NIHR), BUPA, Alzheimer's Society
Importance How important is the question to the overall guideline? The research recommendation should be categorised into one of the following categories of importance: • High: the research is essential to inform future updates of key recommendations in	High. The research is essential to inform future updates of key recommendations in the guideline.

the guideline • Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates • Low: the research is of interest and will fill existing evidence gaps.	

22 Appendix J: Excluded studies

Chapter	Study ID	Reasons for exclusion
Diagnosis	Lubovsky et al (2005)[196]	The trial was excluded because of the very small sample size. Only 13 patients included and only 6 patients received CT and MRI. The results were reported in a way that did not allow calculations of sensitivity and specificity.
Timing of surgery	Davis et al (1988)[68]	No baseline characteristics, no adjustment for comorbidity.
Timing of surgery	Franzo et al (2005)[101]	No clear explanation of adjustment and no baseline characteristics for each group.
Timing of surgery	Gdalevich et al (2004)[108]	No baseline characteristics, no adjustment for comorbidity.
Timing of surgery	Hoenig et al (1997)[146]	Not only surgical delay investigated, unable to extract raw data.
Timing of surgery	Kenzora et al (1984)[177]	No baseline characteristics, no adjustment for comorbidity.
Timing of surgery	Mackenzie wt al (2006)[198]	Letter/short correspondence.
Timing of surgery	McGuire et al (2004)[209]	The aim of the study is on day of the week of admission.
Timing of surgery	Moran et al (2005)[215]	No baseline characteristics, no adjustment for comorbidity.
Timing of surgery	Novack et al (2007)[243]	Adjusted hazard ratios given.
Timing of surgery	Rae et al (2007)[280]	Baseline characteristics not given for each group.
Timing of surgery	Rogers et al (1995)[290]	No baseline characteristics, no adjustment for comorbidity.

Timing of surgery	Sebestyen et al (2008)[302]	No adjustment for comorbidity.
Timing of surgery	Shabat et al (2003)[304]	Inadequate methodology.
Timing of surgery	Sircar et al (2007)[312]	No baseline characteristics, no adjustment for comorbidity.
Timing of surgery	Sund & Liski (2005)[322]	Adjusted odds ratios for provider characteristics.
Analgesia	Gorodetskyi et al (2007)[122]	Not a study of nerve blocks.
Analgesia	Mannion et al (2005)[202]	No 'control' group without the nerve block.
Analgesia	Marhofer et al (1998)[205]	No 'control' group without the nerve block.
Analgesia	Mutty et al (2007)[221]	No proximal femoral fractures included.
Analgesia	Piangatelli et al (2004)[272]	No 'control' group without the nerve block.
Analgesia	Schiferer et al (2007)[301]	Inclusion of participants with other conditions. The trialists were unable to provide separate results for only the hip fracture participants.
Analgesia	Turker et al (2003)[332]	No 'control' group without the nerve block
Analgesia	Van Leeuwen et al (2000)[342]	No 'control' group without the nerve block.
Anaesthesia	Alonso Chico et al (2003)[6]	Not a trial of different types of anaesthesia but a comparison of different drugs within one form of anaesthesia.
Anaesthesia	Barna (1981)[13]	No randomisation of patients.
Anaesthesia	Ben-David et al (2000)[16]	Not a trial of different types of anaesthesia but a comparison of different drugs within one form of anaesthesia.
Anaesthesia	Coleman et al (1988)[56]	The study was excluded as it involved a change in the types of drugs used only, not a change in the method of anaesthesia.
Anaesthesia	Critchley et al (1995)[57]	Not a trial of different types of anaesthesia but a comparison of different drugs within one form of anaesthesia.
Anaesthesia	Darling et al (1994)[64]	The study was excluded as it was not felt relevant to this review as no clinical outcomes were reported.
Anaesthesia	Dyson et al (1988)[75]	Lack of outcome data for the anaesthesia comparison.
Anaesthesia	El-Zahaar et al (1995)[79,334]	This trial was excluded because separate results for patients having surgery for a hip fracture were not presented.
Anaesthesia	Favarel-Garrigues et al (1996)[92]	The trial was excluded as it was not considered a comparison of different forms of anaesthesia, only of a modification of anaesthetic technique.
Anaesthesia	Hemmingsen & Nielsen (1991)[143]	Not a trial of different types of anaesthesia but a comparison of different drugs within one form of anaesthesia.
Anaesthesia	Marhofer et al (1999)[204]	Not a comparison of anaesthetic methods.
Anaesthesia	Matot et al (2003)[207]	Compared techniques outside the scope of

		this review.
Anaesthesia	Maurette et al (1993)[208]	The trial was excluded as it was a trial of different drugs with the same anaesthetic technique, not a comparison of different types of anaesthesia.
Anaesthesia	Naja et al (2000)[223]	No randomisation of patients.
Anaesthesia	Nishikawa et al (2002)[242]	Not a comparison of different types of anaesthesia.
Anaesthesia	Owen & Hutton (1982)[252]	Not a comparison of anaesthetic techniques.
Anaesthesia	Sinclair et al (1997)[311]	Not a comparison of different types of anaesthesia.
Anaesthesia	Sutcliffe & Parker (1994)[323]	No randomisation of patients.
Anaesthesia	Tonczar & Hammerle (1981)[329]	The study was excluded as it involved a neuroleptic anaesthesia and the only outcome measures were plasma catecholamines, cortisol, blood pressure and changes in heart rate.
Anaesthesia	Ungemach (1987)[333]	The trial was excluded as it was a comparison of different drugs within one type of anaesthesia (general anaesthesia) and not a comparison of different anaesthetic techniques.
Surgeon Seniority	Claque et al (2002) [52]	Retrospective study, unclear if adjusted for confounders. Not stated how patients were allocated to surgeons.
Surgeon Seniority	Englesbe et al (2009) [82]	Compares outcomes at time when new trainees start compared to other times of the year. Not about surgeon seniority.
Surgeon Seniority	Evans et al (1979) [87]	No results or data for surgeon seniority analysis.
Surgeon Seniority	Faraj & Drakau (2007) [90]	No adjustment for confounders and no indication of how patients were allocated to surgeons.
Surgeon Seniority	Fung et al (2007) [104]	No outcome of interest.
Surgeon Seniority	Giannoudis et al (1998) [111]	No outcome of interest.
Surgeon Seniority	Grimley et al (1980) [126]	Compares hospitals outcomes rather than surgeon seniority. Unclear if retrospective or prospective. No indication of how patients were allocated to surgeons.
Surgeon Seniority	Harper & Walsh (1985) [135]	Unclear if retrospective or prospective, no adjustment for confounders.
Surgeon Seniority	Holmberg et al (1987) [149]	Unclear if retrospective or prospective, no adjustment for confounders.
Surgeon Seniority	Holt et al (1994) [151]	No adjustment for confounders.
Surgeon Seniority	Levi & Gebuhr (2000) [192]	Unclear if retrospective or prospective, no adjustment for confounders, no outcomes measured by surgeon seniority only reports in words there was no difference

		between registrars and consultants.
Surgeon Seniority	Kukla et al (2001) [181]	Unclear if retrospective or prospective. Examines years of experience but inexperienced surgeons were supervised. Results presented as a continuous variable.
Surgeon Seniority	Parker et al (1994) [271]	Not surgeon seniority, investigates the use of a special "Hip Fracture Team".
Surgeon Seniority	Sarvilinna et al (2002) [299]	Retrospective study, no adjustment for confounders.
Surgeon Seniority	Sehat et al (2006) [303]	Not about surgeon seniority.
Surgeon Seniority	Weinrauch (2006) [350]	Not stated how patients were assigned to surgeons. Not stated the total number of surgeons involved nor how many involved in each category. Does not adjust for any confounders.
Internal fixation vs arthroplasty	Bhandari et al (2003) [21]	Systematic review, used Cochrane review instead.
Internal fixation vs arthroplasty	Bjorgul et al (2006) [25]	Non-randomised study.
Internal fixation vs arthroplasty	Bray et al (1988) [35]	Excluded from Cochrane review due to inadequate randomisation. Patients were allocated according to day of week and surgeon preference. In addition to the low numbers recruited five were lost to follow-up.
Internal fixation vs arthroplasty	El-Abed et al (2005) [78]	Excluded from Cochrane review as non-randomised study, type of procedure used was by the preference of the attending surgeon on the day of admission.
Internal fixation vs arthroplasty	Gjertsen et al (2010) [118]	Non-randomised study.
Internal fixation vs arthroplasty	Haentjens et al (2005) [130]	Non-randomised study.
Internal fixation vs arthroplasty	Heetveld et al (2009) [142]	Non-randomised study.
Internal fixation vs arthroplasty	Hunter (1974) [156]	Excluded from Cochrane review as non-randomised study.
Internal fixation vs arthroplasty	Hunter (1969) [155]	Excluded from Cochrane review as non-randomised study.
Internal fixation vs arthroplasty	Neander (2000) [238]	Excluded from Cochrane review due to inadequate randomisation procedure. The first 20 patients were randomised with closed envelopes but the last 80 were allocated according to the day of week they were admitted (Monday to Thursday total hip replacement, Friday to Sunday reduction and fixation).
Internal fixation vs arthroplasty	Parker (1992) [261]	Excluded from Cochrane review as non-randomised study.
Internal fixation vs arthroplasty	Riley (1978) [285]	Excluded from Cochrane review as study provided no adequate data.

Internal fixation vs arthroplasty	Rodriguez et al (1987) [289]	Excluded from Cochrane review as non-randomised study.
Internal fixation vs arthroplasty	Rogmark & Johnell (2006) [292]	Systematic review, used Cochrane review instead.
Internal fixation vs arthroplasty	Sikorski & Barrington (1981) [309]	This comparison excluded from Cochrane review due to poor methodological quality.
Internal fixation vs arthroplasty	Stewart (1984) [321]	Excluded from Cochrane review as non-randomised study.
Internal fixation vs arthroplasty	Wang et al (2009) [347]	Systematic review, used Cochrane review instead.
Hemiarthroplasty vs total hip replacement	Goh et al (2009) [120]	Systematic review, used Cochrane review instead.
Hemiarthroplasty vs total hip replacement	Haentjens et al (2005) [130]	Non-randomised study.
Hemiarthroplasty vs total hip replacement	Heetveld et al (2009) [142]	Non-randomised study.
Hemiarthroplasty vs total hip replacement	Kavcic et al (2006) [172]	Methodology not reported. Only mentions patients were randomly selected. No indication of allocation concealment, method of randomisation, blinding, or inclusion/exclusion criteria.
Cement	Ahn et al (2008) [2]	Systematic review that includes randomised and non-randomised studies. Used Cochrane review.
Cement	Bajammal et al (2008) [10]	Systematic review of cement use in appendicular fractures, not just hip fractures. Used Cochrane review.
Cement	Christie et al (1994) [50]	Excluded from Cochrane review as biometric study with no clinical outcome measures. No methods given for RCT, no outcomes from our protocol.
Cement	Clark et al (2001) [53]	Excluded from Cochrane review as non-randomised study.
Cement	Dorr et al (1986) [73]	Cemented vs uncemented hemiarthroplasty not a randomised comparison
Cement	Faraj & Branfoot (1999) [89]	Excluded from Cochrane review as non-randomised study, use of cement was at operating surgeon's preference.
Cement	Field & Rushton (2005) [93]	Excluded from Cochrane review because of a limited number of cases using what is at present an experimental new cup.
Cement	Georgescu et al (2004) [109]	Excluded from Cochrane review because of a lack of reported results within the conference abstract
Cement	Gierer et al (2002) [112]	Excluded from Cochrane review as non-randomised study, use of cement was at operating surgeon's preference.

Cement	Graf et al (2000) [123]	Excluded from Cochrane review as non-randomised study.
Cement	Johnson et al (2001) [164]	Excluded from Cochrane review as non-randomised study.
Cement	Karpmann et al (1992) [170]	Excluded from Cochrane review as there was inadequate reporting of the trial. Attempts were made to contact the trialists for further information, without success.
Cement	Khan et al (2002) [178]	Systematic review, excluded as used Cochrane review instead.
Cement	Lachiewicz et al (2008) [184]	Elective hip replacement patients, not hip fracture patients.
Cement	Leidinger et al (2002) [190]	Excluded from Cochrane review as variations of cementing technique are not part of the protocol
Cement	Pitto et al (2000) [273]	Excluded from Cochrane review as small numbers and only outcome measure is transoesophagel echocardiography shown embolism. No methods given for RCT, no outcomes from our protocol.
Cement	Sadr & Arden (1977) [295]	Excluded from Cochrane review as unclear whether randomised, the use of Proplast coated prosthesis is no longer prevalent, small study of 40 patients with limited reporting of outcomes for the 25 assessed patients at follow up.
Cement	Vochteloo et al (2009) [345]	Protocol for a randomised study, study not completed.
Surgical approach to hemiarthroplasty	Barden et al (2001) [12]	Excluded from Cochrane review as not a comparison of different surgical approaches.
Surgical approach to hemiarthroplasty	Cashman & Cashman (2008) [47]	Elective hip replacement patients.
Surgical approach to hemiarthroplasty	Chan & Hoskin (1975) [49]	No adjustment for confounders.
Surgical approach to hemiarthroplasty	Enocson et al (2009) [83]	About total hip replacement.
Surgical approach to hemiarthroplasty	Enocson et al (2010) [84]	Possible double counting of the included study ENOCSON 2008. No adjustment for confounders.
Surgical approach to hemiarthroplasty	Keene et al (1993) [175]	Not about surgical approach.
Surgical approach to hemiarthroplasty	Lafosse et al (2007) [187]	About a minimumally invasive approach.
Surgical approach to hemiarthroplasty	Lafosse et al (2007) [186]	About a minimumally invasive approach.
Surgical approach to hemiarthroplasty	Lafosse et al (2008) [185]	About a minimumally invasive approach.
Surgical approach to hemiarthroplasty	Unwin & Thomas (1994) [336]	No adjustment for confounders.

Surgical approach to hemiarthroplasty	Wang et al (2010) [346]	About a minimumally invasive approach.
Surgical approach to hemiarthroplasty	Yang et al (2010) [356]	About a minimumally invasive approach.
Surgical approach to hemiarthroplasty	Widman & Isacson (2001)[353]	Excluded from Cochrane review as not a comparison of different surgical approaches.
Screws/nails	Baumgaertner et al (1998)[15]	No relevant outcomes.
Screws/nails	Benum et al (1994)[18]	Abstract only.
Screws/nails	Butt et al (1995)[40]	Does not meet our inclusion criteria: includes trochanteric and subtrochanteric combined.
Screws/nails	Davis et al (1988)[67]	Does not meet our inclusion criteria: includes trochanteric and associated subtrochanteric combined.
Screws/nails	Dujardin et al (2001)[74]	Experimental nail not used commercially.
Screws/nails	Kuwabara et al (1998)[183]	Unable to obtain paper.
Screws/nails	Lee et al (2007)[188]	Does not meet our inclusion criteria: all high energy trauma (subtrochanteric fractures).
Screws/nails	Mehdi et al (2000)[212]	Abstract only.
Screws/nails	Michos et al (2001)[213]	Abstract only.
Screws/nails	Mott et al (1993)[217]	Abstract only.
Screws/nails	Pahlpatz & Langius (1993)[253]	Does not meet our inclusion criteria: Includes trochanteric and subtrochanteric fractures combined.
Screws/nails	Rahme & Harris (2007)[281]	Does not meet our inclusion criteria: all high energy trauma (subtrochanteric).
Surgical procedures (economic evidence)	Giancola et al (2008)[110]	No cost figures were reported.
Surgical procedures (economic evidence)	Gill & Ursic (2007)[114]	Inadequate methodological design and limited applicability to the UK NHS.
Surgical procedures (economic evidence)	Kim et al (2005)[179]	Proximal femoral nail compared to long-stem cementless calcar-replacement prosthesis (not an included intervention).
Surgical procedures (economic evidence)	Marinelli et al (2008)[206]	Inadequate methodology.
Surgical procedures (economic evidence)	Rogmark et al (2003)[291]	The study does not distinguish patients on the basis of whether they received hemiarthroplasty or total hip replacement.
Mobilisation	Binder et al (2004)[24]	The comparison is not versus usual care.
Mobilisation	Galea et al (2008)[106]	The comparison is not versus usual care, both have a targeted plan.
Mobilisation	Graham (1968)[124]	The intervention is weight bearing at 2 weeks or 12 weeks. Not relevant to our review question.
Mobilisation	Mangione et al (2005)[201]	The comparison is not versus usual care.
Mobilisation	Resnick et al (2007)[283]	Does not answer our review question: augmented mobilisation vs. usual care.

Mobilisation	Tsauo et al (2005)[330]	Does not answer our review question: community mobilisation vs. usual care.
Mobilisation	Yu-yahiro et al (2009)[359]	Does not answer our review question: community mobilisation vs usual care.
MDR	Fordham et al (1986)[96]	Discussion paper with a cost benefit analysis
MDR	Giusti et al (2006)[117]	Does not meet our inclusion criteria for MDR team: medicine; nursing; physiotherapy; occupational therapy; and social care. Additional components may include: nutrition; pharmacy; and clinical psychology.
MDR	Gonzalez-Montalvo et al (2010)[121]	Mixed intervention, acute orthogeriatric unit model, plus early surgery.
MDR	Ho et al (2009)[145]	Letter to editor.
MDR	Holt et al (2010)[152]	Does not meet our inclusion criteria: no outcomes reported that were prioritised in our protocol. Survival analysis rather than mortality.
MDR	Iliffe et al (2010)[159]	Protocol only, not full results.
MDR	Kuisma (2002)[180]	Does not meet our inclusion criteria for MDR team: medicine; nursing; physiotherapy; occupational therapy; and social care. Additional components may include: nutrition; pharmacy; and clinical psychology.
MDR	O'Cathain (1994)[245]	Observational study.
MDR	Olsson et al (2007)[248]	Does not meet our inclusion criteria for MDR team: medicine; nursing; physiotherapy; occupational therapy; and social care. Additional components may include: nutrition; pharmacy; and clinical psychology.
MDR	Pryor & Williams (1989)[275]	Observational study.
MDR	Richards et al (1998)[284]	Mixed population, only 31% hip fracture patients.
MDR	Ryan et al (2006)[293]	Does not answer our review question. Intervention is intensity of multidisciplinary rehab (intensive: 6 or more face-to-face sessions per week from MDR team vs. less intensive: 3 or less face-to-face sessions per week).
MDR	Shyu et al (2010)[307]	Reports 2 year follow up. 1 year data already included, which is the longest time point stated in our protocol.
MDR	Uy et al (2008)[338]	Very low number of patients. N = 11
Hospital MDR (economic evidence)	Cameron et al (2000)[41]	The studies included in the HTA were grouped in a different way to that considered for our clinical review, and therefore its cost analysis was not

		applicable for our review question.
Community MDR (economic evidence)	Coast et al (1998)[55]	Mixed population with only 31% hip fracture patients.
Community MDR (economic evidence)	Van Balen et al (2002)[340]	Patients in the early supported discharge scheme were only discharged to a nursing home with rehabilitation facilities and not to their own home.
Patient views	Boutin-Lester & Gibson (2002) [32]	Only 1 / 5 of the patients had HF. This patient also had osteoporosis.
Patient views	Closs & Briggs (2002) [54]	Words used by patients to describe pain, not hip fracture patients only.
Patient views	Franchignoni (2002) [100]	Only 5/55 patients had hip fracture.
Patient views	Gjertsen et al (2008) [119]	Not qualitative research into patient views.
Patient views	Hallstrom et al (2000) [131]	7/9 patients had cervical fractures.
Patient views	Harrison (2006) [138]	Very brief summary of MSc thesis, unable to obtain a copy of thesis.
Patient views	Hedman et al (2008) [141]	Compares level of care received between cognitively impaired and cognitively intact hip fracture patients in two Swedish hospitals.
Patient views	Huang & Acton (2009) [154]	Patient views about the period after discharge from rehabilitation in Taiwan.
Patient views	Lin & Lu (2005) [194]	Caregivers views after discharge from hospital not patient views.
Patient views	Lin (2006) [193]	Not a patient view study.
Patient views	Magasi et al (2009) [199]	About choice of a rehabilitation facility in the US, not applicable to UK.
Patient views	Resnick et al (2005) [282]	Patient views on a specific exercise programme adopted at a centre in the USA.
Patient views	Robinson (1999) [287]	Patient views about adapting to life after rehabilitation.
Patient views	Smith et al (1997) [315]	Review of article on report about patient views on discharge information. Unable to obtain a copy of full report with qualitative research.
Patient views	Webster (1976) [349]	Not qualitative research of patient views.
Patient education	Allegrante et al (2007) [5]	Not patient education intervention alone.
Patient education	Bhandari & Tornetta (2004) [22]	About which way of communicating risk ratios to patients.
Patient education	Elinge et al (2003) [80]	Group learning programme started 3 months after fracture.
Patient education	Gill & Ursic (1994) [115]	Education for nurses not patients.
Patient education	Jackson (2010) [160]	Education intervention for healthcare professionals not patients.
Patient education	Tappen et al (2003) [326]	Effect of video intervention of recovery from hip surgery. Unclear how patients were allocated to interventions.
Patient education	Yoon et al (2008) [357]	Non-randomised study.

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