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# Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

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**(Refereed)**

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# Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

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## A B S T R A C T

**Background**

Hip fracture is a major fall-related injury which causes significant problems for individuals, their family and carers. Over 40% of people with hip fracture have dementia or cognitive impairment, and their outcomes after surgery are poorer than those without dementia. It is not clear which care and rehabilitation interventions achieve the best outcomes for these people.

**Objectives**

(a) To assess the effectiveness of models of care including enhanced rehabilitation strategies designed specifically for people with dementia following hip fracture surgery compared to usual care.

(b) To assess the effectiveness for people with dementia of models of care including enhanced rehabilitation strategies which are designed for all older people, regardless of cognitive status, following hip fracture surgery compared to usual care.

**Search methods**

We searched ALOIS (www.medicine.ox.ac.uk/alois), the Cochrane Dementia and Cognitive Improvement Group Specialised Register, up to and including week 1 June 2014 using the terms hip OR fracture OR surgery OR operation OR femur OR femoral.

**Selection criteria**

We include randomised and quasi-randomised controlled clinical trials (RCTs) evaluating the effectiveness for people with dementia of any model of enhanced care and rehabilitation following hip fracture surgery compared to usual care.

**Data collection and analysis**

Two review authors working independently selected studies for inclusion and extracted data. We assessed the risk of bias of included studies. We synthesised data only if we considered studies sufficiently homogeneous in terms of participants, interventions and outcomes. We used the GRADE approach to rate the overall quality of evidence for each outcome.

**Main results**

We included five trials with a total of 316 participants. Four trials evaluated models of enhanced interdisciplinary rehabilitation and care, two of these for inpatients only and two for inpatients and at home after discharge. All were compared with usual rehabilitation and care in the trial settings. The fifth trial compared outcomes of geriatrician-led care in hospital to conventional care led by the orthopaedic team. All papers analysed subgroups of people with dementia/cognitive impairment from larger RCTs of older people following hip fracture. Trial follow-up periods ranged from acute hospital discharge to 24 months post-discharge.

We considered all of the studies to be at high risk of bias in more than one domain. As subgroups of larger studies, the analyses lacked power to detect differences between the intervention groups. Further, there were some important differences in the baseline characteristics of the participants in experimental and control groups. Using the GRADE approach, we downgraded the quality of the evidence for all outcomes to 'low' or 'very low'.

No study assessed our primary outcome (cognitive function) nor other important dementia-related outcomes including behaviour and quality of life. The effect estimates for most comparisons were very imprecise, so it was not possible to draw firm conclusions from the data. There was low-quality evidence that enhanced care and rehabilitation in hospital led to lower rates of some complications and that enhanced care provided across hospital and home settings reduced the chance of being in institutional care at three months post-discharge (Odds Ratio (OR) 0.46, 95% confidence interval (CI) 0.22 to 0.95, 2 trials, n = 184), but this effect was more uncertain at 12 months (OR 0.90, 95% CI 0.40 to 2.03, 2 trials, n = 177). The effect of enhanced care and rehabilitation in hospital and at home on functional outcomes was very uncertain because the quality of evidence was very low from one small trial. Results on functional outcomes from other trials were inconclusive. The effect of geriatrician-led compared to orthopaedic-led management on the cumulative incidence of delirium was very uncertain (OR 0.73, 95% CI 0.22 to 2.38, 1 trial, n = 126, very low-quality evidence).

**Authors' conclusions**

There is currently insufficient evidence to draw conclusions about how effective the models of enhanced rehabilitation and care after hip fracture used in these trials are for people with dementia above active usual care. The current evidence base derives from a small number of studies with quality limitations. This should be addressed as a research priority to determine the optimal strategies to improve outcomes for this growing population of patients.

# PLAIN LANGUAGE SUMMARY

**Rehabilitation for people with dementia following a hip fracture operation**

**Background**

Hip fracture is an injury primarily of elderly people, usually caused by a fall. It can affect a person's ability to walk, perform activities of daily living and remain independent. Hip fracture is more common in people with dementia and they can find it more difficult to recover. This is because they are at greater risk of becoming more confused and developing additional complications such as pressure sores and chest infections after their operation. They may also find it more difficult to express their pain and discomfort.

**Review Question**

We wanted to find out whether different ways of treating people with dementia following hip fracture might affect how well they recover and what the associated costs of their recovery might be.

**Study Characteristics**

We searched for randomised controlled trials which compared any model of enhanced care and rehabilitation for people with dementia after hip fracture with the usual care provided in the trial setting. The last search was performed on 9th June 2014.

We identified five trials which studied a total of 316 people with dementia following hip fracture. Four trials compared an enhanced interdisciplinary rehabilitation and care programme, where all the different healthcare professionals worked collaboratively across hospital and community settings or just in hospital, to usual hospital care. One trial compared care in hospital led by a geriatrician with care led by an orthopaedic surgeon.

**Key Findings**

There was low-quality evidence that enhanced care and rehabilitation in hospital led to lower rates of some complications and that enhanced care provided across hospital and home settings reduced the chance of being in care such as a hospital, rehabilitation centre or care home at three months post-discharge. This difference was more uncertain at 12 months. The effect of enhanced care and rehabilitation in hospital and at home on functional outcomes was very uncertain because the quality of evidence was very low. The effect of geriatrician-led compared to orthopaedic-led management on delirium was very uncertain, based on very low-quality evidence.

### Quality of the Evidence

The studies were small and at high risk of bias and so the following findings should be interpreted with caution. There was limited research available with none of the care models designed specifically for people with dementia. None of the studies looked at the effect of the care on the participants' dementia or quality of life. All of the studies had significant quality limitations.

### Conclusions

We concluded that the current research was insufficient to determine the best ways to care for people with dementia after a hip fracture operation. However for almost all of the outcomes, the results were inconclusive because the studies were too small and of very low quality. More research is needed to establish what the best strategies are to improve the care of people with dementia following a hip fracture.

### Declarations

This review will form part of a funded NIHR Programme Grant (Reference Number: DTC-RP-PG-0311-10004; Chief Investigator: Fox). No authors declare any conflicts of interest in relation to this work.

# BACKGROUND

## Description of the condition

The hip joint is the articulation between the thigh bone (femur) and the pelvis. The term 'hip fracture' encompasses all fractures of the upper (proximal) part of the thigh bone (femur). Hip fractures are commonly divided into two types: intracapsular fractures, which represent those that occur within or proximal to the attachment of the hip joint capsule to the femur; and extracapsular, which represent fractures occurring outside or lower (distal) than the hip joint capsule (Parker 2010). Hip fracture is a common injury in elderly people.

The majority of people undergo hip surgery following hip fracture (Uzoigwe 2012). The location of the fracture, stability and degree of comminution (number of pieces the bone breaks into) determine which operative procedure should be used to repair the hip fracture. The aim of surgery, irrespective of the type of operation, is to reduce pain, facilitate early weight-bearing mobility to improve outcome, and to facilitate independence in activities of daily living, such as bathing, dressing, and continence (Handoll 2009). A delay in surgical intervention is known to be a key factor in producing poorer outcomes (Vidal 2012).

The annual incidence rate of hip fracture has been estimated as 1.29/1000 person-years in men and 2.24/1000 person-years in women (Adams 2013). This figure is likely to rise over the next few years as the general population increases in age (Cummings 2002). It is the most common physical rehabilitation condition for older adults (Lenze 2007), seen in both those who are cognitively intact and those with all degrees of cognitive impairment, and is associated with significant pain and loss of independence and function (Morrison 2000). Thirty-three to 37% of patients return to their prior level of function by six months, including those needing assistance (Magaziner 2002). However, only 24% of people following hip fracture are independently mobile at six months (Magaziner 2002).

Dementia is a global loss of cognitive and intellectual functioning, which gradually interferes with social and occupational performance (Lieberman 2006; McGilton 2012). It is a common condition with a significant impact on society. A systematic review of observational studies has found that 19.2% of people with hip fracture meet formal diagnostic criteria for dementia and 41.8% are cognitively impaired (Seitz 2011a). It is expected that the number of people with dementia and hip fracture will increase during the next 25 years (Adunsky 2003a; Knapp 2007). Compared to those without dementia, community-dwelling people with dementia have higher mortality after hip fracture and are more likely to be admitted to long-term care (Seitz 2014). Health and social care expenditure in England on people with dementia, in the year following admission for fractured neck of femur, has been esti-

mated to be in excess of GBP one billion (GBP 1037 million in 2005 to 2006 prices), about GBP 0.4 billion higher than expenditure on those without dementia (Henderson 2007). This was estimated as equating to approximately GBP 34,200 per person per annum for those without dementia and GBP 40,300 per person per annum for people with dementia (Henderson 2007).

## Description of the intervention

The provision of high-quality care for people following hip fracture has been identified as a major clinical need in the UK and elsewhere. This has been exemplified in the UK through the development of national guidelines (NICE 2011), the introduction of specific financial incentives for high-quality care through the 'Best Practice Tariff' (NICE 2011), and the national audit of standards of care provision to this population through the National Hip Fracture Database (National Hip Fracture Database 2013). For all people with hip fracture, initial management is usually provided in an acute hospital setting, where the person undergoes an operation for their hip fracture, and rehabilitation in the form of specialist orthopaedic and nursing care, in addition to physiotherapy and occupational therapy. Best practice currently includes shared orthopaedic and geriatric (sometimes termed ortho-geriatric) care pre- and postoperatively to ensure that recipients are medically fit for surgery and to monitor and manage any postoperative issues that may develop (Dy 2012) such as pneumonia, anaemia, dehydration, pressure sores, or cardiovascular complications (Dy 2012; Jameson 2012). During the initial hip fracture admission or index admission (Drummond 2005), health professionals such as nurses, pharmacists, occupational therapists, physiotherapists, social workers and dietitians may be involved in the person's rehabilitation and care (Kammerlander 2010; Stenvall 2012). Depending on their home circumstances and their postoperative functional capabilities, patients may be discharged directly to the residential setting they live in, with or without community or outpatient rehabilitation, or may be transferred to an inpatient rehabilitation unit to receive continued multi-professional rehabilitation. They will remain in this rehabilitation setting until they are sufficiently independent to be discharged to their pre-admission residence or, if this is not achievable, they may be provided with residential or nursing home care (Hashmi 2004).

Over the past 15 years, there have been advances in the management of people with hip fracture (Cameron 2000; Dy 2012). The notion of 'usual care' after hip fracture has changed, so that a greater emphasis on postoperative physiotherapy and occupational therapy, interdisciplinary working and integrated care packages has become standard. Research reports and subsequent clinical guidelines have recommended a number of interventions to improve outcomes for this group of patients (NICE 2011). These have included specific medical management by an ortho-geriatrician on specified hip-fracture wards, considered to enhance interdisciplinary team working; improvement of communication be-

tween health and social agencies (Kammerlander 2010; Stenvall 2012); provision of dedicated functional rehabilitation interventions across acute hospital and community rehabilitation settings (Al-Ani 2010; Huusko 2000); monitoring of postoperative complications including pressure sores (Söderqvist 2007); and optimisation of nutritional levels (Hershkovitz 2010). Specific strategies proposed for people with dementia following hip fracture have included enhanced rehabilitation and care pathways, with an emphasis on orientation to the environment, cues, reminiscence and structured, familiarised routines (Strömberg 1999). Such interventions can be delivered in a variety of healthcare and domiciliary settings.

## How the intervention might work

Interventions that have been proposed to improve the rehabilitation and recovery of people with dementia after hip fracture share many elements with those which have been advocated to improve outcomes for all older people after hip fracture, such as better communication between healthcare professionals and provision of wider healthcare expertise than may be conventionally found on an orthopaedic ward or in a rehabilitation setting (Söderqvist 2007). The overall effectiveness of such enhanced, multidisciplinary rehabilitation and care models remains uncertain even for people who are not cognitively impaired. A Cochrane systematic review was limited by considerable heterogeneity between studies, but there was a suggestion of better short-term functional outcomes for people who had enhanced multidisciplinary rehabilitation after hip fracture (Handoll 2009). People with dementia, who have greater and more complex needs, may gain most from these enhanced rehabilitation strategies following hip fracture surgery. Alternatively, it is possible that their more complex needs render the interventions less effective than in the elderly population without cognitive impairment. Specifically targeted additional elements and resources, drawing on best practice dementia care, may be necessary for people with dementia, and have been recommended (Söderqvist 2007).

## Why it is important to do this review

More than three-quarters of a million people in the UK have dementia, and one in four National Health Service (NHS) beds is usually occupied by someone with dementia. Fractured hips and falls are the commonest reasons for hospital admission. People with dementia who sustain a hip fracture have more complications, disabilities and social needs, and hence more complex healthcare needs. Whilst there have been previous reviews of rehabilitation following hip fracture, no reviews of randomised controlled trials have specifically assessed which features of rehabilitation and care are more effective for those who also have dementia. Since this population has complex care needs and makes a major demand

on healthcare services, this focused review of the literature is warranted.

In this population, factors such as depression, motivation, pain and cognitive impairment have been cited as negatively impacting on clinical outcomes (Lenze 2007). Pain has been acknowledged as a particular problem which, if not assessed and managed adequately, can produce negative postoperative outcomes and complications (Egbert 1996; Feldt 1998; Morrison 1998). These factors may adversely impact on: the ability of a person to return to functional independence; the discharge destination; the length of their inpatient hospital stay; and rehabilitation requirements. The resulting negative consequences have a health economic impact at a personal and a societal level. People who sustain a hip fracture and have dementia experience longer hospitalisations with poorer outcomes, including higher mortality and morbidity rates, with a greater risk of requiring nursing home placement and poorer functional recovery (Gruber-Baldini 2003; Magaziner 1990; Steiner 1997). However, whilst various interventions have been supported for the targeted rehabilitation of people with dementia who experience a hip fracture (Al-Ani 2010; Huusko 2000), these are more expensive than conventional postoperative management (Lenze 2007). More evidence is needed on the relationship between the processes and outcomes of postoperative care, length of stay, and costs in the general population of people with hip fracture (Hunt 2009), and in particular in the subpopulation of those with dementia (Henderson 2007). Decisions as to whether to allocate limited health and social care resources to these new interventions can be informed by economic evaluation, the comparative analysis of outcomes and the costs of alternative treatment programmes (Drummond 2005).

No reviews have specifically assessed the impact of management programmes on behavioural, cognitive or dementia-related outcomes for people with dementia following hip fracture, nor on the relationship between these outcomes and resource use and costs. The purpose of this review is therefore to answer these important questions.

# OBJECTIVES

(a) To assess the effectiveness of models of care including enhanced rehabilitation strategies designed specifically for people with dementia following hip fracture surgery compared to usual care.

(b) To assess the effectiveness for people with dementia of models of care including enhanced rehabilitation strategies which are designed for all older people, regardless of cognitive status, following hip fracture surgery compared to usual care.

# METHODS

## Criteria for considering studies for this review

### Types of studies

We undertook the review in accordance with the previously published review protocol (Smith 2013).

We include randomised, quasi-randomised (method of allocating participants to a treatment which is not strictly random, for example by hospital number) or cluster-randomised controlled clinical trials published in any language, evaluating the effectiveness for people with dementia of any model of enhanced care and rehabilitation following hip fracture surgery compared to usual care.

### Types of participants

We included people who were aged 65 years or over, had any form of dementia, and had undergone hip fracture surgery for a proximal femoral fracture. We excluded studies where over 30% of participants presented with a mid-shaft or distal femoral fracture. We used two approaches for the definition of dementia: (1) we included studies where all participants had dementia diagnosed using a validated instrument such as the Diagnostic and Statistical Manual IV (American Psychiatric Association 1994) or International Classification of Diseases 10th revision (ICD-10) (World Health Organization 2007); (2) we also included studies where all participants were described as presenting with cognitive impairment which is likely to be due to dementia (e.g. persistent cognitive impairment rather than temporary, such as delirium, and not attributed to other causes such as stroke or head injury). We consider this to be closer to the way in which people may be identified for an intervention in clinical practice. We contacted corresponding authors for further information if the method of diagnosing dementia or identifying persistent cognitive impairment was not stipulated in the original paper. Participants could have been resident in the community, in care homes, or in hospitals for short- or long-term care. We included only those studies/subgroups where *all* participants were described as having dementia or were cognitively impaired, i.e. where data on the cognitively-impaired subgroups were either reported separately or were available from the authors.

### Types of interventions

We were interested in identifying any trial which compared a control intervention consisting of usual care (including conventional rehabilitation) in the context where the trial was conducted, and an active intervention consisting of any model of care which involved enhanced rehabilitation intended to improve outcomes for elderly people after hip fracture surgery.

To meet both of our objectives, we included two types of active intervention: (1) for objective 1, the active intervention was any

model of care including enhanced rehabilitation designed specifically for people with dementia. Elements in addition to usual care could have included postoperative recovery on a specialist ward, involvement of specialist staff or enhanced rehabilitation with respect to: orientation to the environment, cues, reminiscence, structured routines or any other element drawn from dementia care practice; (2) for objective 2, the care model was intended for all older people after hip fracture surgery and designed without regard to cognitive status. In comparison to usual care, it might have included protocols for interdisciplinary working, more structured and protocol-driven care and discharge planning, enhanced monitoring for complications which may impact on recovery, intensive rehabilitation regimens or extension of rehabilitation into the community after discharge.

Interventions could be delivered in acute hospital environments, community health or rehabilitation centres, community centres or non-health settings, or in people's homes and residences (domiciliary).

### Types of outcome measures

The primary and secondary outcomes are presented below.

#### Primary outcomes

- Cognitive function as assessed using (for example): Alzheimer's Disease Assessment Scale Cognitive Subscale (ADASCOG) (Rosen 1984), Mini-Mental State Examination (MMSE) (Folstein 1975), Abbreviated Mental Test (Hodkinson 1972), Addenbrooke's Cognitive Examination Revised (ACE-R) (Mathuranath 2005), Montreal Cognitive Assessment (MoCA) (Nasreddine 2005), Hopkins Verbal Learning Test (HVLT-R) (Brandt 1991), the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) (Jorm 1989)

#### Secondary outcomes

- Functional performance assessed by measures such as the: Barthel Index (Mahoney 1965), Nottingham Extended Activities of Daily Living Scale (Nouri 1987), Oxford Hip Score (Dawson 1996), the Bristol Activities of Daily Living Score (Bucks 1996) or a timed walk test
- Behaviour assessed using (for example): Neuropsychiatric Inventory (NPI) (Cummings 1994), Cohen-Mansfield Agitation Inventory (CMAI) (Cohen-Mansfield 1986)
- Quality of life assessed using: the Short Form-36 (Ware 1992), Bath Assessment of Subjective Quality of Life in Dementia (BASQID) (Trigg 2007), DEMQOL (Smith 2005), Short Form-12 (Ware 1996), EuroQol (EQ)-5D (EuroQol Group 1990) and Health Utility Index (Feeny 2002) instruments
- Tools assessing pain, from any cause, using methods suited to people with dementia, such as the Pain Assessment in Advanced Dementia (PAINAD) (Warden 2003)

- Mortality
- Complications such as deep vein thrombosis, pressure sores, pneumonia
- Use of health and social care resources: hospital length of stay, hospital re-admissions, discharge destination (to pre-injury setting, residential or nursing home care), use of primary and community care support services including general physician (GP) visits, medications and tests prescribed, also community and residential rehabilitation
- Costs of hospitalisation, hospital re-admission, health and social care support in the community or in residential or nursing home care, and costs to people with dementia who have had a hip fracture and to their carers (such as travel, carers' lost productivity)

### Search methods for identification of studies

We performed the search methods in accordance with the latest version in the *Cochrane Handbook for Systematic Reviews of Interventions* (Lefebvre 2011).

### Electronic searches

We searched ALOIS (www.medicine.ox.ac.uk/alois), the Cochrane Dementia and Cognitive Improvement Group Specialised Register up to and including Week 1 June 2014.

ALOIS is maintained by the Trials Search Co-ordinator and contains dementia and cognitive improvement studies identified from the following.

1. Monthly searches of a number of major healthcare databases: MEDLINE, EMBASE, CINAHL, PsycINFO, and LILACS.

2. Monthly searches of a number of trial registers: metaRegister of Controlled Trials; Umin Japan Trial Register; WHO Clinical Trials Registry Platform portal (which covers ClinicalTrials.gov; ISRCTN; Chinese Clinical Trial Register; German Clinical Trials Register; Iranian Registry of Clinical Trials; the Netherlands National Trials Register, plus others).

3. Quarterly search of the Central Register of Controlled Trials (CENTRAL) in the Cochrane Library.

4. Monthly searches of a number of grey literature sources: ISI Web of Knowledge Conference Proceedings; Index to Theses; Australasian Digital Theses.

5. Monthly searches of the NHS Economic Evaluation Database (NHS EED).

To view a list of all sources searched for ALOIS see About ALOIS on the ALOIS web site.

We ran additional separate searches in many of the above sources, to ensure that we retrieved the most up-to-date results. The search strategy that we used for the retrieval of reports of trials from

MEDLINE (via the OvidSP platform) can be seen in Appendix 1.

We placed no restriction on the search in respect to date of publication, risk of bias or language of publication.

### Searching other resources

We reviewed the reference lists of all potentially eligible papers and all review papers related to this topic. We also asked the corresponding authors of each included paper to review the search results to identify any papers not initially identified from the previous searches.

We searched the conference proceedings and abstracts from the British Orthopaedic Association Annual Congress, the European Federation of National Associations of Orthopaedics and Traumatology (EFORT), the British Hip Society, and British Trauma Society meetings. We accessed these through the Bone and Joint Journal Orthopaedic Proceedings. We additionally searched the INSIDE (British Library database of conference proceedings and journals).

### Data collection and analysis

### Selection of studies

Two review authors (TS and YH) checked the results of the search strategy. We independently reviewed the titles and abstracts of each citation. We ordered the full-text version of each potentially eligible trial which we then assessed independently for eligibility. We included all full-text papers which satisfied the eligibility criteria. The two review authors (TS and YH) discussed any disagreements about study eligibility, and referred any that were unresolved to a third review author (CF).

### Data extraction and management

Two review authors (TS and YH) reviewed each study satisfying the eligibility criteria, and extracted its data from the original publication independently. These review authors recorded the data on a predefined eligibility database. Data extracted included: country of origin, publication date, number of participants receiving each intervention, gender, age and dementia diagnosis for participants, classification or type of femoral fracture, fracture fixation method, interval between fracture and surgical management, setting, description of control and experimental intervention, duration of intervention, follow-up period, outcome measurements used, and results for each intervention group.

The review authors (TS and YH) resolved any disagreements on data extraction through discussion, referring to a third review author (CF) for adjudication where necessary. We tabulated all agreed data into a single document in Review Manager 5 (Characteristics of included studies).

### Assessment of risk of bias in included studies

We evaluated the quality of the included studies and their risk of bias using the Cochrane 'Risk of bias' assessment tool (Higgins 2011). For each study, we assessed: sequence generation; allocation concealment; blinding; completeness of outcome data; and selective outcome reporting. For each domain, we assessed whether there was a low risk of bias (if the study matched the criteria), a high risk (if the study did not match the criteria), or unclear risk of bias (due to under-reporting).

Two review authors (TS and YH) independently conducted 'Risk of bias' assessments, resolving disagreements on the risk of bias scoring through discussion and recourse to a third review author (CF).

We used the GRADE approach to assess the overall quality of evidence for each outcome. This considers the risk of bias as well as imprecision in the results, inconsistency between studies, publication bias, and indirectness of the evidence.

### Measures of treatment effect

We assessed whether meta-analysis was appropriate based on the heterogeneity of the study characteristics, evaluated by two review authors (TS and CF), using the data extraction tables. Where the studies differed considerably in respect of population, intervention or follow-up procedure, we performed a narrative review to summarise the treatment effects. If we considered studies sufficiently similar in these variables, we performed a meta-analysis. In both cases, we used mean difference (MD) for continuous data and odds ratio (OR) for dichotomous data, with their 95% confidence interval (CI), to measure treatment effects in each individual study. When insufficient data were available to conduct a meta-analysis using data from the original paper or corresponding authors or both, then we quoted analysis results from the original studies.

### Unit of analysis issues

The individual participant was the unit of analysis in this review.

### Dealing with missing data

We contacted corresponding authors regarding any missing data from trials included in the review. If data remained unavailable, we acknowledged this. We did not impute missing outcome data for any outcomes.

## Assessment of heterogeneity

We evaluated study clinical heterogeneity and statistical heterogeneity. We assessed study clinical heterogeneity by examining the data extraction tables. Two review authors (TS and CF) examined the data extraction table and assessed the data for between-study variability with respect to population diagnosis, interventions (pre- and post-surgical) and outcome measurements.

## Assessment of reporting biases

Too few studies were available to allow the use of funnel plots to assess the risk of publication bias.

## Data synthesis

We evaluated study clinical heterogeneity using the data extraction tables. Two review authors (TS and CF) performed this independently. When heterogeneity was substantial in respect of the intervention, population, or method of assessment, we presented a narrative review of the results. When clinical heterogeneity was not substantial, with homogeneity in relation to the intervention, population and method of assessment, we conducted meta-analyses.

For the pooled (meta-) analysis, we used a random-effects statistical model when $I^2$ was greater than 20%, or the Chi² P value was greater than 0.1. We undertook a fixed-effect statistical model when $I^2$ was less than or equal to 20% or Chi² had a P value less than or equal to 0.1.

## Subgroup analysis and investigation of heterogeneity

There were insufficient data to conduct planned subgroup analyses based on age, type of dementia or setting in which the intervention was provided. However there were sufficient data to undertake a subgroup analysis of Huusko 2000 data on mortality and residential placement at three and 12 months postoperatively by severity of cognitive impairment.

## Sensitivity analysis

We did not conduct any sensitivity analyses due to the limited meta-analyses and similarities of quality of evidence from the included studies.

# R E S U L T S

## Description of studies

We present a summary of the included and excluded studies in the Characteristics of included studies and Characteristics of excluded studies tables.

## Results of the search

The results of the search strategy are summarised in Figure 1. In total, we identified 1914 citations from the electronic search strategy and a further 12 from a search of the reference lists of the potentially relevant papers. After removal of duplicates, we screened 297 papers. From these we deemed 22 potentially eligible, and acquired full-text versions to evaluate them against the predefined eligibility criteria (Smith 2013). Following this, 17 papers did not satisfy the eligibility criteria, whilst five papers satisfied the criteria and were subsequently included in the review.

Figure 1.  PRISMA flow diagram summarising the results of the search strategy.
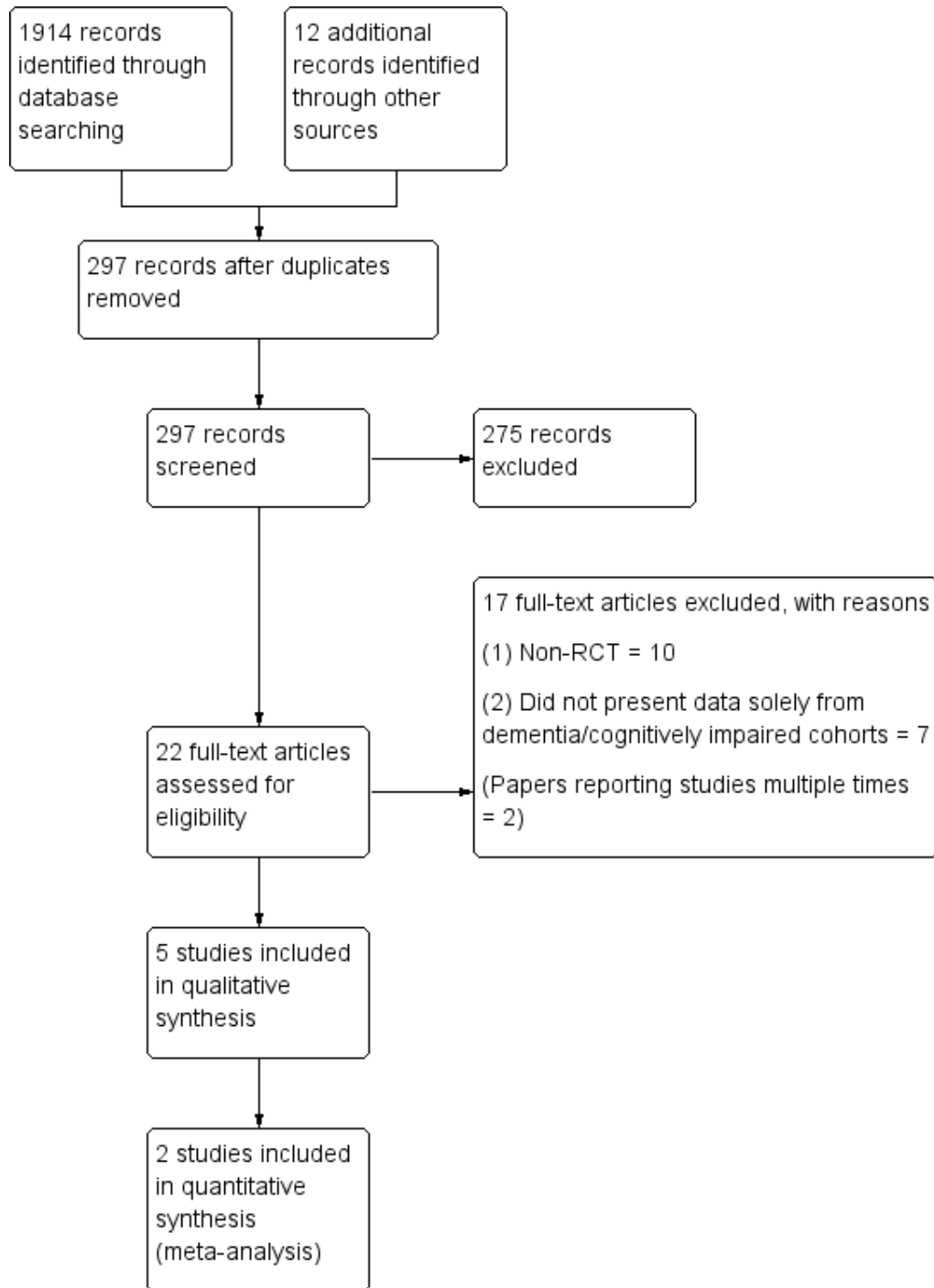
## Included studies

From the five included studies, 316 participants (154 in the experimental groups and 162 in the care-as-usual groups) were included in this review's analyses. We did not identify any studies that investigated the effectiveness of an enhanced rehabilitation strategy or care model specifically designed for people with dementia/cognitive impairment following hip fracture. All studies presented data from subgroups of larger RCTs of enhanced rehabilitation and care models for older people following hip fracture. Of these, four papers presented the findings of their subgroups of people with cognitive impairment/dementia (Huusko 2000; Shyu 2012; Stenvall 2012; Uy 2008). Only one of these studies prespecified their analysis of this subgroup (Huusko 2000). For Shyu 2012, Stenvall 2012 and Uy 2008, it was not possible to determine whether or not the subgroup analysis was prespecified. One study presented the results of their full trial of all older people, as well as the subgroup of their participants categorised as cognitively impaired or with dementia (Marcantonio 2001).

## 1) Participant characteristics

**Diagnosis**: Only one study included participants with dementia diagnosed using a validated diagnostic instrument. Stenvall 2012 determined a diagnosis of dementia with the DSM-IV classification (American Psychiatric Association 1994). The other four studies used various means of assessing the severity of cognitive impairment to identify participants with probable dementia. The MMSE was used in two studies (Huusko 2000; Shyu 2012), the Short Portable Mental Status Questionnaire (SPSMQ; Pfeiffer 1975) in one study (Uy 2008), and the Blessed Dementia Rating Scale (Blessed 1968) in one study (Marcantonio 2001).

**Age**: The mean ages reported for participants were very similar across studies and intervention groups; 78 years (Marcantonio 2001) to 83 years (Stenvall 2012; Uy 2008).

**Hip fracture management**: Two studies presented the method of surgical management for participants with dementia (Huusko 2000; Uy 2008). Three studies did not specify the surgical fixation method for their participants with dementia (Marcantonio 2001; Shyu 2012; Stenvall 2012).

**Comorbidities**: Only Stenvall 2012 reported their cohort's comorbidities on admission. Most commonly reported was depression (n = 40), cardiovascular disease (n = 37), previous cardiovascular respiratory disease (n = 19), diabetes (n = 13), previous hip fracture (n = 11), cancer (n = 7). Two studies measured the frequency of comorbidities using the Charlson Comorbidity Index (Charlson 1987; Marcantonio 2001; Uy 2008). Marcantonio 2001 did not provide Charlson Comorbidity Index data specifically for their participants with dementia. Uy 2008 reported that both treatment groups presented with a Charlson Comorbidity Index of one at baseline assessment.

**Residential background**: Three studies reported the residential setting of their participants prior to hip fracture (Huusko 2000; Stenvall 2012; Uy 2008). The majority of participants in Stenvall 2012 lived in residential, nursing or hospital institutions before their hip fracture. In Huusko 2000, all participants were living independently in the community prior to their hip fracture. Uy 2008 reported that all their participants were nursing-home residents prior to their hip fracture.

## 2) Interventions

The five included studies presented data on enhanced rehabilitation and care models designed for all older people following hip fracture and not specifically for people with dementia. We present full information on the experimental and conventional rehabilitation programmes of these included studies in the Characteristics of included studies tables. We grouped the experimental interventions into three categories:

(1) Enhanced interdisciplinary inpatient rehabilitation and care models (Stenvall 2012; Uy 2008)

(2) Enhanced interdisciplinary inpatient and home-based rehabilitation and care models (Huusko 2000; Shyu 2012)

(3) Geriatrician-led inpatient management (compared to orthopaedic-led management) (Marcantonio 2001)

As the Characteristics of included studies table demonstrates, the three types of intervention all include heightened surveillance for common postoperative complications following hip fracture in older people, namely, pressure sores, poor nutrition, embolic events, pneumonia and delirium. All of the interdisciplinary team interventions, from the four studies which evaluated these, involved staff training and strong communication across multidisciplinary teams which included geriatricians, nursing staff, physiotherapists, social workers and psychologists (Huusko 2000; Shyu 2012; Stenvall 2012; Uy 2008). Care planning and discharge liaison also featured across these interventions. The major difference between the Huusko 2000 and Shyu 2012 studies compared to the Stenvall 2012 and Uy 2008 studies was that the former included continuing community rehabilitation after hospital discharge, whereas the later made no provision for continuing rehabilitation outside hospital. As the Characteristics of included studies table illustrates, the control intervention provided in each trial was a standard nursing, medical and therapy intervention, identified as 'treatment as usual'.

## Outcome Measures

We present a summary of all outcome measures and follow-up periods for the five studies in the Characteristics of included studies table.

No study assessed the review's primary outcome measure (cognitive function) at follow-up. Stenvall 2012 assessed functional performance through walking ability using the Swedish version of the Clinical Outcome Variables, and functional performance of activities of daily living (ADL) using the Staircase of ADLs including the Katz ADL index which measures both personal/primary ADL and instrumental ADLs. Shyu 2012 and Uy 2008 assessed ADLs using the Barthel Index (Mahoney 1965). Shyu 2012 assessed functional performance by the recovery of walking ability using the Chinese Barthel Index. Uy 2008 assessed mobility using a timed 2.44-metre walk.

Three studies assessed mortality (Huusko 2000; Shyu 2012; Stenvall 2012). All three provided mortality data at 12 months. Shyu 2012 also reported mortality at 24 months.

Four studies assessed complications. These were specifically the cumulative incidence of delirium during an acute hospital period in Marcantonio 2001, incidence of all postoperative complications in Stenvall 2012, and the occurrence of falls (Shyu 2012). Huusko 2000 assessed complications at three and 12 months postoperatively.

A variety of measures were reported to evaluate the use of health and social care resources across four studies. These included analysis of length of hospital stay (Huusko 2000; Marcantonio 2001), length of rehabilitation and nursing care recovery (Stenvall 2012), hospital re-admissions (Shyu 2012; Stenvall 2012), accident and emergency (emergency room) visits (Shyu 2012) and discharge destination (Huusko 2000; Marcantonio 2001; Shyu 2012).

No included studies presented data on quality of life or pain. Furthermore, no studies directly examined the costs of hospitalisation, hospital re-admission, health and social care support, residential or nursing-home care, and costs to the person with dementia or their carers (such as travel, carers' lost production).

Duration of follow-up periods varied across the studies. In Marcantonio 2001 participants were followed up until acute hospital discharge. The other studies specified the follow-up duration after randomisation; this was four months in Uy 2008 study, 12 months in Huusko 2000 and Stenvall 2012, and 24 months in Shyu 2012.

### Excluded studies

We excluded 17 studies after reviewing the full texts of these papers (Figure 1). We present the reasons for exclusion in Characteristics of excluded studies table. We excluded 10 papers because they were not randomised controlled trials (Adunsky 2003b; Arinzon 2010; Deschodt 2011; Heruti 1999; Horgan 2003; McGilton 2009; Morrison 2000; Penrod 2004; Rolland 2004; Seitz 2011b). We excluded seven trials which did not provide specific data on participants with dementia or cognitive impairment (Espaulella 2000; Kalisvaart 2005; Naglie 2002; Pitkala 2006; Stenvall 2007; Strömberg 1999; Vidan 2005). Four papers reported the findings from two trials (Shyu 2012; Stenvall 2012). We analysed these as trials, rather than individual papers.

### Risk of bias in included studies

We present a summary of the 'Risk of bias' assessment for each of the included trials in Figure 2 and Figure 3, and summarise them below.

Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.
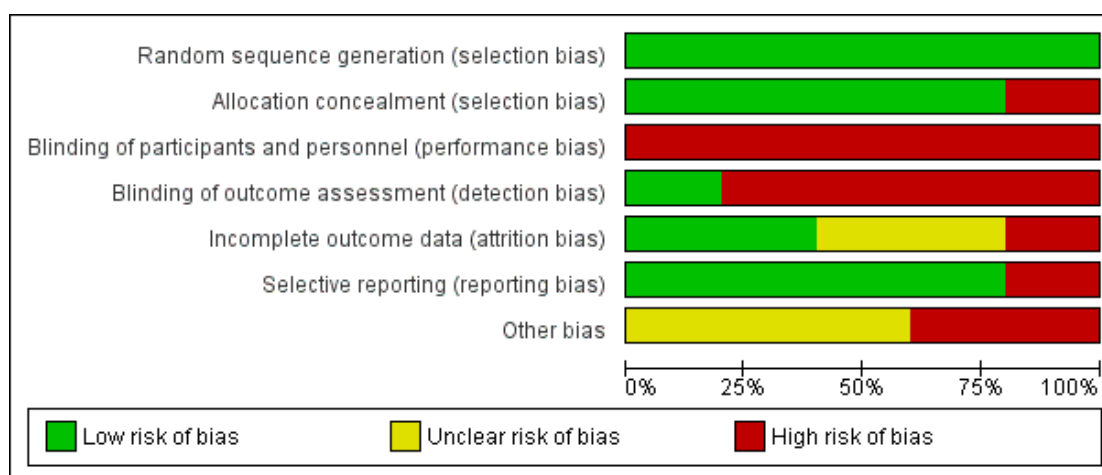
**Figure 3. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.**

## Allocation

We judged that all five included trials presented with a low risk of selection bias in respect to random sequence generation. All clearly described their randomisation procedure, allowing the replication of their allocation strategy. Four trials clearly demonstrated that allocation was concealed (Huusko 2000; Marcantonio 2001; Stenvall 2012; Uy 2008) using a concealed allocation process with sealed envelopes. One trial did not allocate participants to groups using concealed allocation methods (Shyu 2012).

## Blinding

All five included trials presented with high risk of a performance bias. This was attributed to the logistical difficulty in being able to blind participants and clinicians to a recovery programme in which they were actively participating.

Only one trial presented with a low risk of detection bias (Marcantonio 2001). The other four trials did not blind their assessors to participant's group allocation, thus demonstrating high risk of detection bias (Huusko 2000; Shyu 2012; Stenvall 2012; Uy 2008).

## Incomplete outcome data

We judged that two trials had a low risk of attrition bias (Marcantonio 2001; Shyu 2012); all participants who enrolled into the trials were included in the analyses, with no loss to follow-up. Two trials had an unclear risk of attrition bias by not reporting the loss to follow-up (Huusko 2000; Uy 2008). Finally, we considered one trial to have a high risk of attrition bias since there was participant attrition and this could have been a direct consequence of the intervention under investigation (Stenvall 2012). Nine participants (32%) in the enhanced interdisciplinary inpatient care model group and eight (22%) in the conventional care model group were lost to follow-up (Stenvall 2012).

## Selective reporting

We judged four trials to have a low risk of reporting bias (Huusko 2000; Shyu 2012; Stenvall 2012; Uy 2008). There was no evidence of unreported outcomes. The risk of reporting bias was high in one trial (Marcantonio 2001) as the incidence of delirium was determined using a composite measure of MMSE, DSI and MDAS. Consequently, it was not possible to assess cognitive function using MMSE data, as this was not individually reported.

## Other potential sources of bias

All five included trials presented data from subgroups of larger trials (Huusko 2000; Marcantonio 2001; Shyu 2012; Stenvall 2012; Uy 2008). With these small samples, there was a potential for baseline imbalance which could have influenced the interpretation of the intervention effect. Baseline imbalances were reported by

Huusko 2000 and Stenvall 2012. In Huusko 2000 there was a baseline imbalance in MMSE score, with a lower median MMSE score in the experimental group. In Stenvall 2012, there was a baseline imbalance in mobility; 49% of people in the control group had been independently mobile indoors prior to their fracture compared with 21% in the experimental intervention group. Thus, with Huusko 2000 and Stenvall 2012 the measured treatment effect may have been reduced in the experimental group, or could have exaggerated the effect, if people who are more cognitively impaired benefit the most from the experimental intervention. It was not possible to assess for potential baseline imbalance in Marcantonio 2001 since these data were not presented. It was unclear whether there were any other possible biases due to limited study details in the Shyu 2012 or Uy 2008 study reports.

## Effects of interventions

### (a) Enhanced rehabilitation and care models designed specifically for people with dementia following hip fracture surgery

We found no studies investigating enhanced rehabilitation strategies and care models designed specifically for people with dementia following hip fracture surgery.

### (b) Enhanced rehabilitation and care models designed for all older people, regardless of cognitive status following hip fracture surgery.

We considered that the interventions in the included trials could be divided into three types. We pooled results only from studies investigating the same type of intervention.

### (1) Enhanced interdisciplinary inpatient rehabilitation and care models vs conventional rehabilitation and care models

We identified two trials which compared enhanced interdisciplinary inpatient care models with conventional 'treatment as usual' and for which data for participants with dementia or cognitive impairment were reported separately (Stenvall 2012; Uy 2008). Due to inadequate reporting, we were unable to extract data for analysis from Uy 2008. Thus it was not possible to pool these results.

Both trials assessed functional performance. Due to imprecision in the results, it was not possible to determine the effect of the enhanced interdisciplinary care model in Stenvall 2012 on the following outcomes: personal ADL independence at four-month (OR 4.14, 95% CI 0.40 to 42.66, 1 trial, n = 54) or 12-month follow-up (OR 4.62, 95% CI 0.18 to 119.63, 1 trial, n = 47): walking independence without an aid or assistance at four-month (OR 7.63, 95% CI 0.83 to 70.53, 1 trial, n = 54) or 12-month follow-up (OR 7.20, 95% CI 0.74 to 70.42, 1 trial, n = 47). We considered the quality of the evidence for all these outcomes to be very low because of imprecision and a serious risk of bias.

Uy 2008 reported "non-significant trends" for improvement in the Barthel Index and the timed walking test at one month and four months, but these results were based on only three participants in the experimental group and seven in the control group. We considered this very low-quality evidence.

Mortality was assessed in Stenvall 2012. Again, it was not possible to confidently determine any effect of the intervention due to imprecision in the results after four months (OR 2.37, 95% CI 0.73 to 7.32, 1 study, n = 54) and 12 months of follow-up (OR 2.25, 95% CI 0.67 to 7.61, 1 trial, n = 47).

Stenvall 2012 itemised the number of participants who experienced a postoperative complication during their inpatient hospital stay. Due to the imprecision in results, it was not possible to determine the effect of the intervention on complications including: pneumonia (OR 2.04, 95% CI 0.32 to 13.13, 1 trial, n = 64); decubital ulcers (OR 0.36, 95% CI 0.09 to 1.48, 1 trial, n = 64); and postoperative fracture (OR 0.17, 95% CI 0.01 to 3.39, 1 trial, n = 64). Nor was it possible to determine the effect of the intervention on: length of hospital stay (MD 12.30 days, 95% CI: -24.66 to 0.06, 1 trial, n = 64); number of drugs prescribed on discharge (MD 0.20, 95% CI -1.65 to 1.25, 1 trial, n = 64); place of discharge/residential setting at four months (OR 1.25, 95% CI 0.31 to 5.06, 1 trial, n = 54) or 12 months (OR 0.41, 95% CI 0.06 to 2.73, 1 trial, n = 47). We considered the quality of the evidence for all these outcomes to be very low, because of the imprecision (the results for each outcome were based on a small number of events in a single trial), and the risk of bias (the trial was not blinded, introducing a serious risk of performance and detection bias). The frequency of the following complications was reduced in the enhanced interdisciplinary rehabilitation care model group compared to the usual care model group: urinary tract infection (OR 0.15, 95% CI 0.05 to 0.48, 1 trial, n = 64); nutritional problems (OR 0.27, 95% CI 0.08 to 0.88, 1 trial, n = 64); postoperative delirium (OR 0.06, 95% CI 0.01 to 0.51, 1 trial, n = 64); and recurrent falls (OR 0.00, 95% CI 0.00 to 0.03, 1 trial, n = 64). We rated the quality of evidence for these outcomes as low, because the results were from only one trial and were subject to a serious risk of bias.

No data were provided on behaviour, quality of life or pain.

### (2) Enhanced interdisciplinary inpatient and home-based rehabilitation and care models vs conventional rehabilitation and care models

Two trials compared clinical outcomes of enhanced interdisciplinary inpatient and home-based rehabilitation and care models compared to usual care for people with dementia following hip fracture surgery (Huusko 2000; Shyu 2012). We conducted meta-analyses for the following outcomes: mortality at three and 12 months, and place of discharge at three and 12 months. We detected no difference between the groups given enhanced interdisciplinary rehabilitation and care and conventional 'treatment as

usual' for mortality at three months (OR 1.20, 95% CI 0.36 to 3.93, 2 trials, n = 184, Analysis 1.1) or 12 months (OR 1.07, 95% CI 0.47 to 2.45, 2 trials, n = 177, Analysis 1.2), but the results were imprecise and were compatible with either benefit or harm from the experimental intervention. There was a difference between the experimental and control groups for place of discharge (i.e. the proportion of people in institutional care) in favour of the enhanced interdisciplinary rehabilitation and care models at three months (OR 0.46, 95% CI 0.22 to 0.95, 2 trials, n = 184, Analysis 1.3), although not at 12 months (OR 0.90, 95% CI 0.40 to 2.03, 2 trials, n = 177, Analysis 1.4). We downgraded the quality of the evidence for this comparison at three and 12 months to low and very low respectively.

Shyu 2012 reported data on the frequency of participants who regained their pre-fracture walking capability between the interventions. They reported a difference between the groups, with a greater proportion of participants randomised to the enhanced interdisciplinary rehabilitation and care models regaining pre-fracture walking levels at three months (OR 5.10, 95% CI 1.29 to 20.17, 1 trial, n = 43) and 12 months (OR 58.33, 95% CI 3.04 to 1118.19, 1 trial, n = 36). This difference was not evident at the 24-month follow-up period (OR 3.14, 95% CI 0.68 to 14.50, 1 trial, n = 43). We downgraded the quality of this evidence to very low using the GRADE approach, due to the small number of participants from a single trial and the serious risk of bias.

Shyu 2012 also detected better ADL performance in the enhanced interdisciplinary rehabilitation and care model group at three months (MD 18.81, 95% CI 9.40 to 28.22, 1 trial, n = 43) and 12 months (MD 25.40, 95% CI 10.89 to 39.91, 1 trial, n = 36) compared to the conventional rehabilitation and care model group. This difference was not evident at 24 months (MD 7.92, 95% CI -9.88 to 25.72, 1 trial, n = 30). We considered the quality of the evidence for this outcome to be very low because of the small number of participants from a single trial and the serious risk of bias.

Based on Shyu 2012 data, it was not possible to determine any effect of the intervention on: frequency of hospital admissions (three months 0 admissions; 12 months OR 0.71, 95% CI 0.10 to 4.86, 1 trial, n = 43; 24 months OR 1.00, 95% CI 0.14 to 7.10, 1 trial, n = 43); attendance at the emergency room/accident and emergency (three months OR 0.50, 95% CI 0.04 to 5.97, 1 trial, n = 43; 12 months OR 0.50, 95% CI 0.04 to 5.97, 1 trial, n = 36; 24 months OR 3.79, 95% CI 0.17 to 86.13, 1 trial, n = 30). We considered the quality of evidence for all these outcomes to be very low, reflecting limitations in study design (all outcomes) and imprecision of point estimates (all outcomes).

Finally Shyu 2012 reported the incidence of falls in participants in the groups. Due to the imprecision in the results, it was not possible to determine the between-group differences at three months (OR 2.35, 95% CI 0.38 to 14.47, 1 trial, n = 43), 12 months (OR 0.20, 95% CI 0.01 to 4.47, 1 trial, n = 36) or 24 months (OR 0.77, 95% CI 0.16 to 3.74, 1 trial, n = 30). We considered the

quality of evidence for all these outcomes to be very low because of the risk of bias and imprecision.

Huusko 2000 divided their participants by severity of cognitive impairment on the MMSE with 'severe' described as a score between zero and 11; moderate for scores between 12 and 17; mild for scores between18 and 23. They presented the median and range of hospital length-of-stay data for each severity class. For participants with mild dementia, the median length of hospital stay was 29 days (range 16 to 138 days) in the enhanced care group and 46 days (range 10 to 368 days) in the usual-care group. Among participants with moderate dementia this was 47 days (range 10 to 365 days) and 147 days (range 18 to 365 days) respectively. For their participants with severe dementia, the median length of hospital stay was 85 days (range 13 to 365 days) in the enhanced care group and 67 days (range 15 to 365 days) in the conventional-care group. For participants with both mild and moderately severe cognitive impairment, the median length of stay in hospital was shorter for those randomised to enhanced care group than for those in the conventional care group (Mann-Whitney U Test: mild dementia P = 0.002, 1 trial, n = 77; moderate dementia P = 0.04, 1 trial, n = 36). The hospital length of stay was not significantly different between the interventions for people with severe cognitive impairment (Mann-Whitney U Test: P = 0.902, 1 trial, n = 28).

It was possible to perform a subgroup analysis of Huusko 2000 data for mortality and residential placement at three and 12 months, by MMSE grouping, to assess the impact of severity of cognitive impairment on these outcomes. The results of these mirrored the principal analysis. There were no differences between the experimental and control groups in mortality at three or 12 months post-hip fracture for any cognitive impairment classification. However, there was a clinically and statistically significant difference between the interventions in relation to residential placement where 15 people (63%) with moderate dementia in the enhanced interdisciplinary rehabilitation and care model group were still living independently at three months compared to two (17%) in the usual care group (OR 8.33, 95% CI 1.48 to 46.94, P = 0.02, 1 trial, n = 36). This difference was not maintained at 12 months (OR 3.33, 95% CI 0.78 to 14.31, P = 0.11, 1 trial, n = 36). For those with mild dementia, there was also a difference between the groups with 32 people (91%) in the enhanced interdisciplinary rehabilitation and care model group living independently three months postoperatively compared to 28 (67%) in the usual care group (OR 5.33, 95% CI 1.39 to 20.49, P = 0.01, 1 trial, n = 77). Again, this difference was not maintained 12 months postoperatively (OR 1.05, 95% CI 0.36 to 3.015, 1 trial, n = 77). There was no difference between groups for those with severe dementia, three months (OR 0.73, 95% CI 0.15 to 3.65, P = 0.70, 1 trial, n = 28) or 12 months postoperatively (OR 1.17, 95% CI 0.22 to 6.20, P = 0.86, 1 trial, n = 28). Using the GRADE approach, we downgraded the quality of this evidence to very low due to the potential risk of bias and imprecision in the results. We are therefore very uncertain about

the estimate of effect for these analyses.

No data were provided on behaviour, quality of life, pain or complications.

### (3) Geriatrician-led inpatient management vs orthopaedic-led inpatient management

One study compared clinical outcomes of an experimental care model involving geriatrician-led management to a model of usual care in which management was led by an orthopaedic surgeon (Marcantonio 2001). The only outcome presented regarding participants with dementia, as a subgroup was cumulative incidence of delirium during the period of acute hospitalisation. The authors reported no difference between the group who had geriatrician-led management and the group who had orthopaedic-led management from their subgroup analysis (OR 0.73, 95% CI 0.22 to 2.38, 1 trial, n = 126). There was no difference between the management strategies in hospital length of stay (median hospital length of stay 5 days for each group). We judged the quality of this evidence, using the GRADE approach, to be very low because of limitations in design and implementation (the trial was not blinded, introducing a high risk of performance and detection bias) and because of imprecision (results were based on a small number of events).

# DISCUSSION

## Summary of main results

We found five trials examining enhanced rehabilitation and care models for older people following a hip fracture which specifically presented data on those with dementia or cognitive impairment. Four trials compared enhanced interdisciplinary rehabilitation and care models (in hospital or both in hospital and at home) with usual care, whilst one trial compared the outcomes of geriatrician-led care with usual care led by an orthopaedic surgeon. No study assessed the intended primary outcome of cognitive function. There were no reported differences in cognitive deterioration, mortality or frequency of hospital admissions. There was however some evidence to suggest a lower frequency of some complications (urinary tract infection, nutritional problems, postoperative delirium and recurrent falls) among people who experienced an enhanced interdisciplinary rehabilitation and care model in hospital. There was also some evidence to suggest that those exposed to an enhanced interdisciplinary rehabilitation and care model both in hospital and at home had a reduced length of hospital stay, decreased risk of institutional placement at three months, better ADL function and greater probability of regaining pre-fracture walking capability

compared to those who had usual care. Geriatrician-led inpatient management did not reduce the cumulative incidence of delirium compared to orthopaedic-led management.

## Overall completeness and applicability of evidence

The studies included in this review have highlighted the considerable uncertainty that remains surrounding the evidence for enhanced interdisciplinary rehabilitation and care models for people with dementia following a hip fracture above usual active rehabilitation and conventional care models. The literature was incomplete in a number of important aspects. Firstly, no included trials addressed the review's primary research question, as none investigated interventions specifically designed for people with hip fracture and dementia. The available studies were subgroup analyses from larger RCTs which assessed the outcomes of enhanced care models for older people following hip fracture surgery. Consequently, the included studies were not based on sample size calculations for this group and therefore lacked power to detect a statistically significant difference, even if one exists (type two statistical error) for people with dementia.

There was limited assessment of cognitive function post-intervention, which is unsurprising considering the studies were for all older people and not specifically those with dementia. Only three trials measured functional performance (Shyu 2012; Stenvall 2012; Uy 2008). A number of outcomes of interest to us were not reported, including assessment of participant's behaviour, quality of life measured by dementia-specific outcome measures, and pain. These outcomes have been previously acknowledged as difficult to assess in people with dementia and cognitive impairment (Hebert-Davies 2012). Some specific instruments have been developed including the Neuropsychiatric Inventory (NPI) (Cummings 1994) to assess behaviour, DEMQOL (Smith 2005) to assess quality of life and the Pain Assessment in Advanced Dementia (PAINAD) (Warden 2003) to explore pain in this population. There was also limited assessment of the use of health and social care resources and costs. This was a major limitation to the completeness of the literature and a consideration for future trials in rehabilitation and care models for people with dementia.

The literature presents outcomes from programmes of enhanced rehabilitation and care which are context-specific, so that the effectiveness of the individual components of these remains unknown. Questions remain, including determining the effect on postoperative recovery of being in a specialist ortho-geriatric ward, the dose, frequency, duration and intensity of physiotherapy and occupational therapy, the effectiveness of targeted and structured reminiscence therapy, the adoption of familiarised routines and the addition of assistive technologies. Furthermore the impact on effectiveness and resource use of delivering interventions in different settings (acute hospital, community health or rehabilitation centres, or non-health settings) and delivery by different personnel (qualified healthcare professionals, social care providers or non-qualified carers), are not known. Finally, due to the limited amount of data, it remains unclear how important participant factors such as age and type or stage of dementia are to the outcome of specific management strategies.

## Quality of the evidence

In aggregate, we rated the quality of the evidence as very low, mostly reflecting the risk of bias in the data and imprecision of point estimates. This grading means that we are very uncertain about the estimates of effect. Accordingly, the current evidence base is insufficient in both size and quality. The 'Risk of bias' tool identified two key recurrent limitations across the studies; not blinding participants and clinical/research personal, and not blinding assessors to group allocation (Figure 3). Whilst it is logistically difficult, if not impossible, to blind participants and clinical/research team members to group allocation whilst participating in or delivering a physical intervention, assessor blinding would have been possible in these trial designs. This may have prevented detection bias from impacting on the results of the studies, and must be considered in future trials of rehabilitation and care models. Since all included studies were subgroup analyses, there were important baseline imbalances (for severity of cognitive impairment in Huusko 2000 and for pre-fracture mobility in Stenvall 2012) which may have impacted on the estimated intervention effect in an unpredictable way.

As highlighted previously, the trials were not designed to identify differences in outcome for participants with dementia. The numbers of participants with dementia recruited to these trials was not based on a power calculation and hence there was a lack of power to detect a difference in outcome between groups, even if one exists. This may account for the non-statistically significant differences reported for the majority of outcomes in the included trials and the imprecision of our effect estimates.

Finally, the included trials diagnosed dementia inadequately, with only Stenvall 2012 specifically stating that dementia was formally assessed by a geriatrician using the DSM-IV tool. Huusko 2000 provided sufficient evidence through their report and through personal communication that their cohort consisted of people with dementia, excluding other causes of cognitive impairment. However they only specifically evaluated cognitive impairment using a single severity tool, MMSE, rather than a physician-based dementia diagnosis. This was also the case for Marcantonio 2001, Shyu 2012 and Uy 2008, where dementia was diagnosed using surrogate assessments of severity of cognitive impairment with the SPMSQ and MMSE tools. In order to facilitate generalisability to specific populations, it is critical that formal tools and assessment procedures are undertaken to correctly categorise people with or without dementia. However, it is recognised that many people with dementia may be undiagnosed, and the adoption of a pragmatic point-of-admission tool to identify cognitive impairment, such as

MMSE, may be applicable to provide a surrogate for dementia. This tension between generalisability to specific populations and pragmatism on diagnosis should be considered in future study.

### Potential biases in the review process

This review was designed to minimise the risks of potential biases. Strategies to address this have included searching a number of the most relevant published and unpublished literature databases on health and social care rehabilitation and medicine to limit selection bias and identify all relevant studies. Secondly, two review authors independently performed the identification of included studies, data extraction and 'Risk of bias' assessment to minimise the risk of inaccurate reporting of study findings.

Due to the small number of trials and heterogeneity in study interventions, it was not possible to pool data for this review for all three types of interventions assessed, but only for the interdisciplinary inpatient and home-based intervention. It was not possible to construct a funnel plot to assess the risk of small-study effects which might indicate publication bias. It is likely that other studies of generic rehabilitation strategies after hip fracture have included participants with dementia, but data on these participants have not been separately published.

### Agreements and disagreements with other studies or reviews

The conclusions drawn from this review do not agree with the conclusions of the original study trials included in this review. This can be attributed to the interpretation of data following the 'Risk of bias' assessment, providing a more cautious analysis of the findings. Two previous systematic reviews have assessed general management strategies for people with dementia following hip fracture surgery (Allen 2012; Menzies 2010). Both systematic reviews identified the same studies included in this review, in addition to a number of non-randomised controlled trials. Whilst these two systematic reviews only searched published literature databases, the conclusions drawn agree with those of this review. The use of enhanced interdisciplinary rehabilitation and the use of protocol-driven geriatric care were supported in these reviews, particularly for people with mild to moderate dementia (Allen 2012; Menzies 2010). However neither review emphasised that when compared to an active treatment and usual intervention, this apparent difference was largely clinically or statistically insignificant. Whilst Menzies 2010 did not assess the quality of the evidence base, the findings of Allen 2012 are in agreement with this review, in that the quality was limited with a number of major weaknesses. Both Allen 2012 and this review provide a cautious interpretation of the current evidence base, providing a consensus that there is insufficient research to ascertain the optimal rehabilitation and recovery pathway for people with dementia following hip fracture surgery, most notably for people with moderate to severe dementia and those who reside in institutional care homes.

## AUTHORS' CONCLUSIONS

### Implications for practice

There is currently insufficient evidence to inform the adoption of enhanced interdisciplinary rehabilitation and care models for people with dementia following hip fracture surgery over usual, conventional rehabilitation and care models. The optimal rehabilitation and care model for this population is unclear. Existing RCTs have not assessed strategies intended to reduce cognitive deterioration in this population. It is therefore not known whether care and rehabilitation models are more effective if they include dementia-focused interventions such as provision of cues, reminiscence therapy, the adoption of familiarised routines or the use of assistive technologies.

### Implications for research

This review has highlighted a number of priorities which should be considered when designing future research. Firstly, given the uncertainty regarding the optimal enhanced rehabilitation and care model for people with dementia following hip fracture surgery, research is required to assess the clinical effectiveness of different models which may include differing intensities, frequencies, durations and locations for physiotherapy, occupational therapy and other rehabilitative expertise. Additionally, assessing the delivery of these interventions in different locations (hospital and home settings) and care provision by different health and social care workers or carers and family, would provide valuable information to understand how best to rehabilitate this population.

No studies have assessed the cost effectiveness of different enhanced rehabilitation and care models. Furthermore, the assessment of pain, behaviour and quality of life for participants and their carers/family is warranted. Finally, although challenging, including people with severe cognitive impairment is important, so that this group of the dementia population is investigated in future studies. Strategies to include this group in research should be developed to better understand whether and how a more inclusive approach for dementia research can be achieved.

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* Indicates the major publication for the study

# CHARACTERISTICS OF STUDIES

## Characteristics of included studies *[ordered by study ID]*

### Huusko 2000

| | |
|---|---|
| Methods | A randomised controlled trial comparing interdisciplinary geriatric recovery of inpatients with dementia following hip fracture surgery in Finland<br>This was a subgroup analysis of people with dementia as part of a larger randomised controlled trial |
| Participants | **Numbers:** Overall, 243 independently-living people aged 65 years or older admitted to hospital with hip fracture. This included 141 people with dementia<br>**Group Allocation:** In respect of people with dementia, 78 participants were randomised to the interdisciplinary intervention, 63 to the conventional recovery<br>**Diagnosis/Cognitive Status:** Dementia was determined using the assessment of cognitive impairment using the MMSE. A score of 0 - 11 was classified as severe dementia, moderate dementia as 12 - 17 and mild dementia as 18 - 23. Participants with a MMSE score of 24 - 30 were classified as normal. MMSE was assessed 10 days after surgery and randomisation<br>In the interdisciplinary intervention group, the frequency of MMSE score was: 0 - 11: 19; 12 - 17: 24; 18 - 23: 35; 24 - 30: 41<br>In the conventional rehabilitation group, the frequency of MMSE was: 0 - 11: 9; 12 - 17: 12; 18 - 23: 42; 24 - 30: 56<br>**Age:** Mean age of the overall cohort was 80 years, consisting of 174 women and 69 men. No data on mean age or gender mix for the dementia-specific subgroup<br>**Usual Place of Residence:** Not stated<br>**Surgical Management:** All trochanteric fractures were managed with osteosynthesis. In the interdisciplinary intervention group, for cervical fractures, 60 participants were managed with a hemiarthroplasty, 6 with a total hip replacement, 12 with open reduction internal fixation. In the conventional rehabilitation group, for cervical fractures, 53 participants were managed with a hemiarthroplasty, 10 with a total hip replacement, 16 with open reduction internal fixation. No specific data was presented for the people with dementia<br>**Eligibility:** All participants were living independently and had been able to walk unaided before the fracture. Exclusions were people with pathological fractures, multiple fractures, serious early complications, calcitonin treatment, and terminally-ill people |
| Interventions | **Interdisciplinary Recovery Intervention:** Referral to a geriatric ward. postoperatively participants were then managed by a interdisciplinary team consisting of a geriatrician internist, a specially trained general practitioner, nurses with training in the care of older people, a social worker, a neuropsychologist, an occupational therapist, and physiotherapists. For up to 4 days each week, this was supplemented with consultant specialists in physical medicine, a neurologist and a psychiatrist. Collaboration between the family, participant and the interdisciplinary team was encouraged, as was communication with local health centres, nursing homes, home help and home care. Rehabilitation interventions included provision of advice, training, encouragement and listening to participant's concerns, drug treatment, physiotherapy, occupational therapy, speech and language therapy, and help with appliances, equipment and daily living aids. Participants allocated to the interdisciplinary team were assessed by the geriatric team. Physiotherapy was undertaken twice daily with daily activities practised throughout the day with |

**Huusko 2000** *(Continued)*

| | | |
|---|---|---|
| | nurses. Weekly joint meetings between nurses and physiotherapist were undertaken to discuss methods of improving rehabilitation. Each participant was provided with a daily schedule of rehabilitation to support early ambulation, self motivation and to optimise function. Walking aid appliances were reviewed by physiotherapists, whilst occupational therapists evaluated participant's needs for activities of daily living. Communication between family/carer and participants with the nursing and physiotherapy team was provided on numerous occasions for all participants, reinforced with a hip fracture brochure. Discharge planning was undertaken in weekly team meetings with the interdisciplinary team, family and participants. If required, this was supplemented by a physiotherapy-led home visit. All participants discharged to independent living had 10 home visits from the physiotherapist on discharge **Conventional Recovery Intervention:** Referral to local hospital. All participants encouraged to mobilise on the 1st postoperative day. No further information provided | |
| Outcomes | **Follow-up Intervals:** point of discharge, 3 months and 12 months post-surgery **Outcomes:** Length of hospital stay; mortality; place of residence after surgery | |
| Notes | Sample size powered for whole trial of people with dementia and cognitively intact participants (250 in total; 125 per group). The study was not powered to compare interventions for people with dementia specifically | |

*Risk of bias*

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | The allocation sequence was computer-generated and sealed in numbered, opaque envelopes in Helsinki, Finland, by the information technology department of Novartis before the study was started. The envelopes were stored on the orthopaedic ward by the head nurse until patients were randomised (Page 1108) |
| Allocation concealment (selection bias) | Low risk | The allocation sequence was computer-generated and sealed in numbered, opaque envelopes in Helsinki, Finland, by the information technology department of Novartis before the study was started. The envelopes were stored on the orthopaedic ward by the head nurse until patients were randomised (Page 1108) |
| Blinding of participants and personnel (performance bias) All outcomes | High risk | Reported it was not possible to blind the participants, their families/carers or staff delivering the interventions or assessments (Page 1108) |

**Huusko 2000** *(Continued)*

| | | |
|---|---|---|
| Blinding of outcome assessment (detection bias)<br>All outcomes | High risk | Reported it was not possible to blind the staff undertaking the assessments (Page 1108) |
| Incomplete outcome data (attrition bias)<br>All outcomes | Unclear risk | 1 participant in the intervention group and 4 in the control group were not tested with the MMSE (page 1109). The analysis was therefore conducted on 238 participants for the whole study (Page 1109). The attrition rate for people with dementia is unknown |
| Selective reporting (reporting bias) | Low risk | All outcomes planned in the Methods section were reported in the Results section (Page 1108 - 9) |
| Other bias | High risk | The data were a subgroup of a larger RCT. Randomisation of the whole cohort was not stratified for cognitive status. Therefore there was a baseline imbalance between the groups in respect of lower MMSE score in the intervention group. This may have impacted negatively on the estimation of intervention effects |

**Marcantonio 2001**

| | |
|---|---|
| Methods | A randomised controlled trial comparing a geriatrician-led recovery on a general orthopaedic ward compared to an orthopaedic surgeon-led conventional rehabilitation and recovery intervention delivered on an orthopaedic ward for inpatients following hip fracture surgery in the United Sates of America<br>This paper presented data of a subgroup analysis of people with dementia as part of the larger randomised controlled trial |
| Participants | **Sample Size:** 126 participants were randomised to the 2 groups.<br>**Group Allocation:** 62 participants were randomised to receive the geriatrician-led recovery intervention, as opposed to 64 participants who received the orthopaedic surgeon-led recovery intervention from the hospital ward<br>**Diagnosis/Cognitive Status:** From the subgroup of people with cognitive impairment, 21 participants were allocated to the geriatrician-led recovery compared to 29 in the orthopaedic-led recovery group. Cognitive function was assessed with the MMSE, delirium assessed with the DSI, severity of delirium was assessed with the MDAS, and the ascertainment of delirium was assessed using the CAM. Proxy assessments made using the Blessed Dementia Rating Scale. Prefracture dementia was classified on a Blessed score of 4 or higher. Thus, 21 participants in the geriatrician-led recovery group were classified as having dementia as opposed to 29 in the orthopaedic surgeon-led recovery group<br>**Age:** The mean age of the geriatrician-led recovery intervention group was 78 years (SD 8), as opposed to 80 years (SD 8) in those who received the orthopaedic surgeon-led |

|  | recovery in the hospital ward<br>**Gender Mix:** The geriatrician-led recovery intervention group consisted of 13 men and 49 women, whilst the orthopaedic surgeon-led recovery intervention group from the hospital ward consisted of 14 men and 50 women<br>**Surgical Management:** Hip replacement surgery (unspecified if hemiarthroplasty or total hip arthroplasty) was performed in 20 participants in the geriatrician-led recovery group, whilst 22 participants from the orthopaedic-led recovery groups received this intervention<br>**Usual Place of Residence:** Not stated<br>**Comorbidites:** Comorbidites were assessed using the Charlson index. Based on this, 24 people in the geriatrician-led recovery consultation review group had a Charlson index of 4 or greater, whilst this related to 21 people in the orthopaedic-led recovery group<br>**Eligibility:** Inclusion: People aged 65 years and older admitted for primary surgical repair of hip fracture. Exclusion: presence of metastatic cancer or comorbid illnesses likely to reduce life expectancy to less than 6 months, or inability to obtain informed consent within 24 hours of surgery or 48 hours of admission. If patients demonstrated evidence of dementia or delirium at the time of enrolment, consent was also obtained from a designated healthcare proxy |
|---|---|
| Interventions | **Geriatrician-led recovery intervention:** Geriatric consultation preoperatively or within 24 hours postoperatively. A geriatrician performed daily visits to each participant randomised to this group and made targeted recommendations based on a protocol on aspects of care including: oxygen delivery; fluid and electrolyte balance; pain management; medication review to eliminate unnecessary medications; regulation of bowel and bladder function; nutritional intake; early mobilisation and rehabilitation; prevention, early detection and treatment of major postoperative complications such as cardiac conditions, embolism, respiratory conditions and urinary tract infections; optimising environmental stimuli through provision of glasses and hearing aids, and provision of clocks, calenders, radios, tape recorders and soft lighting; and the treatment of agitated delirium. No more than 5 recommendations could be prioritised after the initial visit, and no more than 3 after follow-up visits<br>**Orthopaedic-led recovery intervention:** Pre- and postoperative management by the orthopaedic team with reactive internal medicine or geriatric consultation rather than on a proactive basis as per the geriatrician-led recovery group |
| Outcomes | **Follow-up intervals:** Daily assessment of outcomes during acute hospital length of stay<br>**Outcomes:** MMSE; DSI; MDAS; CAM; incidence of severe delirium, defined as a CAM-defined delirium when the MDAS score was 18 or higher on a least 1 hospital day; hospital length of stay; discharge disposition |
| Notes | The sample size calculation was based on a target to observe a ½ reduction of delirium in the intervention groups compared to usual care with an 80% power |

*Risk of bias*

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | Sequence generation made using a random-number table (page 517) |

**Marcantonio 2001** *(Continued)*

| | | |
|---|---|---|
| Allocation concealment (selection bias) | Low risk | A sealed-envelope system containing the randomised assignments derived from a random number table ensured allocated concealment (Page 517) |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk | Due to the nature of this intervention, it was not possible to blind either the participants or personnel to the interventions |
| Blinding of outcome assessment (detection bias)<br>All outcomes | Low risk | A research interviewer who was trained to collect the outcome data was blinded to group allocation (Page 517) |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | Data from all people who enrolled on the trial were analysed and included in the trial (Figure 1, page 518) |
| Selective reporting (reporting bias) | High risk | MMSE, DSI and MDAS were collected to inform the incidence of delirium, but not reported as a single outcome of cognitive impairment. No study protocol was presented to confirm full reporting of outcomes |
| Other bias | Unclear risk | This was a subgroup analysis of a larger RCT. Accordingly it was not possible to assess whether there was a difference in baseline characteristics between the groups. This may have had a negative effect on estimating the intervention effect |

**Shyu 2012**

| | |
|---|---|
| Methods | A randomised controlled trial comparing an interdisciplinary recovery intervention (inpatient and community) to conventional recovery for PwD following hip fracture surgery in Taiwan |
| Participants | **Sample Size:** 160 people recruited<br>**Group Allocation:** Interdisciplinary rehabilitation (n = 79); conventional rehabilitation (n = 81) groups<br>**Diagnosis/Cognitive Status:** 24 (29.6%) in the interdisciplinary recovery intervention and 27 (34.2%) of the conventional recovery group were cognitively impaired according to MMSE. MMSE cut-offs for differing severities of cognitive impairment were not described<br>**Age:** In the PwD, mean age of the interdisciplinary recovery intervention was 81.3 years. In the PwD conventional recovery group, mean age was 81.7 years<br>**Gender Mix:** In the PwD, interdisciplinary recovery intervention group consisted of 24 women and 3 men. The PwD conventional recovery group consisted of 16 women and |

| | |
|---|---|
| | 8 men<br>**Surgical management:** For the whole cohort, 100 participants received an open reduction internal fixation procedure, whilst 60 participants received a hemiarthroplasty<br>**Usual Place of Residence:** Not stated<br>**Eligibility:** Participants were included if they were: (1) age 60 years or older; (2) admitted to hospital for an accidental single-side hip fracture; (3) receiving hip arthroplasty or internal fixation; (4) able to perform full range of motion (ROM) against gravity and against some or full resistance before hip fracture; (5) moderately dependent or better in ADLs before hip fracture (score $\geq$ 70 on the CBI) and; (6) living in northern Taiwan<br>People were excluded if they were: (1) severely cognitively impaired (score < 10 on the CMMSE); (2) terminally ill<br>Dementia was determined using the assessment of cognitive impairment using the MMSE. On the basis of the pre-discharge cognitive function assessment, participants were categorised as cognitively impaired and assigned to the cognitive-impairment group if they had < 6 years of education and a CMMSE score < 21 or had $\geq$ 6 years of education and scored < 25 |
| Interventions | **Interdisciplinary recovery intervention:** The intervention programme included 3 components: a geriatric consultation service; a rehabilitation programme; and a discharge-planning service. Each participant in this group received a geriatric consultation by a geriatrician and geriatric nurses. This assessed participants to determine potential medical and functional problems and to decrease delays preoperatively. This was used to allow the geriatric consultant to make recommendations regarding the timing of surgery, infection and thromboembolic prophylaxis, postoperative nutritional management, urinary tract management and delirium management<br>Postoperatively, this pre-operative assessed formed the basis of an individualised care plan for each participant, delivered by the interdisciplinary healthcare team. This team consisted of a gerontological nurse, the geriatrician, the primary surgeon, a rehabilitation physician, geriatric nurses, and a physical therapist<br>Every intervention-group participant received both in-hospital rehabilitation (delivered during hospitalisation) and in-home rehabilitation (delivered in the home setting). Rehabilitation started 1 day after surgery and continued until 3 months after discharge. Both rehabilitation phases consisted of a hip fracture-oriented rehabilitation programme to restore deteriorated physical fitness. The inpatient hospital rehabilitation consisted of daily visits from the geriatric nurse and rehabilitation physician and twice-daily visits from the physical therapist. During the in-home rehabilitation programme, the geriatric nurse visited 4 times during the 1st month, and 4 times during the 2nd and 3rd months post-discharge. Physicial therapists visited 3 times post-discharge<br>The interdisciplinary team's discharge service was delivered by geriatric nurses and included a discharge assessment, necessary referrals, a home assessment and suggested environmental modifications. Discharge assessment, which occurred during hospitalisation, evaluated caregiver competence, resources, family function, participant's self-care ability, and need for community or long-term care services<br>**Conventional recovery programme:** Rehabilitation was not interdisciplinary with no continuity of care between healthcare professionals or inpatient/in-home rehabilitation. Inpatient rehabilitation consisted of 3 physical therapy sessions, and no in-home rehabilitation. No further information on the conventional recovery and rehabilitation programme was provided |

**Shyu 2012**   (*Continued*)

| Outcomes | **Follow-up Intervals:** 1, 3, 6, 12, 18, and 24 months after hospital discharge. **Outcomes:** Hip flexion ratio (range of motion of the affected hip joint divided by the range of motion of the unaffected hip joint); recovery of walking ability (comparing before and after fracture mobility) based on the CBI; ability to perform ADLs based on the CBI; occurrence of falls; mortality; emergency room visits; hospital readmissions; and incidence of institutionalisation to care/nursing facility |
|---|---|
| Notes | Sample size was not based on a power calculation. Unclear how and where follow-up data collection was performed<br>The study excluded people with severe cognitive impairment, so the population from which the sample was drawn might have been less cognitively impaired than populations sampled in other studies. The findings of non-significant differences in mortality and institutionalisation among older participants with and without cognitive impairment might have been due to excluding the sickest and most cognitively-impaired people who were most likely to die or to be institutionalised. Thus, the numbers of deaths and institutionalisation were small |

*Risk of bias*

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | Participants were recruited from the emergency room by research assistants and provided informed consent before participation (Page 532). Those who agreed to participate were randomly assigned to an intervention or control group by flipping a coin (Page 532) |
| Allocation concealment (selection bias) | High risk | This was not undertaken (Page 532). |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk | Due to the nature of this intervention, it was not possible to blind either the participants or personnel to the interventions |
| Blinding of outcome assessment (detection bias)<br>All outcomes | High risk | Outcome assessors were not blinded to group allocation. |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | All participants who were lost to follow-up were accounted for (Figure 1), and management of missing data was addressed in the analysis (Page 532) |
| Selective reporting (reporting bias) | Low risk | All outcome measures reported in the Methods section were reported and accounted for in the Results section |

| Other bias | Unclear risk | It was unclear whether there were any other possible biases due to limited study details |
|---|---|---|

**Stenvall 2012**

| Methods | A randomised controlled trial comparing an interdisciplinary recovery programme (inpatient) to a conventional recovery programme for people after hip fracture surgery in Sweden |
|---|---|
| | This is a subgroup analysis of people with dementia as part of a larger randomised controlled trial |

| Participants | **Sample Size:** 64 people with dementia were analysed from a total cohort of 199 |
|---|---|
| | **Group Allocation:** 28 assigned to the multidisciplinary recovery programme, 36 to the conventional recovery programme |
| | **Diagnosis/Cognitive Status:** Assessed by a geriatrician using the DSM-IV. Cognitive impairment was evaluated using the MMSE. Mean MMSE score at admission for the multidisciplinary recovery programme was 8.6 (SD 7.1) and 6.9 (SD 5.0) for the conventional recovery programme |
| | **Gender Mix:** The cohort consisted of 47 women and 17 men. |
| | **Age:** Mean age of participant was 81.0 for the multidisciplinary recovery programme and 83.2 for the conventional recovery programme |
| | **Surgical Management:** The surgical procedures undertaken to manage the hip fracture were not stated |
| | **Usual Place of Residence:** 22 participants (79%) in the multidisciplinary recovery and 26 participants (72%) lived in institutional care prior to hospitalisation in the conventional recovery programme |
| | **Comorbidites:** The frequency of comorbidities was presented for the multidisciplinary recovery programme and conventional recovery programme. These were: cancer (3,4) , previous stroke (9,10), previous hip fracture (6,5), diagnosis of depression (15, 25), diabetes (6,7) and cardiovascular disease (16, 21) respectively |
| | **Eligibility:** Participants were included if they: (1) presented with a femoral neck fracture; (2) were aged 70 or over years; (3) were admitted to the orthopedic department at Umeå University Hospital, Sweden. Patients were excluded if they presented with: (1) rheumatoid arthritis; (2) severe hip osteoarthritis; (3) severe renal failure; (4) pathological fracture; (4) or were bedridden pre-fracture |

| Interventions | **Multidisciplinary recovery programme:** All multidisciplinary team members, consisting of a physician, nurse and occupational therapist and physiotherapist, complied with a comprehensive geriatric assessment and rehabilitation programme. This consisted of: staff education; greater team working and communication; individualised care planning and rehabilitation; active prevention, detection and treatment of postoperative complications, especially delirium; focused attention on improving bowel and bladder care and minimising complications; reasons for poor sleep were investigated; prevention and treatment of decubitus ulcers; a pain management programme; prescription of oxygen enriched air during the first postoperative day; surveillance of body temperature, blood pressure; nutritional advice and support from a dietitian; early postoperative mobilisation in the first 24 hours; rehabilitation by the physiotherapists, occupational therapist and care staff which was progressed daily throughout the participant's inpatient rehabilitation |
|---|---|

**Stenvall 2012**  *(Continued)*

and focused on re-ablement to functional return; specific assessment and management of falls and osteoporosis. The staffing ratio on the multidisciplinary recovery programme ward was 1.07 nurses/aids per bed. The multidisciplinary team assessed all participants 4 months postoperatively for postoperative complications and to determine any further care needs

**Conventional recovery programme:** This was delivered on a specialist orthopaedic ward, with subsequent, longer-term follow-up (required by 13 participants) delivered on a geriatric ward. The staffing ratio in the conventional recovery programme was 1. 01 nurses/aided per bed in the orthopaedic ward, and 1.07 nurses/aids per bed in the geriatric ward. The control group followed conventional postoperative routines which included the non-formalised and inconsistent provision of team working, individualised care planning and rehabilitation, prevention, detection and treatment of postoperative complications, especially delirium, improving bowel and bladder care and minimising complications, reasons for poor sleep were investigated, prescription of oxygen-enriched air during the 1st postoperative day, surveillance of blood pressure, nutrition, early post-operative mobilisation in the first 24 hours, rehabilitation by the physiotherapists, occu-pational therapist and care staff and progressed daily throughout the participant's inpa-tient rehabilitation focusing on re-ablement to functional return, and specific assessment and management of falls and osteoporosis. All participants in the conventional recovery intervention received prevention and treatment of decubitus ulcers, a pain management programme, surveillance of body temperature, but, unlike the multidisciplinary rehabil-itation programme, were not reviewed by a dietitian regarding nutritional support

| Outcomes | **Follow-up intervals:** during hospital stay; on discharge from the hospital; at 4 months (± 2 weeks) and 12 months (± 1 month) postoperatively<br><br>**Outcomes:** Incidence of postoperative complications, readmission; inpatient hospital days after discharge; walking ability using the Swedish version of the Clinical Outcome Variables; functional performance of ADL using the Staircase of ADL including the Katz ADL index which measures both personal/primary ADL and instrumental ADL; geriatric depression scale; MMSE; modified Organic Brain Syndrome Scale to assess cognitive, perceptual, emotional and personality changes and fluctuations in clinical state; the Geriatric Depression Scale to assess signs of depression; and living situation i. e. institutionalised or independent living in a community dwelling |
|---|---|
| Notes | |

*Risk of bias*

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | Using opaque sealed envelopes, sequen-tially numbered, not computer-generated but mixed by people not involved in the study, patients were randomly assigned to postoperative care in a geriatric ward with a special intervention programme or to con-ventional care in an orthopedic ward. All participants received this envelope while in the emergency room but it remained un- |

**Stenvall 2012**  (*Continued*)

| | | |
|---|---|---|
| | | opened until immediately before surgery to ensure that all participants received similar pre-operative treatment. People not involved in the study carried out the randomisation procedure (Page 285) |
| Allocation concealment (selection bias) | Low risk | People not involved in the study carried out the randomisation using opaque sealed envelopes, sequentially numbered. Patients were randomly assigned to postoperative care in a geriatric ward with a special intervention program or to conventional care in an orthopedic ward. All participants were randomised whilst in the emergency room and their allocation concealed until immediately before surgery to ensure that all participants received similar preoperative treatment (Page 285) |
| Blinding of participants and personnel (performance bias) All outcomes | High risk | No specific blinding of participants or personnel. However this could have been difficult due to the nature of this intervention (Page 285) |
| Blinding of outcome assessment (detection bias) All outcomes | High risk | Assessors were not blinded to group allocation (Page 285). |
| Incomplete outcome data (attrition bias) All outcomes | High risk | Participant loss to follow-up was accounted for in Figure 1 (Page 286). 9 participants in the interdisciplinary inpatient rehabilitation group and 8 in the conventional rehabilitation group were lost to follow-up. Missing data were not accounted for in the analysis |
| Selective reporting (reporting bias) | Low risk | All outcomes reported in the Methods were accounted for and presented in the Results (Page 285-7) |
| Other bias | High risk | The data were a subgroup of a larger RCT. Randomisation of the whole cohort was not stratified for cognitive status. There was a baseline imbalance between the groups with respect to mobility. This may have impacted negatively on the estimation of intervention effects |

**Uy 2008**

| | |
|---|---|
| Methods | A randomised controlled trial comparing clinical outcomes of an inpatient multidisciplinary rehabilitation intervention to a conventional rehabilitation for people following hip fracture who live in nursing homes in Australia |
| Participants | **Sample Size:** 11 participants in total enrolled in the trial, 10 participants completed the 4-month follow-up period and were included in the analysis<br>**Group Allocation:** 3 participants were randomised to the Inpatient multidisciplinary rehabilitation Intervention. 7 participants were randomised to the conventional rehabilitation Intervention group<br>**Diagnosis/Cognitive Status:** All participants were classified as having moderate to severe cognitive impairment using the SPMSQ - the 'best' score within this cohort being 6<br>**Age:** Median age in the inpatient multidisciplinary recovery Intervention group was 80 years, and 83 years in the conventional recovery intervention group<br>**Gender Mix:** All participants in each group were women.<br>**Surgical Management:** In the inpatient multidisciplinary recovery intervention group hemiarthroplasty (n = 1) and compression screw and plates (n = 2) were undertaken. In the conventional recovery intervention group, hemiarthroplasty (n = 5) and compression screw and plates (n = 2) were undertaken<br>**Usual Place of Residence:** 100% of the cohort lived in nursing homes prior to hospitalisation<br>**Comorbidites:** Comorbidites were assessed using the Charlson index. Based on this, the median Charlson index for both groups was 1<br>**Eligibility:** Inclusion: Women who lived in a nursing home within the catchment of the study hospital prior to a hip fracture; were ambulant without the assistance of another person prior to their hip fracture; were able to follow commands at the time of seeking informed consent in the postoperative period |
| Interventions | **Interdisciplinary intervention: Immediate postoperative nursing care plan devised to encourage early mobility and self care**. Physician with a special interest in rehabilitation and geriatric medicine reviewed the participant with 24 hours postoperatively. This was used to identify and treat intercurrent illness, review prior level of disability, and to determine the participant's level of social support. The physician planned the woman's rehabilitation. Mobilisation began post-check x-ray and stable medical condition. Objective was to sit out of bed on the day after the operation and attempt walking the next day. Mobilisation was supervised by the nursing staff in consultation with a visiting physiotherapist. Mobilisation supervised by a physiotherapist was provided daily each weekday, and 2 sessions of physiotherapy daily were considered ideal. Mobility training was continued by the nursing staff at other times. The orthopaedic surgeon and the rehabilitation physician reviewed the woman 3 or 4 times weekly.<br>Participants returned to their nursing home as soon as was feasible given the medical condition. The rehabilitation physician liaised with the nursing home and confirmed arrangements for the mobilisation of the participant. Mobilisation was supervised by the nursing staff in consultation with a visiting physiotherapist. Progress was checked after several weeks by the rehabilitation physician, and orthopaedic review was arranged according to need<br>**Conventional recovery intervention:** Standard treatment provided at the study hospital at the time of the trial. Participants living in nursing homes and those with limited disability were discharged when deemed orthopaedically appropriate |

| Outcomes | **Follow-up Intervals:** 1 month and 4 months post-hip fracture<br>**Outcomes:** BI, gait velocity measured by a timed 2.44M walk test |
|---|---|
| Notes | |

*Risk of bias*

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | The numbers were generated using a random number table (Page 43) |
| Allocation concealment (selection bias) | Low risk | Numbered opaque envelopes used for allocation (Page 43) |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk | No specific blinding of participants or personnel. However this could have been difficult due to the nature of this intervention (page 43) |
| Blinding of outcome assessment (detection bias)<br>All outcomes | High risk | No blinding of assessors who determined the BI or gait velocity (page 43 - 4) |
| Incomplete outcome data (attrition bias)<br>All outcomes | Unclear risk | 1 early death in the intervention group but it was not clear whether this could have been related to the study management or not (page 43) |
| Selective reporting (reporting bias) | Low risk | All outcomes reported in the Methods section (page 43) were reported in the Results section (page 43 - 4) |
| Other bias | Unclear risk | It was unclear whether there were any other possible biases due to limited study details |

ADL: activities of daily living
BI: Barthel index
CAM: confusion assessment method
CBI: Chinese Barthel Index
CMMSE: Chinese mini-mental state examination
DSI: delirium symptom interview
MDAS: memorial delirium assessment scale
MMSE: mini-mental state examination
PwD: person with dementia
SD: standard deviation
SPMSQ: Short Portable Mental Status Questionnaire

## Characteristics of excluded studies  *[ordered by study ID]*

| Study | Reason for exclusion |
|---|---|
| Adunsky 2003b | Non-randomised controlled trial |
| Arinzon 2010 | Non-randomised controlled trial |
| Deschodt 2011 | Non-randomised controlled trial |
| Espaulella 2000 | Does not provide specific data on participants with dementia or cognitive impairment |
| Heruti 1999 | Non-randomised controlled trial |
| Horgan 2003 | Non-randomised controlled trial |
| Kalisvaart 2005 | Does not provide specific data on participants with dementia or cognitive impairment |
| McGilton 2009 | Non-randomised controlled trial |
| Morrison 2000 | Non-randomised controlled trial |
| Naglie 2002 | Does not provide specific data on participants with dementia or cognitive impairment |
| Penrod 2004 | Non-randomised controlled trial |
| Pitkala 2006 | Does not provide specific data on participants with dementia or cognitive impairment |
| Rolland 2004 | Non-randomised controlled trial |
| Seitz 2011b | Non-randomised controlled trial |
| Stenvall 2007 | Does not provide specific data on participants with dementia or cognitive impairment |
| Strömberg 1999 | Does not provide specific data on participants with dementia or cognitive impairment |
| Vidan 2005 | Does not provide specific data on participants with dementia or cognitive impairment |

## Characteristics of ongoing studies  *[ordered by study ID]*

**Wyller 2012**

| | |
|---|---|
| Trial name or title | The Effect of a Pre- and Postoperative Orthogeriatric Service. A Randomised, Controlled Trial |
| Methods | A randomised controlled trial to assess the effect of a model of preoperative as well as early postoperative care, treatment and rehabilitation in a dedicated ortho-geriatric ward in a single-blind randomised study in Norway |

**Wyller 2012**   *(Continued)*

| | |
|---|---|
| Participants | **Inclusion Criteria:** Eligible patients will be admitted acutely for a femoral neck fracture, a trochanteric or a subtrochanteric femoral fracture<br>**Exclusion Criteria:** (1) Hip fracture as part of multi-trauma or high-energy trauma (defined as a fall from a higher level than 1 metre). 1 recent fracture in addition to the hip fracture (e.g. radius or shoulder) is acceptable; (2) Regarded as moribund at admittance; (3) Absence of a valid informed consent or assent |
| Interventions | Operative and anaesthesiologic procedures will be the same in the 2 groups<br>**Orthogeriatric intervention:** The intervention group participants were to be transferred as soon as possible to the ortho-geriatric ward, stabilised there preoperatively, and transferred back to the same ward postoperatively for further treatment and rehabilitation<br>**Conventional recovery intervention:** A traditional orthopaedic ward with conventional rehabilitation |
| Outcomes | **Outcomes: Primary:** a composite endpoint by these 2 instruments: CDR, and the 10 words memory task from the CERAD battery<br>**Secondary:** ADL Scale; NEADL scale; intrahospital mortality; cumulative mortality; the SPPB scale; pre-/postoperative delirium; duration/severity of delirium; other complications; incidence of dementia 12 months postoperatively; length of hospital stay; markers of bone turnover; micronutrients in blood<br>**Time points:4** and 12 months. |
| Starting date | September 2009 |
| Contact information | Prof Torgeir Bruun Wyller - Geriatric Department, Faculty of Medicine, University of Oslo |
| Notes | Proposed end date: December 2012. ClinicalTrials.gov registration: NCT01009268<br>Last Update 15th May 2013 - Study Completed. |

ADL: activities of daily living
CDR : clinical dementia rating scale
CERAD: Consortium to Establish a Registry for Alzheimer's Disease
NEADL: Nottingham Extended Activities of Daily Living
SPPB: Short Physical Performance Battery

# DATA AND ANALYSES

**Comparison 1. Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation**
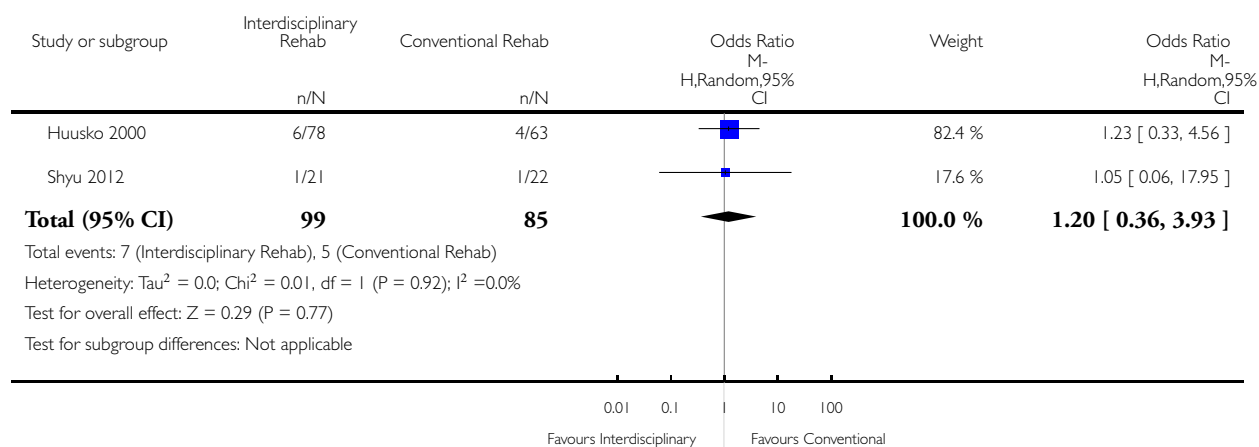
| Outcome or subgroup title | No. of studies | No. of participants | Statistical method | Effect size |
|---|---|---|---|---|
| 1 Mortality at 3 months post-hip fracture | 2 | 184 | Odds Ratio (M-H, Random, 95% CI) | 1.20 [0.36, 3.93] |
| 2 Mortality at 12 months post-hip fracture | 2 | 177 | Odds Ratio (M-H, Fixed, 95% CI) | 1.07 [0.47, 2.45] |
| 3 Number of participants in institutionalised care (hospital or nursing home) at 3 months post-hip fracture | 2 | 184 | Odds Ratio (M-H, Fixed, 95% CI) | 0.46 [0.22, 0.95] |
| 4 Number of participants in institutionalised care (hospital or nursing home) at 12 months post-hip fracture | 2 | 177 | Odds Ratio (M-H, Fixed, 95% CI) | 0.90 [0.40, 2.03] |

**Analysis 1.1. Comparison 1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation, Outcome 1 Mortality at 3 months post-hip fracture.**

Review: Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

Comparison: 1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation

Outcome: 1 Mortality at 3 months post-hip fracture

| Study or subgroup | Interdisciplinary Rehab n/N | Conventional Rehab n/N | Odds Ratio M-H,Random,95% CI | Weight | Odds Ratio M-H,Random,95% CI |
|---|---|---|---|---|---|
| Huusko 2000 | 6/78 | 4/63 | | 82.4 % | 1.23 [ 0.33, 4.56 ] |
| Shyu 2012 | 1/21 | 1/22 | | 17.6 % | 1.05 [ 0.06, 17.95 ] |
| **Total (95% CI)** | **99** | **85** | | **100.0 %** | **1.20 [ 0.36, 3.93 ]** |

Total events: 7 (Interdisciplinary Rehab), 5 (Conventional Rehab)

Heterogeneity: Tau$^2$ = 0.0; Chi$^2$ = 0.01, df = 1 (P = 0.92); I$^2$ =0.0%

Test for overall effect: Z = 0.29 (P = 0.77)

Test for subgroup differences: Not applicable

0.01  0.1  1  10  100

Favours Interdisciplinary    Favours Conventional

**Analysis 1.2.   Comparison 1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation, Outcome 2 Mortality at 12 months post-hip fracture.**

Review:    Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

Comparison:    1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation

Outcome:    2 Mortality at 12 months post-hip fracture

| Study or subgroup | Interdisciplinary Rehab n/N | Conventional Rehab n/N | Odds Ratio M-H,Fixed,95% CI | Weight | Odds Ratio M-H,Fixed,95% CI |
|---|---|---|---|---|---|
| Huusko 2000 | 13/78 | 10/63 | | 84.7 % | 1.06 [ 0.43, 2.61 ] |
| Shyu 2012 | 2/17 | 2/19 | | 15.3 % | 1.13 [ 0.14, 9.07 ] |
| **Total (95% CI)** | **95** | **82** | | **100.0 %** | **1.07 [ 0.47, 2.45 ]** |

Total events: 15 (Interdisciplinary Rehab), 12 (Conventional Rehab)

Heterogeneity: Chi$^2$ = 0.00, df = 1 (P = 0.95); I$^2$ =0.0%

Test for overall effect: Z = 0.16 (P = 0.87)

Test for subgroup differences: Not applicable

```
        0.01   0.1    1    10   100

  Favours Interdisciplinary    Favours Conventional
```
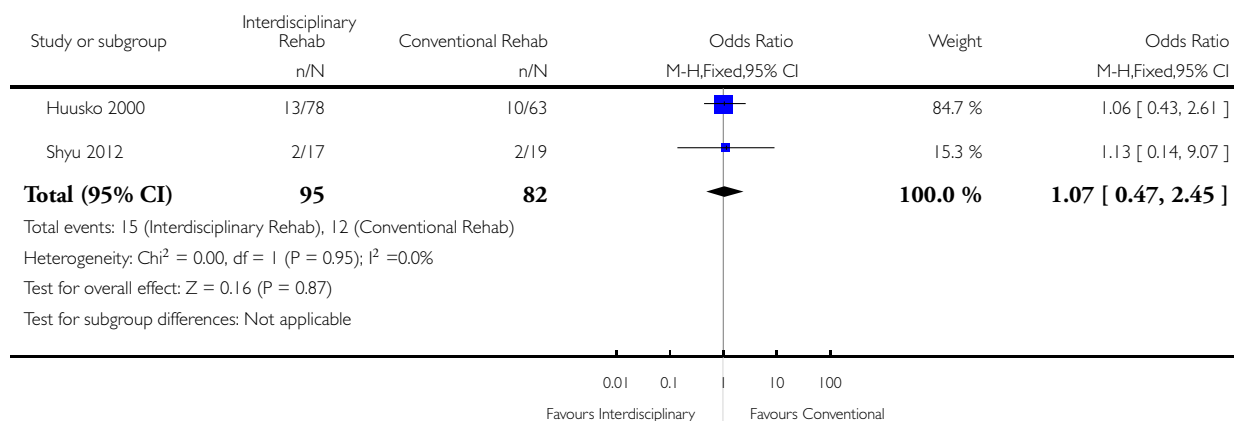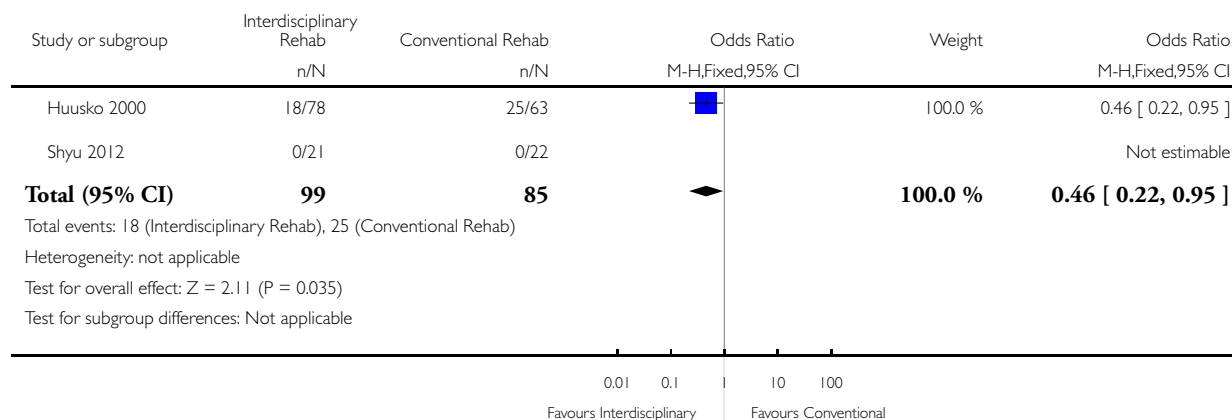
**Analysis 1.3.  Comparison I Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation, Outcome 3 Number of participants in institutionalised care (hospital or nursing home) at 3 months post-hip fracture.**

Review:   Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

Comparison:   1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation

Outcome:   3 Number of participants in institutionalised care (hospital or nursing home) at 3 months post-hip fracture

| Study or subgroup | Interdisciplinary Rehab | Conventional Rehab | Odds Ratio | Weight | Odds Ratio |
|---|---|---|---|---|---|
| | n/N | n/N | M-H,Fixed,95% CI | | M-H,Fixed,95% CI |
| Huusko 2000 | 18/78 | 25/63 | | 100.0 % | 0.46 [ 0.22, 0.95 ] |
| Shyu 2012 | 0/21 | 0/22 | | | Not estimable |
| **Total (95% CI)** | **99** | **85** | | **100.0 %** | **0.46 [ 0.22, 0.95 ]** |

Total events: 18 (Interdisciplinary Rehab), 25 (Conventional Rehab)

Heterogeneity: not applicable

Test for overall effect: Z = 2.11 (P = 0.035)

Test for subgroup differences: Not applicable

```
        0.01    0.1      I      I0    I00
      Favours Interdisciplinary    Favours Conventional
```
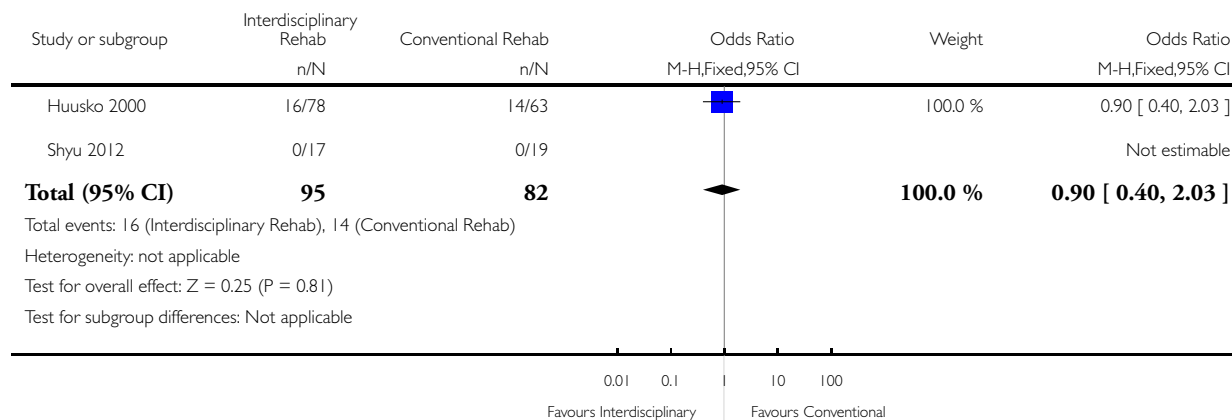
**Analysis 1.4.  Comparison I Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation, Outcome 4 Number of participants in institutionalised care (hospital or nursing home) at 12 months post-hip fracture.**

Review:   Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery

Comparison:   1 Interdisciplinary geriatric rehabilitation (inpatient and community rehabilitation) versus conventional rehabilitation

Outcome:   4 Number of participants in institutionalised care (hospital or nursing home) at 12 months post-hip fracture

| Study or subgroup | Interdisciplinary Rehab n/N | Conventional Rehab n/N | Odds Ratio M-H,Fixed,95% CI | Weight | Odds Ratio M-H,Fixed,95% CI |
| --- | --- | --- | --- | --- | --- |
| Huusko 2000 | 16/78 | 14/63 | | 100.0 % | 0.90 [ 0.40, 2.03 ] |
| Shyu 2012 | 0/17 | 0/19 | | | Not estimable |
| **Total (95% CI)** | **95** | **82** | | **100.0 %** | **0.90 [ 0.40, 2.03 ]** |

Total events: 16 (Interdisciplinary Rehab), 14 (Conventional Rehab)

Heterogeneity: not applicable

Test for overall effect: Z = 0.25 (P = 0.81)

Test for subgroup differences: Not applicable

```
        0.01   0.1    1    10   100
     Favours Interdisciplinary  Favours Conventional
```

# A P P E N D I C E S

## Appendix 1. Search Strategies

### 1. ALOIS (www.medicine.ox.ac.uk/alois)

hip OR fracture OR surgery OR operation OR femur OR femoral (120)

### 2. MEDLINE In-process and other non-indexed citations and MEDLINE 1950-present (Ovid SP)

1. exp Dementia/
2. Delirium/
3. Wernicke Encephalopathy/
4. Delirium, Dementia, Amnestic, Cognitive Disorders/
5. dement*.mp.
6. alzheimer*.mp.
7. (lewy* adj2 bod*).mp.
8. deliri*.mp.
9. (chronic adj2 cerebrovascular).mp.
10. ("organic brain disease" or "organic brain syndrome").mp.
11. ("normal pressure hydrocephalus" and "shunt*").mp.

12. "benign senescent forgetfulness".mp.
13. (cerebr* adj2 deteriorat*).mp.
14. (cerebral* adj2 insufficient*).mp.
15. (pick* adj2 disease).mp.
16. (creutzfeldt or jcd or cjd).mp.
17. huntington*.mp.
18. binswanger*.mp.
19. korsako*.mp.
20. or/1-19
21. exp Femur/
22. exp Fractures, Bone/
23. exp Fracture Fixation/
24. exp Fracture Healing/
25. or/22-24
26. 21 and 25
27. (hip or hips or pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*).ti,ab.
28. ((femur* or femoral*) adj3 (neck or proximal)).ti,ab.
29. 27 or 28
30. ((hip or hips or pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular* or ((femur* or femoral*) adj3 (neck or proximal))) adj4 fracture).ti,ab.
31. randomized controlled trial.pt.
32. controlled clinical trial.pt.
33. randomi?ed.ab.
34. randomly.ab.
35. placebo.ab.
36. drug therapy.fs.
37. trial.ab.
38. groups.ab.
39. ("double-blind*" or "single-blind*").ti,ab.
40. (RCT or CCT).ti,ab.
41. or/31-40
42. (animals not (humans and animals)).sh.
43. 41 not 42
44. 29 or 30
45. 20 and 43 and 44 (255)


**3. EMBASE 1980-2013 July 03 (Ovid SP)**

1. exp dementia/
2. Lewy body/
3. delirium/
4. Wernicke encephalopathy/
5. cognitive defect/
6. dement*.mp.
7. alzheimer*.mp.
8. (lewy* adj2 bod*).mp.
9. deliri*.mp.
10. (chronic adj2 cerebrovascular).mp.
11. ("organic brain disease" or "organic brain syndrome").mp.
12. "supranuclear palsy".mp.
13. ("normal pressure hydrocephalus" and "shunt*").mp.
14. "benign senescent forgetfulness".mp.
15. (cerebr* adj2 deteriorat*).mp.

16. (cerebral* adj2 insufficient*).mp.
17. (pick* adj2 disease).mp.
18. (creutzfeldt or jcd or cjd).mp.
19. huntington*.mp.
20. binswanger*.mp.
21. korsako*.mp.
22. CADASIL.mp.
23. or/1-22
24. femur/ or femur fracture/
25. fracture/
26. 24 and 25
27. (hip or hips or pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
28. fracture*.ti,ab.
29. femur.ti,ab.
30. or/24-29
31. 23 and 30
32. randomized controlled trial/
33. trial.ab.
34. randomly.ab.
35. groups.ab.
36. randomi?ed.ti,ab.
37. placebo.ab.
38. RCT.ti,ab.
39. "double-blind*".ti,ab.
40. or/32-39
41. 31 and 40 (716)


## 4. PSYCINFO 1806-July week 1 2013 (Ovid SP)

1. exp Dementia/
2. exp Delirium/
3. exp Huntingtons Disease/
4. exp Kluver Bucy Syndrome/
5. exp Wernickes Syndrome/
6. exp Cognitive Impairment/
7. dement*.mp.
8. alzheimer*.mp.
9. (lewy* adj2 bod*).mp.
10. deliri*.mp.
11. (chronic adj2 cerebrovascular).mp.
12. ("organic brain disease" or "organic brain syndrome").mp.
13. "supranuclear palsy".mp.
14. ("normal pressure hydrocephalus" and "shunt*").mp.
15. "benign senescent forgetfulness".mp.
16. (cerebr* adj2 deteriorat*).mp.
17. (cerebral* adj2 insufficient*).mp.
18. (pick* adj2 disease).mp.
19. (creutzfeldt or jcd or cjd).mp.
20. huntington*.mp.
21. binswanger*.mp.
22. korsako*.mp.
23. ("parkinson* disease dementia" or PDD or "parkinson* dementia").mp.

24. or/1-23
25. (hip or hips or pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*).ti,ab.
26. fracture*.ti,ab.
27. femur.ti,ab.
28. femoral*.ti,ab.
29. or/25-28
30. 24 and 29
31. exp Clinical Trials/
32. randomly.ab.
33. randomi?ed.ti,ab.
34. RCT.ti,ab.
35. groups.ab.
36. placebo.ab.
37. "double-blind*".ti,ab.
38. or/31-37
39. 30 and 38 (86)


## 5. CINAHL (EBSCOhost)

S1 (MH "Dementia+")
S2 (MH "Delirium") or (MH "Delirium, Dementia, Amnestic, Cognitive Disorders")
S3 (MH "Wernicke's Encephalopathy")
S4 TX dement*
S5 TX alzheimer*
S6 TX lewy* N2 bod*
S7 TX deliri*
S8 TX chronic N2 cerebrovascular
S9 TX "organic brain disease" or "organic brain syndrome"
S10 TX "normal pressure hydrocephalus" and "shunt*"
S11 TX "benign senescent forgetfulness"
S12 TX cerebr* N2 deteriorat*
S13 TX cerebral* N2 insufficient*
S14 TX pick* N2 disease
S15 TX creutzfeldt or jcd or cjd
S16 TX huntington*
S17 TX binswanger*
S18 TX korsako*
S19 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
S20 TX hip OR hips OR fracture* OR femur OR femoral OR pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*
S21 (MH "Hip Fractures")
S22 S20 OR S21
S23 S19 AND S22
S24 (MH "Randomized Controlled Trials") OR (MH "Clinical Trials")
S25 TX randomly
S26 AB trial
S27 AB placebo
S28 AB placebo
S29 AB "double-blind*"
S30 AB groups
S31 AB groups
S32 S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31
S33 S23 AND S32 (125)

### 6. ISI Web of Science (1945-present) and conference proceedings

Topic=(dement* OR alzheimer* OR "lewy bod*" OR DLB OR "vascular cognitive impairment*" OR FTD OF FTLD OR "cerebrovascular insufficienc*") AND Topic=(hip OR hips OR fracture* OR femur OR femoral OR pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*) AND Topic=(randomly OR trial OR cluster* OR RCT OR placebo OR randomised OR randomized)

Timespan=All years. Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC (324)

### 7. LILACS (BIREME)

cadera OR hip OR hips OR caderas OR fractura OR fracture OR fémur OR femur OR fêmur OR quadril [Words] and dementia OR demência OR alzheimer OR "cognitive impair$" OR "deterioro cognitivo" [Words] (12)

### 8. CENTRAL (The Cochrane Library) (Issue 8 of 12, 2012)

#1 MeSH descriptor: [Dementia] explode all trees
#2 dement*
#3 alzheimer*
#4 lewy* near/2 bod*
#5 deliri*
#6 chronic near/2 cerebrovascular
#7 "organic brain disease" or "organic brain syndrome"
#8 "normal pressure hydrocephalus" and "shunt*"
#9 "benign senescent forgetfulness"
#10 cerebr* near/2 deteriorat*
#11 cerebral* near/2 insufficient*
#12 pick* near/2 disease
#13 creutzfeldt or jcd or cjd
#14 huntington*
#15 binswanger*
#16 korsako*
#17 "cognit* impair*"
#18 MeSH descriptor: [Cognition Disorders] explode all trees
#19 MCI
#20 ACMI
#21 ARCD
#22 SMC
#23 CIND
#24 BSF
#25 AAMI
#26 LCD
#27 AACD
#28 MNCD
#29 MCD
#30 "N-MCI" or "A-MCI" or "M-MCI"
#31 (cognit* or memory or cerebr* or mental*) near/3 (declin* or impair* or los* or deteriorat* or degenerat* or complain* or disturb* or disorder*)
#32 "preclinical AD"
#33 "pre-clinical AD"
#34 aMCI or MCIa
#35 "CDR 0.5" or "clinical dementia rating scale 0.5"
#36 "GDS 3" or "stage 3 GDS"
#37 "global deterioration scale" and "stage 3"

#38 "mild neurocognit* disorder*"

#39 prodrom* near/2 dement*

#40 episodic* near/2 memory

#41 #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

#42 hip or hips or pertrochant* or intertrochant* or trochanteric or subtrochanteric or extracapsular*

#43 (femur* or femoral*) near/3 (neck or proximal)

#44 MeSH descriptor: [Femur] explode all trees

#45 MeSH descriptor: [Fractures, Bone] explode all trees

#46 MeSH descriptor: [Fracture Fixation] explode all trees

#47 MeSH descriptor: [Fracture Healing] explode all trees

#48 #42 or #43 or #44 or #45 or #46 or #47

#49 #48 and #41 in Trials (148)

### 9. Clinicaltrials.gov (www.clinicaltrials.gov)

hip OR hips OR surgery OR pertrochant* OR intertrochant* OR trochanteric OR subtrochanteric OR extracapsular OR femur OR femoral | Interventional Studies | dementia OR alzheimer OR alzheimers OR lewy OR vascular cognitive impairment (104)

### 10. ICTRP Search Portal (http://apps.who.int/trialsearch) [includes: Australian New Zealand Clinical Trials Registry; ClinicalTrilas.gov; ISRCTN; Chinese Clinical Trial Registry; Clinical Trials Registry - India; Clinical Research Information Service - Republic of Korea; German Clinical Trials Register; Iranian Registry of Clinical Trials; Japan Primary Registries Network; Pan African Clinical Trial Registry; Sri Lanka Clinical Trials Registry; The Netherlands National Trial Register]

#1 hip AND dementia = 5

#2 fracture AND dementia = 9

#3 femur AND dementia = 10

## CONTRIBUTIONS OF AUTHORS

TS: Contributed to the literature search; reviewed the search results for review eligibility; identified all included trials; independently performed the data extraction; assessed the risk of bias for the included studies; conducted the data analysis; was involved in the writing and approval of the protocol and the final review; acts as guarantor.

YH: Contributed to the literature search; reviewed the search results for review eligibility; identified all included trials; independently performed the data extraction; assessed the risk of bias for the included studies; provided judgements on the interpretation of the results and conclusions drawn; was involved in the writing and approval of the protocol and the final review.

CH: Provided judgements on the analysis of health economic outcomes; provided judgements on the interpretation of the results and conclusions drawn; was involved in the writing and approval of the protocol and the final review.

JC: Provided judgements on the interpretation of the results and conclusions drawn; was involved in the writing and approval of the protocol and the final review.

OS: Provided judgements on the interpretation of the results and conclusions drawn; was involved in the writing and approval of the protocol and the final review.

CF: Adjudicated the data extraction and assessment of risk of bias processes; provided judgements on the interpretation of the results and conclusions drawn; was involved in the writing and approval of the protocol and the final review.

# DECLARATIONS OF INTEREST

Toby O Smith - none known

Yasir A Hameed - none known

Jane L Cross - none known

Catherine Henderson - none known

Opinder Sahota - none known

Chris Fox - none known

# SOURCES OF SUPPORT

# DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We did not identify any trials assessing the effectiveness of a rehabilitation or care model following a hip fracture intended specifically for people with dementia. Therefore the review was amended from the original protocol to include rehabilitation and care models designed for older people following hip fracture. This review therefore assessed whether enhancing rehabilitation and care models for older people after hip fracture is also useful for people with dementia, but did not assess the effectiveness of specific interventions designed for people with dementia. Given only one study diagnosed dementia with a validated instrument (Stenvall 2012), we broadened the diagnostic criteria for dementia in this full review. We therefore included studies reporting people with cognitive impairment when data from only cognitively-impaired/those with dementia were available for analysis, and not combined with the non-cognitively-impaired/dementia data sets.

We clarified the terminology around rehabilitation and care models for the full review. Since the long-term aim of the review was to examine what can be drawn from the current literature to help devise an intervention specifically for people with dementia, an assessment of care models examining all interdisciplinary interventions along the patient's care pathway in addition to more conventionally interpreted rehabilitation from physiotherapy and occupational therapy was deemed appropriate. In response to this, we amended the title of the review and the terminology to embrace this distinction.

Originally we planned to assess the quality of the evidence related to the primary and first four secondary outcome measures using the GRADE approach. We amended this in the full review to assess all outcome measures. We originally planned to present the findings in 'Summary of findings' tables. However, due to the very low quality of the evidence, we decided to include the GRADE rating in the text to highlight this to the reader whilst interpreting the review's clinical findings.

Due to the limited number of eligible papers identified by the search strategy, it was not possible to: construct a funnel plot to assess small-sample-size publication bias; perform a meta-analysis to pool the data from all included studies for all identified intervention strategies; nor undertake sensitivity analyses for pooled data.