Intramedullary nails for extracapsular hip fractures in adults (Review)

Queally JM, Harris E, Handoll HHG, Parker MJ

THE COCHRANE COLLABORATION®

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2014, Issue 9

http://www.thecochranelibrary.com

WILEY

TABLE OF CONTENTS

[Intervention Review]

Intramedullary nails for extracapsular hip fractures in adults

Joseph M Queally[1], Ella Harris[2], Helen HG Handoll[3], Martyn J Parker[4]

[1]Higher Surgical Training Group, Royal College of Surgeons in Ireland, Dublin, Ireland. [2]Department of Bioengineering, Biomedical Sciences, Dublin, UK. [3]Health and Social Care Institute, Teesside University, Middlesbrough, UK. [4]Department of Orthopaedics, Peterborough and Stamford Hospitals NHS Foundation Trust, Peterborough, UK

Contact address: Joseph M Queally, Higher Surgical Training Group, Royal College of Surgeons in Ireland, 123 St Stephens Green, Dublin, Dublin 2, Ireland. josephqueally@gmail.com.

Editorial group: Cochrane Bone, Joint and Muscle Trauma Group.
Publication status and date: New search for studies and content updated (conclusions changed), published in Issue 9, 2014.
Review content assessed as up-to-date: 6 January 2014.

Citation: Queally JM, Harris E, Handoll HHG, Parker MJ. Intramedullary nails for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2014, Issue 9. Art. No.: CD004961. DOI: 10.1002/14651858.CD004961.pub4.

ABSTRACT

Background

Intramedullary nails may be used for the surgical fixation of extracapsular hip fractures in adults. This is an update of a Cochrane review first published in 2005 and last updated in 2008.

Objectives

To assess the effects (benefits and harms) of different designs of intramedullary nails for treating extracapsular hip fractures in adults.

Search methods

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (6 January 2014), the Cochrane Central Register of Controlled Trials (*The Cochrane Library* Issue 12, 2013), MEDLINE (1966 to November Week 3, 2013), MEDLINE In-Process & Other Non-Indexed Citations (3 January 2014), EMBASE (1988 to 2014, Week 1) and the World Health Organization (WHO) International Clinical Trials Registry Platform (accessed January 2014).

Selection criteria

All randomised or quasi-randomised trials comparing different types, or design modifications, of intramedullary nails in the treatment of extracapsular hip fractures in adults.

Data collection and analysis

At least two review authors independently selected studies, assessed risk of bias and extracted data. We performed limited meta-analysis using the fixed-effect model.

Main results

We included eight new trials, testing seven new comparisons in this update. Overall, we included 17 trials, testing 12 comparisons of different cephalocondylic nail designs. The trials involved a total of 2130 adults (predominantly female and older people) with mainly unstable trochanteric fractures.

All trials were at unclear risk of bias for most domains, with the majority at high risk of detection bias for subjective outcomes. The three quasi-randomised trials were at high risk for selection bias.

Four trials (910 participants) compared the proximal femoral nail (PFN) with the Gamma nail. There was no significant difference between the two implants in functional outcome (the very low quality evidence being limited to results from single trials), mortality (low quality evidence: 86/415 versus 80/415; risk ratio (RR) 1.08, 95% confidence interval (CI) 0.82 to 1.41), serious fixation complications (operative fracture of the femur, cut-out, non-union and later fracture of the femur) nor re-operations (low quality evidence: 45/455 versus 36/455; RR 1.25, 95% CI 0.83 to 1.90).

Two trials (185 participants) provided very low quality evidence of a lack of clinically significant difference in outcome (functional score, mortality, fracture fixation complications and re-operation) between the ACE trochanteric nail and the Gamma nail.

Two trials (200 participants) provided very low quality evidence of a lack of significant difference in outcome (mobility score, pain, fracture fixation complications or re-operations) between the proximal femoral nail antirotation (PFNA) nail and the Gamma 3 nail.

Seven of the nine trials evaluating different comparisons provided very low quality evidence of a lack of significant between-group differences in all of the reported main outcomes for the following comparisons: ACE trochanteric nail versus Gamma 3 nail (112 participants); gliding nail versus Gamma nail (80 participants); Russell-Taylor Recon nail versus long Gamma nail (34 participants, all under 50 years); proximal femoral nail antirotation (PFNA) nail versus Targon PF nail (80 participants); dynamically versus statically locked intramedullary hip screw (IMHS) nail (81 participants); sliding versus non-sliding Gamma 3 nail (80 participants, all under 60 years); and long versus standard PFNA nails (40 participants with reverse oblique fractures).

The other two single comparison trials also provided very low quality evidence of a lack of significant between-group differences in all of the main outcomes with single exceptions. The trial (215 participants) comparing the ENDOVIS nail versus the IMHS nail found low quality evidence of poorer mobility in the ENDOVIS nail group, where more participants in this group were bedridden after their operation (29/105 versus 18/110; RR 1.69, 95% CI 1.00 to 2.85; P = 0.05). The trial (113 participants) comparing the InterTan nail versus the PFNA II nail found very low quality evidence that more PFNA II group participants experienced thigh pain (3/47 versus 12/46; RR: 0.24, 95% CI 0.07 to 0.81).

Authors' conclusions

The limited evidence from the randomised trials undertaken to date is insufficient to determine whether there are important differences in outcome between different designs of intramedullary nails used in treating extracapsular hip fractures. Given the evidence of superiority of the sliding hip screw compared with intramedullary nails for extracapsular hip fractures, further studies comparing different designs of intramedullary nails are not a priority. Any new design should be evaluated in a randomised comparison with the sliding hip screw.

PLAIN LANGUAGE SUMMARY

Intramedullary nails for extracapsular hip fractures in adults

What is the medical problem?

Fractures of the upper part of the thigh bone (femur) are termed hip or proximal femoral fractures. These fractures are most common in women aged over 65 years. Roughly two out of five hip fractures are 'extracapsular' in that they lie outside the hip joint capsule.

What treatments are available?

The majority of these fractures are fixed surgically using metal implants. One increasingly used implant is the 'intramedullary nail'. This consists of a metal rod, which is usually inserted from the upper end of the femur into the inner cavity (medulla) of the femur bone and held in place with screws. There are several different types of nails, usually made by different manufacturers, in use.

Are some intramedullary nails better than others for these fractures?

This review set out to examine the evidence from trials that compared different designs of nails in clinical practice.

We searched medical databases and registers of new studies (until January 2014) and found 17 trials that compared different nail designs. These involved a total of 2130 participants. Most participants were older women.

The quality of the evidence from these trials is low or very low, partly because most trials used flawed methods that mean their results may not be reliable. In addition, several trials did not report on function or provide data that could be used. Of the 12 different comparisons tested, nine were tested by one trial only.

Four trials compared the proximal femoral nail (PFN) with the Gamma nail in 910 older adults. Two trials compared the ACE intramedullary nail with the Gamma nail in 185 older adults. Two trials compared the proximal femoral nail antirotation (PFNA) with the Gamma 3 nail in 200 older adults. The other nine trials were single comparisons of different types of nail designs.

Overall, the weak evidence available for all 12 comparisons showed no important differences in outcome (function, mobility, pain, death, fracture fixation complications and revision surgery) between the two nails or two nail designs under test. There was one possible exception. There was weak evidence from one trial of 215 older adults that the ENDOVIS nail resulted in poorer mobility (more people could not walk after their operation) when compared with the intramedullary hip screw (IMHS). However, more evidence is required to be confident of this result.

In conclusion, the available evidence is insufficient to determine whether there are important differences in outcome between different designs of intramedullary nails used for fixing extracapsular hip fractures. In terms of future research, we propose that priority is given to comparisons of intramedullary nails with another type of device in common use, the sliding hip screw.

BACKGROUND

Description of the condition

Hip fracture is the general term for fracture of the proximal (upper) femur. These fractures can be subdivided into intracapsular fractures (those occurring within or proximal to the attachment of the hip joint capsule to the femur) and extracapsular (those occurring outside or distal to the hip joint capsule). Extracapsular hip fractures are defined as those fractures that occur within the area of bone bounded by the attachment of the hip joint capsule and extending down to a level which is five centimetres below the distal (lower) border of the lesser trochanter. Other terms used to describe these fractures include trochanteric, subtrochanteric, pertrochanteric and intertrochanteric fractures. These terms reflect the proximity of these fractures to the greater and lesser trochanters, which are two bony protuberances (bulges) at the upper end of the femur outside the joint capsule.

Hip fractures occur predominantly in older people (aged over 65 years), especially women. The incidence of hip fracture varies considerably between different populations (Bjorgul 2007). An incidence of 1024 per 100,000 for women over 50, and 452 per 100,000 for men over 50 was reported for Norway between 1998 and 2003 (Bjorgul 2007). The relative proportion of extracapsular fractures also varies: 39% of hip fractures were extracapsular fractures in Bjorgul 2007 and 48% in Karagas 1996. A summary of the casemix for 61,508 hip fractures occurring between 1 April 2012 and 31 March 2013 in 180 hospitals in England, Wales and Northern Ireland is presented by an annual report of the National Hip Fracture Database (NHFD 2013). This shows that around three-quarters of hip fractures (73.2%) occurred in women, and over 90% of cases were aged over 70 years. In each of four years from 2009, around 40% of fractures were extracapsular.

Numerous subdivisions and classification methods exist for these fractures (e.g. the AO classification (Muller 1991)). The most practical classification, and that used for this review, is the basic division into four types: stable trochanteric fractures (AO classification type A1); unstable trochanteric fractures (AO classification type A2); fractures at the level of the lesser trochanter (transtrochanteric or AO classification type A3); and subtrochanteric fractures. Stable trochanteric fractures are two part fractures in which the fracture line runs obliquely (at an angle) between the lesser and greater trochanter of the femur. Unstable trochanteric fractures again have an oblique fracture line running between the trochanters, but in addition there is comminution (fragmentation) of the fracture site. The comminution fragments may be the lesser trochanter, greater trochanter or both trochanters. Transtrochanteric fractures, sited at the level of the lesser trochanter, have a slightly more distally located (lower) fracture line that either runs transversely (across the bone) at the level of the lesser trochanter or in an oblique direction that is opposite (or 'reverse') to that of the stable and unstable trochanteric fractures. Transtrochanteric fractures may be two part or comminuted. This fracture pattern is unstable as the femur is displaced medially (inwards) due to the pull of the adductor muscles. Subtrochanteric fractures are those fractures in which the fracture crossing the femur is predominately found within the five centimetres of bone immediately below the lesser trochanter. These fractures may be two part or comminuted, and in some instances the fracture may extend proximally into the trochanteric region or distally into the shaft of the femur.

Description of the intervention

Operative treatment of hip fractures was introduced in the 1950s using a variety of different implants. Implants may be either extramedullary or intramedullary in nature. The most commonly

used extramedullary implant is the sliding hip screw (SHS), which is synonymous with the term compression hip screw and equivalent models such as the Dynamic, Richards or Ambi hip screws. Intramedullary nails used for the internal fixation of extracapsular fractures can either be inserted from proximal to distal (cephalocondylic nails) or from distal to proximal (condylocephalic nails). Cephalocondylic nails are inserted through the greater trochanter of the femur and secured by a cross pin or screw, which is passed up the femoral neck into the femoral head. A number of different designs have been developed and marketed by different manufacturers. Examples include the Gamma nail (Stryker-Howmedica), the intramedullary hip screw (Smith and Nephew Richards), the proximal femoral nail (Synthes) and the ACE trochanteric nail (DePuy Orthopaedics). Table 1 presents further information of the nails to date examined by the included trials in this review.

Condylocephalic nails are inserted into the distal femur and passed up the intramedullary cavity across the fracture site and up into the femoral head. The best known and tested type of such nails is the Ender nail.

How the intervention might work

Successive updates of our Cochrane review (Parker 2010) comparing the Gamma and other cephalocondylic intramedullary nails with extramedullary implants for extracapsular hip fractures have consistently found that cephalocondylic nails incur the complications of intra-operative fracture, and later fracture around the implant. Based primarily on the higher rate of complications and re-operations of these nails for trochanteric fractures, we suggested that the SHS (an extramedullary implant) appears to be the better device for these fractures. We also suggested that "Further studies are required to determine if different types of intramedullary nail produce similar results, or if intramedullary nails have advantages for selected fracture types (for example, subtrochanteric fractures)."

Our Cochrane review of randomised trials comparing condylocephalic nails with extramedullary fixation (Parker 1998) concluded that the use of condylocephalic nails could not be recommended because of the markedly increased risk of fracture-healing complications and other problems associated with condylocephalic nails (in particular Ender nails).

Why it is important to do this review

Despite the evidence of poor performance of intramedullary nails in comparison with the SHS (an extramedullary implant), developments and modifications to intramedullary nails, especially cephalocondylic nails, continue. Additionally, the use of these nails is increasing (Anglen 2008). This systematic review of randomised trials examines studies that have compared different types, or modifications to the design, of intramedullary nails for extracapsular proximal femoral fractures. This is an update of a Cochrane review first published in Parker 2005 and last updated in Parker 2008.

OBJECTIVES

To assess the effects (benefits and harms) of different designs of intramedullary nails for treating extracapsular hip fractures in adults.

METHODS

Criteria for considering studies for this review

Types of studies

All randomised or quasi-randomised (for example, alternation) controlled trials comparing different types of intramedullary nails.

Types of participants

Skeletally mature patients with an extracapsular proximal femoral fracture. Given that one of the authors (MJP) has become aware of the growing use of intramedullary nails in intracapsular fractures, we note here that in a future update we will consider including trials with a mixed population of intracapsular and extracapsular proximal femoral fractures. We will, however, request separate data for the two fracture types.

Types of interventions

Surgical fixation of the fracture with either a cephalocondylic intramedullary nail (for example, the Gamma nail, the intramedullary hip screw (IMHS) and the proximal femoral nail (PFN)) or a condylocephalic nail (for example, the Ender nail). In setting out our comparisons we generally selected the older, more conventional, or static, or both, implant design as our control group. Before we undertake our next update, we will consider setting up comparisons addressing more general design concepts, such as long versus short nails.

Types of outcome measures

The primary focus is on long-term functional outcome, preferably measured at one year or more.

Primary outcomes

- Functional outcomes: preferably, validated patient-reported measures of lower limb or hip function (e.g. Oxford hip score; Western Ontario and McMaster Universities Arthritis Index (WOMAC)) and activities of daily living and health related quality of life scores (SF-36). Composite scores of subjectively and objectively rated function and overall outcome (e.g. Harris hip score, Merle D'Aubigne hip score).
- "Poor outcome", defined as death or deterioration of functional status leading to markedly increased dependency in the community or admission to institutional care.
- Serious adverse events and technical complications of fixation (e.g. deep infection, avascular necrosis, later fracture of the femur, non-union, cut-out, implant breakage) for which substantive treatment, such as revision surgery, is indicated or performed.

Secondary outcomes

- Mobility, use of walking aids, presence of a limp.
- Hip, lower limb pain (chronic).
- Medical complications: pneumonia; thromboembolism (symptomatic deep vein thrombosis or pulmonary embolism); pressure sore; urinary tract infection; delirium.
- Less serious local complications: intra-operative periprosthetic fracture; surgical site infection (superficial); wound haematoma; minor operation for removal of hardware.

Other outcomes

Data for the following outcomes were collected for completeness, but not presented as main results for this review.

- Operative details: length of surgery, operative blood loss, number of patients transfused, radiographic screening time.
- Functional impairment: range of motion, muscle strength.
- Anatomical restoration: leg shortening (preferably > 2 cm), varus deformity of the femoral neck, external rotation deformity (preferably > 20 degrees).

Economic outcomes

Each trial report was reviewed for costs and resource data, such as length of hospital stay and number of outpatient attendances, that would enable economic evaluation.

Search methods for identification of studies

Electronic searches

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (6 January 2014), the Cochrane Central Register of Controlled Trials (*The Cochrane Library* Issue 12, 2013), MEDLINE (1966 to November Week 3, 2013), MEDLINE In-Process & Other Non-Indexed Citations (3 January 2014) and EMBASE (1988 to 2014, Week 1). We searched the WHO International Clinical Trials Registry Platform (accessed January 2014) for ongoing and recently completed trials. We did not apply any language restrictions.

Previously, we searched the UK National Research Register (accessed June 2007, now archived) and Current Controlled Trials (accessed June 2007) for ongoing and recently completed trials.

Search strategies developed for *The Cochrane Library* (2007 onwards), MEDLINE (2007 onwards) and EMBASE (2007 onwards) are shown in Appendix 1. The subject specific MEDLINE search was combined with the sensitivity-maximizing version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials (Lefebvre 2011). Previous search strategies can be found in Appendix 2.

Searching other resources

We searched reference lists of articles and our own reference databases.

In our previous update, we included the findings from handsearches of the British Volume of the Journal of Bone and Joint Surgery supplements (1996 onwards) and abstracts of the OTA (Orthopaedic Trauma Association) annual meetings (1996 to 2006) and AAOS (American Academy of Orthopaedic Surgeons) annual meetings (2004 to 2007). We also included handsearch results from the final programmes of SICOT (Société Internationale de Chirurgie Orthopédique et de Traumatologie) (1996 and 1999) and SICOT/SIROT (Société Internationale de Recherche en Orthopédie et Traumatologie) (2003), EFORT (European Federation of National Associations of Orthopaedics and Traumatology) (2007) and the BOA (British Orthopaedic Association) Congress (2000, 2001, 2002, 2003, 2005 and 2006). We scrutinised weekly downloads of "Fracture" articles in new issues of 15 journals (Acta Orthopaedica Scandinavica; American Journal of Orthopedics; Archives of Orthopedic and Trauma Surgery; Clinical Journal of Sport Medicine; Clinical Orthopaedics; Foot and Ankle International; Injury; Journal of the American Academy of Orthopaedic Surgeons; Journal of Arthroplasty; Journal of Bone and Joint Surgery American volume; Journal of Bone and Joint Surgery British volume; Journal of Foot and Ankle Surgery; Journal of Orthopaedic Trauma; Journal of Trauma; Orthopedics) from AMEDEO.

Data collection and analysis

Selection of studies

Three review authors (JQ, EH and HH) independently screened search results and, after obtaining full reports, assessed potentially eligible trials for inclusion. The other review author (MJP) provided feedback on selection and notification of results from his ongoing scrutiny of the hip fracture literature. We did not mask the titles of journals, names of authors or supporting institutions at any stage.

Data extraction and management

Using a data extraction form, two review authors (JQ and EH) independently extracted data for the outcomes listed above and resolved any differences by discussion. Data entry by these two review authors was checked by a third author (HH). We contacted all trialists for additional data and clarification when necessary.

Assessment of risk of bias in included studies

At least two review authors (always JQ and EH) independently assessed risk of bias for all trials without masking of the source and authorship of the trial reports, including those that had been assessed in previous versions of the review. We piloted the assessment form on one trial. JQ checked between rater consistency in assessment at data entry, and this was subsequently checked by HH. We resolved all differences by discussion. We used the tool outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). This tool incorporates assessment of randomisation (sequence generation and allocation concealment), blinding (of participants and treatment providers, and outcome assessment), completeness of outcome data, selection of outcomes reported, and other sources of bias. We considered 'subjective' outcomes (e.g. functional outcome scores, pain) and 'objective' outcomes (mortality, complications) separately in our assessment of blinding (outcome assessment) and short-term (in hospital; up to four months) and longer-term (four months and above; post-hospital discharge) outcomes for completeness of outcome data. We assessed three additional sources of bias: bias resulting from major imbalances in key baseline characteristics (e.g. age, gender, type of fracture, prior mobility); performance bias, particularly 'differential expertise' bias resulting from lack of comparability in surgeon's expertise with the devices under test; and bias relating to a commercial conflict of interest.

Measures of treatment effect

For each study, we calculated risk ratios (RRs) with 95% confidence intervals (CIs) for dichotomous outcomes, and mean differences (MDs) with 95% CIs for continuous outcomes.

Unit of analysis issues

The unit of analysis was individual patients in these trials but we remained alert to other potential unit of analyses issues, such as the repeated observation from more than one time-point, and multiple observations for the same outcome (e.g. total adverse events).

Dealing with missing data

We contacted trial authors for missing data and information. Where reported, we used the numbers of participants reported as providing data for any particular outcome. In studies for which a number of events were reported, but the denominator was unclear, we used numbers randomised or alive at follow-up. We did not impute missing standard deviations (SDs) but derived these from standard errors, 95% CIs or exact P values, if these were presented instead.

Assessment of heterogeneity

We used both the Chi^2 statistic and I^2 test (Higgins 2003), as well as visual inspection, to determine whether heterogeneity was present and whether data pooling was appropriate.

Assessment of reporting biases

Should data for meta-analyses be available for 10 or more trials in a future update, we will consider the generation of funnel plots to explore the potential for publication bias.

Data synthesis

Where appropriate, we pooled results of comparable groups of trials using the fixed-effect model. We would have used the random-effects model to compare the results where there was substantial and unexplained heterogeneity.

Subgroup analysis and investigation of heterogeneity

No subgroup analyses were specified a priori in the protocol. For this update, we prespecified two subgroups (type of fracture - initially, intertrochanteric versus subtrochanteric - and gender) and indicated that we would test whether the subgroups were statistically significantly different from one another by inspecting the overlap of CIs and performing the test for subgroup differences available in Review Manager (RevMan 2014). However, we found there were insufficient data to conduct either subgroup analysis.

Sensitivity analysis

There were insufficient data to conduct our planned exploratory sensitivity analyses based on allocation concealment and on the reporting of surgical experience. Sensitivity analyses using numbers

randomised were done for any outcome for which denominators other than number randomised had been used, in order to assess any impact of missing data on results.

Quality assessment

We used the GRADE approach to assess the quality of evidence relating to the primary outcomes for the individual comparisons (Schünemann 2011).

RESULTS

Description of studies

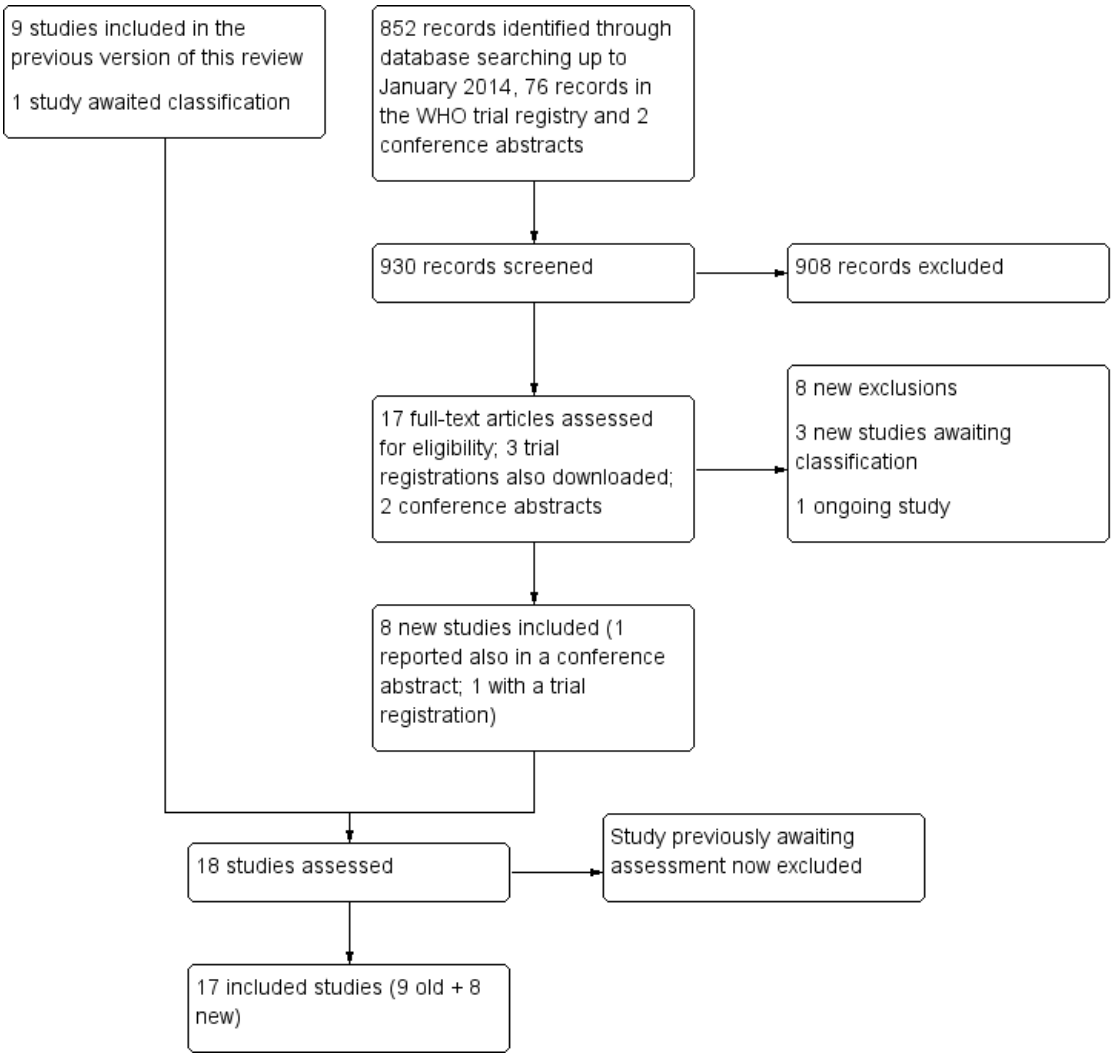
Results of the search

For this update (search completed January 2014), we screened a total of 852 records from the following databases: Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (20 records), Cochrane Central Register of Controlled Trials (276), MEDLINE (255) and EMBASE (301). We also screened further records for 76 trials from a search of the WHO International Clinical Trials Registry Platform conducted in January 2014, and obtained references for two abstracts in Journal of Bone and Joint Surgery (British Volume) supplements from one review author (MJP). The results from the previous searches (up to June 2007) are shown in Appendix 3. Upon assessment, we excluded Gahr 2003, which had been in 'Studies awaiting classification', because a full trial report has not been forthcoming of the currently inadequately reported quasi-randomised trial.

The search update resulted in the identification of 22 potentially eligible studies, which consisted of 17 full reports, three trial reports and two conference abstracts. Of the 17 fully reported trials, we included eight new trials (De Grave 2012; Makridis 2010; Okcu 2013; Vaquero 2012; Wild 2010; Xu 2010a; Zhang 2013; Zhu 2012), excluded seven others (Cao 2009; Dall'Oca 2010; Huang 2012; Ouyang 2010; Pan 2009; Xu 2010b; Yang 2011) and left two in 'Studies awaiting classification' pending further information (Park 2010; Stern 2011). Of the three potentially eligible studies identified from our search of the WHO International Clinical Trials Registry Platform, one trial (NCT00736684) was identified as having been published (Vaquero 2012), one is excluded (NTR1133) and one is ongoing (NCT01437176). One conference abstract also awaits classification (Mora 2011). (The other conference abstract was another report of Makridis 2010).

Figure 1 presents the study flow diagram for this review update. Overall, there are now 17 included trials (De Grave 2012; Efstathopoulos 2007; Fritz 1999; Hardy 2003; Herrera 2002; Makridis 2010; Marques 2005; Okcu 2013; Papasimos 2005; Schipper 2004; Starr 2006; Vaquero 2012; Vidyadhara 2007; Wild 2010; Xu 2010a; Zhang 2013; Zhu 2012), 12 excluded studies (Cao 2009; Dall'Oca 2010; Gahr 2003; Huang 2012; Merenyi 1995; NTR1133; Ouyang 2010; Pan 2009; Suckel 2006; Wagner 1998; Xu 2010b; Yang 2011), one ongoing trial (NCT01437176) and three studies awaiting classification (Mora 2011; Park 2010; Stern 2011).

Figure 1. Study flow diagram



Included studies

Sixteen included trials were reported in full in English language journals; a full translation from Spanish being obtained for Marques 2005. Thirteen were single centre trials based in seven different countries (Belgium: De Grave 2012; Hardy 2003; China: Xu 2010a; Zhu 2012; Germany: Fritz 1999; Wild 2010; Greece: Efstathopoulos 2007; Makridis 2010; Papasimos 2005; India: Vidyadhara 2007; Spain: Herrera 2002; Marques 2005; USA: Starr 2006). Four were multi-centre trials: Okcu 2013 and Zhang 2013 were two-centre trials based respectively in Turkey and China; Schipper 2004 was a multi-centre trial based in The Netherlands and Vaquero 2012 was a multi-centre trial carried out in Spain. Papasimos 2005 tested three implants: those patients allocated to the sliding hip screw (SHS) are included in a separate Cochrane review (Parker 2010). Fifteen trials had predominantly older populations, with mean ages ranging between 69 and 85 years. The two exceptions were Starr 2006, which only included adults under 50 years of age with high-energy fractures and Zhu 2012 which included adults under 60 years of age. Ten trials (Fritz 1999; Hardy 2003; Marques 2005; Schipper 2004; Okcu 2013; Papasimos 2005; Vaquero 2012; Vidyadhara 2007; Xu 2010a; Zhang 2013) included only patients with unstable trochanteric proximal femoral fractures, whereas a minority of patients in the other seven trials (De Grave 2012; Efstathopoulos 2007; Herrera 2002; Makridis 2010; Starr 2006; Wild 2010; Zhu 2012) had sta-

ble fractures. Further details of the 17 included studies are given in the Characteristics of included studies. The trials tested 12 different comparisons between various cephalocondylic nail designs (the nails are described in Table 1). There were no trials evaluating condylocephalic nails.

Proximal femoral nail (PFN) versus Gamma nail

The PFN was compared with the standard Gamma nail in 250 participants in Herrera 2002, in 156 participants in Marques 2005, in 80 participants in Papasimos 2005, and in 424 participants in Schipper 2004.

ACE trochanteric nail versus Gamma nail

The ACE trochanteric nail was compared with the trochanteric Gamma nail in 112 participants in Efstathopoulos 2007, and with the Gamma AP nail in 73 participants in Vidyadhara 2007.

ACE trochanteric nail versus Gamma 3 nail

The ACE trochanteric nail was compared with the Gamma 3 nail in 112 participants in De Grave 2012.

Gliding nail versus Gamma nail

One trial (Fritz 1999) involving 80 participants compared the gliding nail (where the lag screw of a Gamma nail is replaced with a double T-shaped blade) with the Gamma nail.

ENDOVIS nail versus intramedullary hip screw (IMHS)

One trial (Makridis 2010) involving 215 participants compared the ENDOVIS nail (contains two holes for cephalic screw insertion) and the IMHS nail.

Russell-Taylor recon nail versus long Gamma nail

One trial (Starr 2006) involving 34 participants compared the Russell-Taylor Recon nail with the long Gamma nail.

Proximal femoral nail antirotation (PFNA) versus Targon PF nail

One trial (Wild 2010) compared the PFNA (intramedullary device with a helical blade instead of a screw) with the Targon PF nail (a device that has an extra antirotation pin in the femoral neck) in 80 participants.

PFNA versus Gamma 3 nail

The PFNA nail was compared with the Gamma 3 nail in 136 participants in Xu 2010a and 64 participants in Vaquero 2012.

Dynamic versus static locked intramedullary hip screw (IMHS)

One trial (Hardy 2003) involving 81 participants compared a modified intramedullary hip screw (IMHS) featuring a single slotted hole that allowed dynamic locking of the nail versus the standard IMHS, which is locked distally with two screws.

Sliding versus non-sliding lag screw Gamma 3 nail

One trial (Zhu 2012) compared a sliding versus a non-sliding lag screw in 80 participants, all of whom were under 60 years of age, who were treated with a Gamma 3 nail.

InterTan nail versus PFNA II

One trial (Zhang 2013) involving 113 participants compared the InterTan nail with the PFNA II nail

Long versus standard PFNA nail

One trial (Okcu 2013) compared long versus standard (short) PFNA nails in 40 participants with reverse oblique type proximal femoral fractures.

Excluded studies

We excluded 12 studies for the reasons given in the Characteristics of excluded studies. Eight trials were either not randomised or very unlikely to be randomised trials. We excluded Xu 2010b because the population overlapped to an unknown extent with that of Xu 2010a. We excluded Yang 2011 because of concerns raised from similarities of this report with that of an earlier trial (Makridis 2010). We excluded NTR1133 because it seems very unlikely that this trial, if started, will be published. We excluded Dall'Oca 2010 as it did not compare two different nails but the same nail (Gamma nail), used with and without cement augmentation.

Risk of bias in included studies

The risk of bias assessments for the individual trials are shown in Figure 2 and as a composite for all trials in Figure 3.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

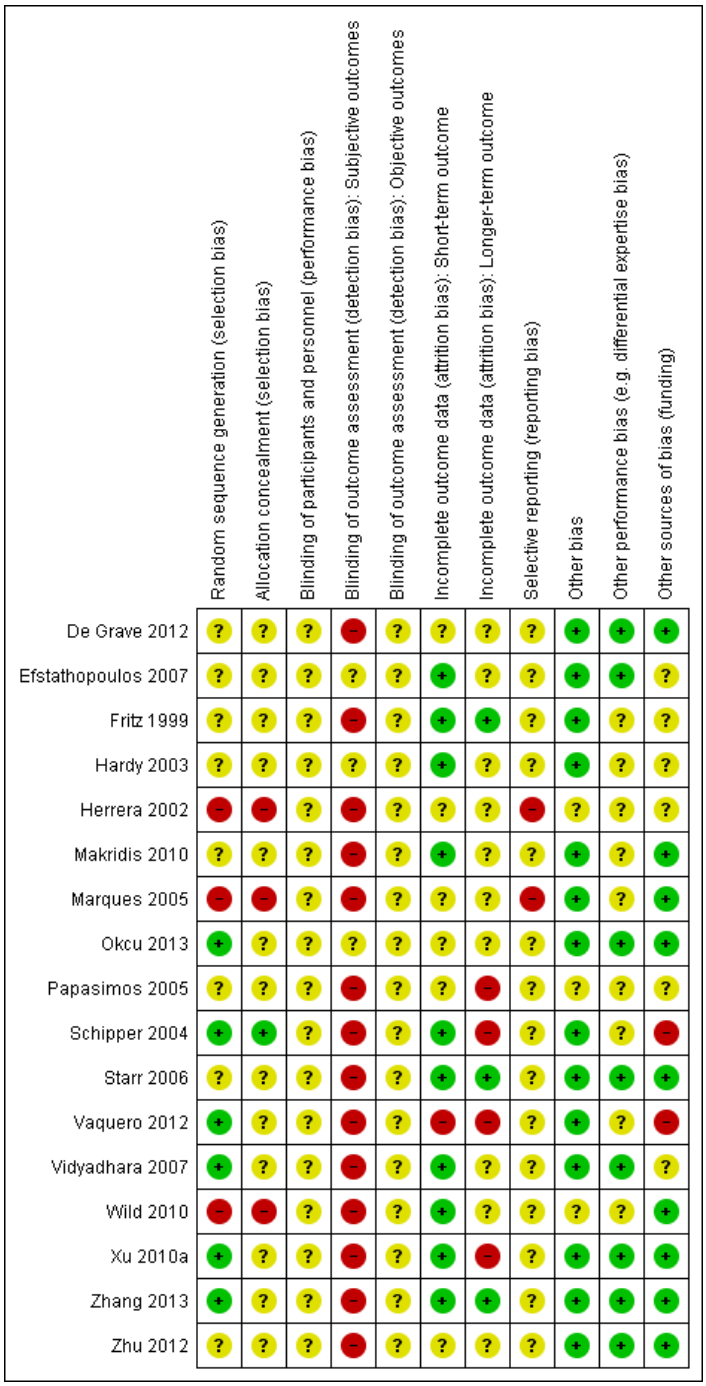
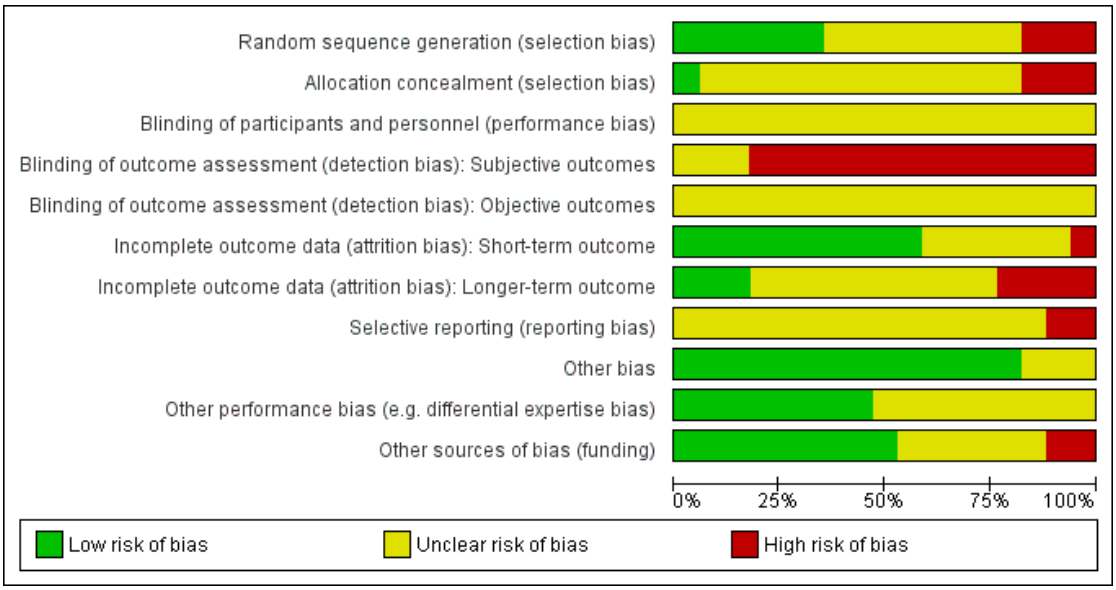


Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Allocation

All three quasi-randomised trials were deemed at high risk of selection bias in terms of sequence generation (allocation was based on odd and even record numbers in Herrera 2002 and Marques 2005; and on admission sequence in Wild 2010) and lack of allocation concealment.

Eight trials (De Grave 2012; Efstathopoulos 2007; Fritz 1999; Hardy 2003; Makridis 2010; Papasimos 2005; Starr 2006; Zhu 2012) did not specify their method of random sequence generation and were judged at unclear risk of bias for this domain. The remaining five trials (Okcu 2013; Vaquero 2012; Vidyadhara 2007; Xu 2010a; Zhang 2013) used a computer-generated random numbers table or list and were judged at low risk of bias.

Efstathopoulos 2007, Makridis 2010, Starr 2006, Vaquero 2012, Xu 2010a, Zhang 2013 and Zhu 2012 used sealed envelopes. These were reported to be numbered in Starr 2006, Xu 2010a and Zhang 2013. We judged these seven studies and the six studies not providing details of their method of randomisation (De Grave 2012; Fritz 1999; Hardy 2003; Okcu 2013; Papasimos 2005; Vidyadhara 2007) to be at unclear risk of bias for allocation concealment.

We only considered Schipper 2004, which used computer-generated randomisation (stratified by participating centre and balanced in blocks of four and six patients), and numbered and blinded envelopes, to be at low risk of bias for both domains.

Blinding

Blinding of the participants did not appear to have occurred in any of the trials. The surgeons could not be blinded. We judged all trials to be at unclear risk of performance bias relating to blinding. Complete assessor blinding does not appear to have occurred in any of the trials. Okcu 2013 had a blinded assessor for the mobility and Harris hip scores and so we judged this as unclear risk of bias for 'subjective' outcomes. We also judged Efstathopoulos 2007 (which did not report subjective outcomes) and Hardy 2003 (which included some cross-checking of results) at unclear risk of bias for subjective outcomes, whereas we judged the rest to be at high risk of detection bias for these outcomes. The final classification of complications was done using anonymised date in Vaquero 2012. We judged all studies to be at unclear risk of detection bias for objective outcomes.

Incomplete outcome data

We judged 10 trials to be at low risk of attrition bias for short-term outcome assessment; six were deemed to be at 'unclear risk', either because of lack of information on early losses (De Grave 2012; Herrera 2002; Marques 2005; Papasimos 2005) or because data were provided for survivors only (Okcu 2013) or people without complications (Zhu 2012). We judged Vaquero 2012 to be at high risk of short-term bias because of a 33% loss at three months, with only a quarter of these attributable to mortality.

We judged four trials (Fritz 1999; Starr 2006; Zhang 2013; Zhu 2012) to be at low risk of attrition bias for long-term outcome assessment; and four trials (Papasimos 2005; Schipper 2004; Vaquero 2012; Xu 2010a), at high risk. Of special note is that in Schipper 2004, follow-up was discontinued at four months for participants with complete radiological consolidation; this considerably reduced the number of participants available at one year follow-up. For Vaquero 2012, there was no explanation provided for the high attrition rate of 61% at long-term follow-up. We deemed the remaining nine trials to be at unclear risk of bias.

Selective reporting

Protocols were not available for any of these trials, which were judged to be at unclear risk of bias with the exception of Herrera 2002 and Marques 2005. We judged these two trials to be at high risk because several outcome measures mentioned in the methods sections were not presented in their results. Zhu 2012 excluded three cases with complications from the final analysis for unspecified reasons.

Other potential sources of bias

Baseline characteristics

The baseline characteristics of the intervention groups were well matched in the majority of studies. We judged three trials to be at unclear risk of bias relating to this item: data for age and gender were not presented in Herrera 2002; group allocation and baseline data were missing for 21 participants not available at follow-up in Papasimos 2005 and baseline mobility status was not documented in Wild 2010.

Performance bias relating to surgeon expertise and care programmes

Eight trials were judged at low risk of performance bias (De Grave 2012; Efstathopoulos 2007; Okcu 2013; Starr 2006; Vidyadhara 2007; Xu 2010a; Zhang 2013; Zhu 2012) as the surgeons were reported as being experienced in the interventions under test and care programmes were comparable in the two groups. The remaining trials were all judged as being at unclear risk of bias. Of particular note is that both Marques 2005 and Hardy 2003 had a higher number of junior surgeons performing the surgery in one group and Papasimos 2005 reported that the four surgeons involved had less experience with the PFN. There was a lack of information to judge whether post-operative care was the same for both groups in Fritz 1999 and Wild 2010.

Funding source or conflict of interest

We judged the nine trials that explicitly indicated there was no conflict of interest to be at low risk of bias and that six provided no information at unclear risk. Schipper 2004 and Vaquero 2012 were judged to be at high risk reflecting the financial support received from the manufacturer of one of the implants in their respective trials.

Effects of interventions

In the following we have presented the outcomes in five categories, starting with 'Final outcome measures'. Appendix 4 shows the relationship between the outcomes listed in Types of outcome measures and these categories.

Proximal femoral nail (PFN) versus Gamma nail

Four trials (Herrera 2002; Marques 2005; Papasimos 2005; Schipper 2004) compared the PFN with the standard Gamma nail in a total of 910 participants. All participants had unstable fractures other than 32 participants with stable fractures in Herrera 2002. Aside from Herrera 2002, which included 13 patients with "neoplasia", pathological fractures were excluded.

Final outcome measures

There was no statistically significant difference between the two groups in mortality at 12 months for the three trials that provided data (86/415 versus 80/415; risk ratio (RR) 1.08; 95% confidence interval (CI) 0.82 to 1.41; *see* Analysis 1.1). Papasimos 2005 excluded from their analyses the data from the 10 people who had died by one year follow up.

The few functional outcome data that could be presented are shown in Analysis 1.2 and Analysis 1.3. Data from Herrera 2002 showed no statistically significant difference between the two groups in the failure to recover pre-fracture walking ability (RR 1.03; 95% CI 0.80 to 1.33). Pain in the thigh at follow-up was reported as being statistically significantly less in the PFN group in Marques 2005 (4.7% versus 27.3%; reported P = 0.004) but this difference was not apparent when the actual numbers of participants with pain were obtained from the trialist (*see* Analysis 1.2). Marques 2005 reported there was no statistically significant difference between the two groups in the final independent mobility scores. Papasimos 2005 reported there was no significant difference between the two groups in the return to pre-fracture level of ambulation and independence. The Harris hip scores at four weeks, six months and one year reported in Schipper 2004

showed no statistically significant difference between groups (*see* Analysis 1.3); however, this was for a subgroup of patients at each time point and thus may not be representative of the outcome for the population of survivors.

Fracture fixation complications

Operative details as presented by each study are summarised in Analysis 1.4. None of the differences between the two groups in the various aspects and intra-operative complications of fracture fixation was statistically significant other than an increased risk of greater trochanteric fractures, or intra-operative comminution of the fracture around the trochanteric region, for those treated with the Gamma nail (*see* Analysis 1.4.6, 6/165 versus 20/165; RR 0.30, 95% CI 0.12 to 0.73). Herrera 2002 did not reveal the surgical consequences of these fractures; both cases in Papasimos 2005 were treated conservatively. The difference between the two groups in the more important outcome of operative fracture of the femur was not statistically significant (*see* Analysis 1.4.7, 1/455 versus 5/455; RR 0.33, 95% CI 0.07 to 1.63). Marques 2005 attributed all three intra-operative femoral fractures to bad surgical technique. The operative fracture in the Gamma nail group of Papasimos 2005 was managed conservatively. In Schipper 2004, both operative fractures of the femur, featuring a subtrochanteric extension, occurred in the Gamma nail group.

Analysis 1.5 presents the fracture healing complications as reported by each study. None of the differences in outcomes between the two implants in the pooled data from three or four studies was statistically significant. The tendency to a higher rate of secondary varus, reflecting a loss of reduction, in Herrera 2002 was stated as not being linked with subsequent clinical problems. The most common fracture healing complication was cut-out of the implant (17/455 versus 24/455; RR 0.71, 95% CI 0.39 to 1.30). It should be noted that in Schipper 2004, participants whose fractures were judged to be healed at four months had no further radiological follow-up. There was no significant difference in the incidence of local complications, which included cut-out, infection, haematoma, migration of hip screws, malrotation, shaft fracture and nail fatigue, at four months in Schipper 2004 (45/211 versus 47/213); and similarly at 12 months (51/211 versus 50/213).

Pooled data from all four trials for re-operation showed no statistically significant difference between the two groups (*see* Analysis 1.6, 45/455 versus 36/455; RR 1.25, 95% CI 0.83 to 1.90). There were no significant differences between the two implants in any of the reported wound complications (*see* Analysis 1.7).

Post-operative complications and hospital stay

None of the differences between the two implant groups in specific post-operative complications were statistically significant in Herrera 2002, Marques 2005 or Papasimos 2005 (*see* Analysis 1.8). Schipper 2004 reported no difference between groups in medical complications that had occurred by one year follow up.

Herrera 2002 reported that trial participants remained in hospital for an average of 14.1 days. The mean length of stay in hospital was nearly a week longer in Schipper 2004; there being no significant difference between the two groups (*see* Analysis 1.9). Similarly, the difference between the two groups in the mean hospital stays were reported to be not statistically significant for both Marques 2005 (11.1 days for the PFN group versus 12.2 days for the Gamma nail group) and Papasimos 2005 (8.6 days versus 8.8 days).

Anatomical restoration

These outcomes were not reported in any of the trials. However, two participants of the PFN group and one of the Gamma nail group had re-operations for "rotational defect of the leg" in Herrera 2002.

Operative details

The mean length of surgery of the PFN group reported as being significantly shorter in Herrera 2002 (49 versus 68 minutes), whereas it was reported to be significantly longer in Papasimos 2005 (71 versus 51 minutes). The mean length of surgery was 60 minutes in both groups of Schipper 2004. Marques 2005 reported the difference between the two groups in the median length of surgery (45 versus 40 minutes) was not statistically significant.

Schipper 2004 found intra-operative blood loss was statistically significantly lower in the PFN group (mean difference (MD) -67.00 mL, 95% CI -111.40 to -22.60 mL: *see* Analysis 1.10). Papasimos 2005 found the difference between the two groups in mean operative blood loss (265 mL versus 250 mL) was not statistically significant. Though significantly more participants in the PFN group of Herrera 2002 received blood transfusion, the converse was true for Marques 2005 (*see* Analysis 1.11). These results were not pooled since visual inspection of the transfusion results from the two trials shows substantial heterogeneity (I^2 = 88.9% when pooled).

Neither trial reporting radiographic screening time found a statistically significant difference in this outcome between the two groups: for Marques 2005, the median times were 100 versus 120 seconds; for Papasimos 2005, the mean times were 0.26 minutes in both groups.

ACE trochanteric nail versus Gamma nail

Two trials (Efstathopoulos 2007; Vidyadhara 2007) made this comparison although with some variations in the intervention. Efstathopoulos 2007 compared the ACE nail used with one proximal screw versus the trochanteric Gamma nail in 112 people, 82% of whom had unstable fractures. In Vidyadhara 2007, the ACE nail had two proximal screws and was compared with the AP

(Asian/pacific) Gamma nail in 73 people with unstable fractures. Neither study included subtrochanteric fractures.

Final outcome measures

There was no difference between the two groups in mortality (*see* Analysis 2.1). Vidyadhara 2007 found no statistically significant differences between the two groups in hip pain at one month after injury, or the presence of a limp or difficulty in squatting at two years (*see* Analysis 2.2). Efstathopoulos 2007 found no difference between the two groups in mobility scores at follow-up (*see* Analysis 2.3). Although the Harris hip scores at four months, one year and two years were significantly different in the two groups of Vidyadhara 2007, the very small differences were clinically insignificant (*see* Analysis 2.4).

Fracture fixation complications

There were no fracture healing complications reported in Efstathopoulos 2007 and only one in Vidyadhara 2007 (*see* Analysis 2.5). This was a cut-out in the Gamma nail group that was treated by removal of the implant followed by bed rest for three months. Vidyadhara 2007 reported no wound infection whilst Efstathopoulos 2007 reported four cases of superficial wound infection in the ACE nail group versus three in the Gamma nail group (*see* Analysis 2.6).

Post-operative complications and hospital stay

There were no significant differences between the two groups in the limited data provided for post-operative complications (*see* Analysis 2.7). Efstathopoulos 2007 reported similar mean lengths of hospital stay for the two groups (7.2 versus 7.0 days; reported as not significant).

Anatomical restoration

Three people had limb shortening in Vidyadhara 2007, with no significant differences between the two groups (*see* Analysis 2.8).

Operative details

Efstathopoulos 2007 reported no difference in the mean length of surgery between groups (*see* Analysis 2.9). Vidyadhara 2007 reported a higher median length of surgery for the ACE nail (43 versus 32 minutes). The statistically significantly greater blood loss found in Vidyadhara 2007 for the ACE nail is clinically minor (*see* Analysis 2.9: mean difference 13 mL; 95% CI 6.78 to 19.22). Efstathopoulos 2007 found no statistically significant differences in the units of blood transfused, number of patients transfused or the radiographic screening time (*see* Analysis 2.9 and Analysis 2.10).

ACE trochanteric nail versus Gamma 3 nail

One trial (De Grave 2012), with 112 participants with stable or unstable trochanteric fractures, compared the ACE trochanteric nail versus the Gamma 3 nail. The numbers of participants available at each follow-up was not provided.

Final outcome measures

De Grave 2012 reported no statistically significant differences between the two groups at fracture consolidation (between three and 12 months post-operatively) in the mean Merle d'Aubigne scores for pain, walking function, mobility or overall (0 to 18: best outcome) between the two groups (14.12 (SD 2.95) versus 14.19 (SD 2.86); reported P = 0.92). Walking ability was restored in 83% of participants in the ACE group and in 80% of the Gamma 3 group. There was no significant difference between the two groups in mortality at one year (12/51 versus 14/61; RR 1.03, 95% CI 0.52 to 2.01; *see* Analysis 3.1).

Fracture fixation complications

There were no statistically significant differences between the two groups for these outcomes which included fixation failure, non-union, wound infection and re-operation (*see* Analysis 3.2). There were no intra-operative complications. Two people in each group underwent another operative procedure, each receiving a hip arthroplasty, because of either cut-out or secondary displacement of their fracture. There was no wound infection or non-union.

Post-operative complications and hospital stay

No trial participant had a deep vein thrombosis. The only recorded complication was a peripheral nerve injury that resulted in foot drop in one participant of the Gamma 3 nail group (*see* Analysis 3.3).

Anatomical restoration

These outcomes were not reported.

Operative details

De Grave 2012 reported that the mean operative time was 51 minutes in the ACE group and 41 minutes in the Gamma 3 nail group.

Gliding nail versus Gamma nail

Fritz 1999 compared the gliding nail (a modification of the Gamma nail) with a standard Gamma nail. There were 40 participants, all with an unstable trochanteric fracture, in each group.

Final outcome measures

No statistically significant difference was found between the two groups for mortality (*see* Analysis 4.1), for residence of survivors in a geriatric institution (*see* Analysis 4.2) or overall unfavourable outcome, defined as residence in a geriatric institution or dead, at six months. Fritz 1999 reported there were no statistically significant differences between the two groups in the Merle d'Aubigne scores for pain, walking function, mobility or overall.

Fracture fixation complications

There were no statistically significant differences between the two groups for these outcomes (*see* Analysis 4.3). There was one intra-operative complication (a minor shaft fracture) in the gliding nail group and seven intra-operative complications (six were due to failed placement of the second locking screw) in the Gamma nail group. One woman in the gliding nail group fell during mobilisation, fracturing her femur shaft. Cut-out of the implant occurred in three cases in the standard nail group. Re-operations (three versus four) resulted from these two complications, as well as from wound infection and a haematoma.

Post-operative complications and hospital stay

There were no statistically significant differences between the two groups in those with any post-operative medical complication or for specific complications as presented in Analysis 4.4. Fritz 1999 reported there was no statistically significant difference between the two groups in the mean hospital stay (9.2 versus 10.4 days).

Anatomical restoration

There were no statistically significant differences between the two groups in those with leg shortening or rotational deformity (*see* Analysis 4.5).

Operative details

Fritz 1999 reported there were no statistically significant differences between the two groups for length of surgery (mean duration: 63 versus 62 minutes) or operative blood loss (mean loss: 338 mL versus 296 mL).

ENDOVIS nail versus intramedullary hip screw (IMHS)

Makridis 2010 compared the Endovis nail versus the IMHS nail in 215 participants with either stable or unstable pertrochanteric fractures.

Final outcome measures

More participants in the ENDOVIS nail group were bedridden, and thus unable to walk, after their operation (29/105 versus 18/110; RR 1.69, 95% CI 1.00 to 2.85; *see* Analysis 5.1). The post-operative Parker-Palmer mobility scores also reflected poorer mobility after ENDOVIS nails (mean scores 4.7 versus 6.4; 9 = fully mobile); the difference between the two groups was reported to be statistically significant ($P < 0.05$). There was no difference between the two groups in mortality, either in hospital (3/105 versus 2/110; RR 1.57, 95% CI 0.27 to 9.22) or at one year (16/105 versus 15/110; RR 0.99; 95% CI 0.53 to 1.85); *see* Analysis 5.2.

Fracture fixation complications

The majority of these complications occurred in the ENDOVIS group. None of the differences between the two groups for the more serious complications were statistically significant (*see* Analysis 5.3); these include cut-out (3/105 versus 1/110), later femoral shaft fracture (0/105 versus 1/110), intra-operative femoral shaft fracture (0/105 versus 1/110); Z-phenomena (2/105 versus 0/110) and nail breakage (1/105 versus 1/110). The operative fracture was successfully treated with circular wires. Overall, there were five re-operations in the ENDOVIS group (three for cut-out, one for a Z-phenomenon and one for a reverse Z-phenomenon) versus two re-operations in the IMHS group (one for cut-out, one for periprosthetic femoral shaft fracture): RR 2.62, 95% CI 0.52 to 13.21. Similar rates (two in each group) of infection were seen in both groups; all were superficial wound infections successfully treated by intravenous antibiotics.

Post-operative complications and hospital stay

Post-operative medical complications were not assessed.

Anatomical restoration

Anatomical restoration outcomes were not assessed. However, shortening was reported for five patients in the ENDOVIS nail group who had medial displacement of the femur shaft.

Operative details

The mean operative times were similar in both groups (24.8 minutes versus 25.4 minutes). There were no significant differences reported between the groups regarding blood loss, haemoglobin levels or numbers of patients receiving transfusion (28/105 versus 29/105; (RR 1.01, 95% CI 0.65 to 1.58; *see* Analysis 5.4).

Russell-Taylor Recon nail versus long Gamma nail

Starr 2006 compared the Russell-Taylor Recon nail with the long Gamma nail in 34 people, aged between 19 and 50 years, with

high energy extracapsular hip fracture. Five trial participants had stable and 21 unstable trochanteric fractures, and the other eight had subtrochanteric fractures. Three patients had open fractures and 17 had concurrent surgery for other injuries.

Final outcome measures

No deaths occurred within the one year follow-up period. Starr 2006 found no statistically significant differences between the two groups in the numbers of participants who were unable to walk independently or unable to return to the same work (*see* Analysis 6.1). The person who was unable to walk had sustained a spinal cord injury at the time of her initial trauma. Similarly, there were no statistically significant differences between the two groups in the range of hip or knee movements. The Harris hip scores were similar for the two groups (mean scores: 86 versus 84; reported P = 0.60).

Fracture fixation complications

There were no fracture fixation complications reported (*see* Analysis 6.2). One patient in the long Gamma nail group had wound debridement for sepsis and a further 12 patients had elective removal of their implants for persistent pain (*see* Analysis 6.2).

Post-operative complications and hospital stay

These outcomes were not reported in Starr 2006.

Anatomical restoration

These outcomes were not reported in Starr 2006.

Operative details

Starr 2006 reported there were no statistically significant differences between the two groups for length of surgery (mean duration: 106 versus 88 minutes; reported P = 0.26) or operative blood loss (mean loss: 328 versus 282 mL; reported P = 0.15).

PFNA versus Targon PF nail

Wild 2010 compared the PFNA with the Targon PF nail (a device that has an extra antirotation pin) in 80 patients with a pertrochanteric femoral fracture.

Final outcome measures

There were no perioperative deaths. Overall, 18 patients died in the first post-operative year but their group allocation was not reported. Wild 2010 found no difference between the two groups in the modified Harris hip score (0 to 100: best outcome) at one year: mean 78.5 versus 78.1; reported P = 0.83). There were also no significant differences in the range of motion measures between the two groups.

Fracture fixation complications

There were no statistically significant differences between the two groups for these outcomes, which included cut-out (three versus two), periprosthetic fracture (one versus zero); fracture non-union (zero versus one), implant breakage (zero versus zero) and superficial wound infection (four versus two): *see* Analysis 7.1. Two cut-outs in the PFNA group required a re-operation as there was irritation of the iliotibial band/tract. Revision surgery was implied for all six cases of wound infection but we suspect this was a typographical error in the report given the infections were all superficial. The sequelae of the periprosthetic fracture were not recorded.

Post-operative complications and hospital stay

These outcomes were not reported.

Anatomical restoration

These outcomes were not reported.

Operative details

Duration of operation (66.2 minutes versus 84.7 minutes; reported P < 0.01) and fluoroscopy (103.6 sec versus 164.5 sec; reported P < 0.01) were significantly shorter in the PFNA group.

PFNA versus Gamma 3 nail

Two trials (Vaquero 2012; Xu 2010a) compared the PFNA nail with the Gamma 3 nail in 200 participants with unstable proximal femoral fractures.

Final outcome measures

Separate group data were not reported for the 43/136 participants in Xu 2010a who were not available at final follow-up (17.68 months, range 12 to 27 months). Of these, three participants died in the immediate post-operative period and a further 12 participants died before the final follow-up. Twenty-one participants were too ill to attend and seven were lost to follow-up in terms of functional outcomes. Thirty-five participants (55%) were lost to follow-up at 12 months in Vaquero 2012. All four recorded deaths that had occurred by 12 months in Vaquero 2012 were in the PFNA group (4/31 versus 0/30; RR 8.72, 95% CI 0.49 to 155.27; *see* Analysis 8.1). There were no significant differences found in a variety of functional scores and return to mobility assessment. Vaquero 2012 found no significant difference between the groups in the Harris Hip Score at six and 12 months (65.1 versus 72.6; MD 7.50, 95% CI -12.19 to 27.19; *see* Analysis 8.2). Similarly,

Xu 2010a found no statistically significant differences between the two groups in mobility scores (0 to 9: best score; 6.30 versus 6.10; MD 0.20, 95% CI -0.51 to 0.91, *see* Analysis 8.3) and similar proportions of participants in each group recovered their pre-operative weight bearing ability (29/46 versus 32/47, RR 0.93, 95% CI 0.69 to 1.24 *see* Analysis 8.4). Vaquero 2012 found no significant difference between the two groups at six or 12 months in the SF-36 Physical and Mental Health Scores (*see* Analysis 8.5 and Analysis 8.6), or the Katz ADL scores (0 to 6, higher score meaning best function) (4 versus 3.6, *see* Analysis 8.7) at 12 months. Xu 2010a found no difference between the two groups in mean hip flexion (98.3 versus 94.9 degrees, *see* Analysis 8.8). Slightly more participants in the PFNA had hip and thigh pain in Xu 2010a but this difference was not statistically significant (19/46 versus 11/47; RR 1.76, 95% CI 0.95 to 3.29, *see* Analysis 8.10). Vaquero 2012 used a numeric pain score (0 to 10, higher score meaning worse pain) to assess thigh pain and found no significant difference between the groups at 12 months follow-up (mean score 1 versus 1.5, MD -0.50, 95% CI -1.80, 0.80, *see* Analysis 8.9).

Fracture fixation complications

None of the differences between the two groups in specific fracture fixation complications were statistically significant; *see* Analysis 8.11. Xu 2010a reported no significant difference in intra-operative femoral shaft fractures (2/66 versus 1/70), all of which were treated with delayed weight bearing for six to eight weeks. One (1/97) femoral shaft fracture occurred in the PFNA group one month post-operatively and was treated with plate osteosynthesis; this was the only reported re-operation in Xu 2010a. One post-operative femoral (1/100) shaft fracture occurred in the Gamma 3 group and was treated with a secondary procedure, the exact details of which were not given. There were no significant differences between the groups in blade/screw cut-out (2/97 versus 0/100, RR 4.84, 95% CI 0.24 to 96.89, *see* Analysis 8.11) or non-union rates (2/30 versus 3/31). The two cases of cut-out reported occurred in the PFNA group and were treated with a secondary procedure. There were no significant differences between the groups in superficial wound infection (2/66 versus 1/70), wound haematoma (5/66 versus 6/70) or deep wound infection (2/31 versus 0/30). There was no significant difference in proximal screw migration in Xu 2010a who reported nine cases of proximal screw migration (6/66 versus 3/70), all of which were treated conservatively. The mean time to fracture healing was similar in the two groups of this trial (9.65 weeks versus 10.21 weeks; reported P = 0.183).

Post-operative complications and hospital stay

Vaquero 2012 reported that 16 participants in each group had a "general" complication, which mainly related to the need for transfusion. There were similar numbers in the two groups of patients with post-operative medical complications of chest infection, decubitus ulcers and urinary tract infection in Xu 2010a (*see* Analysis 8.12). In Vaquero 2012, the mean Sangha scores (questionnaire based co-morbidity score; 1 to 6, higher score equals more comorbidity) were not significantly different at 12 months follow-up (mean 4.6 versus 4.5, *see* Analysis 8.13). There was no significant difference between the two groups in length of hospital stay (*see* Analysis 8.14).

Anatomical restoration

No significant difference in the amount of femoral shortening was observed between the two groups at final follow-up in Xu 2010a (5.30 mm versus 5.49 mm; MD -0.19 mm, 95% CI -1.23 to 0.85; *see* Analysis 8.15).

Operative details

There was no significant difference between the groups in operating time (two trials, MD -3.03 minutes, 95% CI -6.88 to 0.82 minutes; *see* Analysis 8.16); notably surgery took between 27 to 33 minutes longer in Xu 2010a. There was no significant difference in fluoroscopy time (2.7 versus 3.2 minutes; MD -0.50 minutes, 95% CI -0.88 to -0.12; *see* Analysis 8.16). Intra-operative blood loss was significantly lower in the PFNA group (217.4 mL versus 272.7 mL; MD -55.30, 95% CI -94.70 to -15.90; *see* Analysis 8.16) in Xu 2010a. However, there was no significant difference between the two groups in the number of participants transfused (24/66 versus 31/70; RR 0.82, 95% CI 0.54 to 1.24; *see* Analysis 8.17) nor in the mean number of units transfused (1.95 versus 2.03 units) in this trial.

Dynamic versus static locked intramedullary hip screw

Hardy 2003 compared a dynamically locked intramedullary hip screw (IMHS), which was allocated to 42 patients, with the usual statically locked IMHS allocated to 39 patients.

Final outcome measures

No statistically significant difference was found between the two groups for mortality (*see* Analysis 9.1). Pain in the mid-thigh region was reported at follow-up for two participants of the dynamic group and six in the static group (*see* Analysis 9.2). The pain impaired walking in four of the latter group. All six participants reporting mid-thigh pain in the static group had cortical hypertrophy. The other instance of cortical hypertrophy occurred in a participant of the dynamic group who did not report mid-thigh pain. Hardy 2003 reported similar results in the two groups for accommodation, mobility scores and independence rating of survivors at one year.

Fracture fixation complications

There were no statistically significant differences between the two groups for these outcomes (*see* Analysis 9.3). Cut-out of the implant occurred in one case in the dynamic group and a fracture below the tip in one case in the static group. Re-operations (one versus three) resulted from these two complications as well as from two operations for hardware removal in the static group.

Post-operative complications and hospital stay

Medical complications and length of hospital stay were not reported in Hardy 2003. Though there were some discrepancies between text and tables in the trial report for discharge destination and in-hospital deaths, there was clearly no difference between the two groups in these outcomes.

Anatomical restoration

Incomplete data for leg shortening (*see* Analysis 9.4) showed no statistically significant difference between the two groups (subsidence of the nail in the femoral shaft was seen in nine participants of the dynamic group compared with none in the static group). No information on deformity was presented in Hardy 2003.

Operative details

There were no statistically significant differences between the two groups for length of surgery, operative blood loss, haemoglobin levels or transfusion requirements (*see* Analysis 9.5).

Sliding versus non-sliding Gamma 3 nail

Zhu 2012 compared a sliding versus a non-sliding lag screw in the Gamma 3 nail in 80 participants with intertrochanteric fractures. Separate data for some outcomes were presented by subgroups based on the AO fracture classification with group A being participants with the most stable fractures (AO 31A1.1, 1.2 and 1.3 fractures), group B being participants with less stable fractures (AO 31A2.1) and group C being participants with the least stable fractures (AO 31A2.2 and 2.3).

Final outcome measures

There was no statistical or clinically significant difference between the sliding and non-sliding groups in their Harris hip scores (MD -1.27, 95% CI -4.98 to 2.43; *see* Analysis 10.1).

Fracture fixation complications

Although all four reported complications occurred in the non-sliding group, the differences between the two groups for these outcomes, which were non-union (0/40 versus 1/40), cut-out (0/40 versus 1/40) and femoral shaft fracture (0/40 versus 2/40), were not statistically significant (*see* Analysis 10.2). There was also no significant difference between the two intervention groups in time to fracture healing (MD -0.06 months, 95% CI -0.55 to 0.43 months; *see* Analysis 10.3).

Post-operative complications and hospital stay

There was no between-group difference in the length of hospital stay (*see* Analysis 10.5), which was four days in each group. Post-operative complications other than fracture fixation complications were not reported.

Anatomical restoration

Although in the 41 participants with unstable comminuted intertrochanteric fractures (Group C, AO 31A2.2 and A2.3 fractures) a significant difference in leg length was reported (*see* Analysis 10.6, 0.573 mm versus 0.955 mm; MD 0.38 mm, 95% CI 0.37 to 40 mm), this is not a clinically significant leg length discrepancy. No other anatomical parameters were reported.

Operative details

There were no significant differences between the two groups in the operation time (46.73 min versus 48.35 min) or intra-operative blood loss (141.1 mL versus 138.5 mL); *see* Analysis 10.4). No participants received a blood transfusion.

InterTan nail versus PFNA II nail

Zhang 2013 compared the InterTan nail with the PFNA II nail in 113 participants with unstable intertrochanteric fractures.

Final outcome measures

Of the 113 participants in the study, 15 died within 12 months and five were lost to follow-up due to illness.There was no difference in mortality at 12 months after the procedure (8/57 versus 7/56; RR 1.12, 95% CI 0.44 to 2.89, *see* Analysis 11.1). For the 93 participants followed-up for one year or longer, there were no significant differences between the groups in their Harris hip scores (mean 80.2 versus 82.6, MD -2.40, 95% CI -7.50 to 2.70) or walking ability scores (mean 5.8 versus 6.1; MD -0.30, 95% CI -1.03 to 0.43; *see* Analysis 11.2). There was no difference between the groups in the number of participants complaining of hip pain at final follow-up (2/47 versus 2/46). However, significantly fewer participants in the InterTan nail group had thigh pain (3/47 versus 12/46; RR: 0.24, 95% CI 0.07 to 0.81; *see* Analysis 11.3).

Fracture fixation complications

There were no significant differences between the two groups for outcomes such as cut-out (2/47 versus 0/46), intra-operative femoral shaft fracture (1/57 versus 2/56) or later femoral shaft fracture (0/47 versus 1/46), blade migration (0/47 versus 4/46), problems with distal locking or prominence of the nail proximally in the greater trochanter (*see* Analysis 11.4). A similar finding applied to re-operation, the reasons for the five re-operations were not detailed in the report (2/47 versus 3/46). There was a significant difference in time to fracture healing, with fractures healing quicker in the InterTan group (14 versus 17 weeks; MD -3.0, 95% CI -4.88 to -1.12 weeks; *see* Analysis 11.5).

Post-operative complications and hospital stay

There was no difference between the groups in the occurrence of superficial (3/47 versus 2/46) or deep (2/47 versus 1/46) wound infection, deep vein thrombosis, pulmonary embolism, pressure sores or urinary tract infection (*see* Analysis 11.6). There was no significant difference in the length of hospital stay (mean 8.33 versus 8.03 days; *see* Analysis 11.7).

Anatomical restoration

These outcomes were not reported. (While results for femoral neck shortening were reported, the clinical significance of these is unclear given that the results in both groups were less than the 5 mm of shortening required to affect abductor function (Zlowodzki 2008)).

Operative details

Zhang 2013 found that the length of surgery was longer in the InterTan nail group (mean 66.5 versus 53.7 minutes; MD 12.80 min, 95% CI 7.87 to 17.73 minutes) as was the fluoroscopy time, which took 1.5 minutes longer on average (*see* Analysis 11.8). While the intra-operative blood losses were also greater in this group, the between-group difference was not significant (mean 235.5 mL versus 197.5 mL; MD 37.80 mL, 95% CI -4.12 to 79.72 mL).

Long versus standard PFNA nail

Okcu 2013 compared long versus standard PFNA nails in 40 participants with reverse oblique fractures. Aside from mortality, the results were presented for the 33 survivors at a minimum of one year follow-up.

Final outcome measures

There was no significant difference in mortality at one year between the two groups (34/22 versus 4/22; RR 1.09, 95% CI 0.28 to 4.26; *see* Analysis 12.1). Similarly there was no significant difference at one year between the two groups in the reported functional outcomes, namely the Harris hip score (0 to 100; top score equals best outcome): 79 versus 74; MD 5.00, 95% CI -1.14 to 11.14; and the Parker and Palmer mobility score (0 to 9; top score equals best outcome): 5.5 versus 5.2; MD 0.30, 95% CI -0.94 to 1.54); *see* Analysis 12.2.

Fracture fixation complications

There were no statistically significant differences between the two groups for re-operation or other outcomes in this category (*see* Analysis 12.3). Both re-operations were in the long nail group, separately these were for blade cut-out and deep infection. There were no cases of non-union in either group. There was one case of superficial wound infection in the standard nail group.

Post-operative complications and hospital stay

There was no significant difference in the length of hospital stay (5.4 days versus 4.9 days, reported P = 0.51). There was no report of post-operative complications.

Anatomical restoration

There was no significant difference in the number of malunions, defined as angulation or rotation deformity more than 10 degrees or limb shortening more than one centimetre (6/18 versus 3/15; RR 1.67, 95% CI 0.50 to 5.56; *see* Analysis 12.3).

Operative details

As would be expected given that reaming of the femoral canal is required when placing a long nail, both duration of operation (71.8 versus 52.6 minutes; reported P < 0.001) and fluoroscopy (75.3 versus 58.6 seconds; reported P < 0.001) were significantly longer in the long PFNA group.

DISCUSSION

Summary of main results

The 17 trials included in this review, involving a total of predominantly female and older participants with predominantly unstable trochanteric fractures, tested 12 comparisons of different cephalocondylic nail designs. There were no trials evaluating condylocephalic nails. A summary of the risk of bias assessment and findings for each of the comparisons are provided below.

Proximal femoral nail (PFN) versus Gamma nail

All four trials contributing to this comparison were at high risk of bias. Of note, is that two trials (Herrera 2002; Marques 2005) were quasi-randomised and thus at high risk of selection bias; and the other two trials (Papasimos 2005; Schipper 2004) were at high risk of attrition bias.

There were no significant differences between groups in functional outcome, these data being limited to results from single trials. Pooled results from three trials showed no difference in mortality between the two groups (86/415 versus 80/415; risk ratio (RR) 1.08; 95% confidence interval (CI) 0.82 to 1.41). There were no statistically significant differences between the two implants in serious fixation complications (operative fracture of the femur, cut-out, non-union and later fracture of the femur) nor re-operations (45/455 versus 36/455; RR 1.25, 95% CI 0.83 to 1.90). These revision rates (9.8% versus 7.9%) are high, particularly in the context of those found for short femoral nails (5.4%) or, indeed, the sliding hip screw (3.4%) (Parker 2010). Schipper 2004 acknowledged the high revision rates, for both implants in their study but stressed their inclusion of exclusively unstable fractures.

ACE trochanteric nail versus Gamma nail

The two small trials (Efstathopoulos 2007; Vidyadhara 2007) addressing this comparison used different implants or techniques and had different populations. They were judged as being at unclear risk of bias for most domains; Vidyadhara 2007 being at high risk of detection bias for subjective outcomes.

The outcome of Vidyadhara 2007, which had no deaths or loss to follow-up, was very favourable for both groups as shown by the usually high Harris hip scores with very little variation within each group. Supposing that the correct statistics were presented, the clinical significance of the statistically significant differences in the Harris hip scores at one year follow-up (MD 1.00, 95% CI 0.28 to 1.72) is questionable. Two participants died in each group of Efstathopoulos 2007. The only fracture fixation complication reported was a cut-out which resulted in a re-operation in Vidyadhara 2007.

ACE trochanteric nail versus Gamma 3 nail

The single trial (De Grave 2012) in this comparison was at unclear risk of bias for most domains but at high risk of detection bias for subjective outcomes. De Grave 2012 found no differences between the two implants in any of the outcomes assessed (functional score, mortality, fracture fixation complications and re-operation). Two patients in each group underwent a revision procedure for either cut-out or fracture displacement.

Gliding nail versus Gamma nail

The single trial (Fritz 1999) in this comparison was at unclear risk of bias for most domains, but at high risk of detection bias for subjective outcomes. Fritz 1999 found no differences between the two implants in any of the outcomes assessed (mortality, poor outcome, fracture fixation complications and re-operation).

ENDOVIS nail versus intramedullary hip screw (IMHS)

The single trial (Makridis 2010) in this comparison was at unclear risk of bias for most domains but at high risk of detection bias for subjective outcomes.

Makridis 2010 reported poorer mobility scores in the ENDOVIS nail group: this reflected that more participants in the ENDOVIS nail group were bedridden, and thus unable to walk, after their operation (29/105 versus 18/110; RR 1.69, 95% CI 1.00 to 2.85). There were no significant differences between the two groups in other outcomes (mortality, fracture fixation complications, re-operation).

Russell-Taylor Recon nail versus long Gamma nail

The single trial (Starr 2006) included people with high energy fractures aged between 18 and 50 years; 17 of whom had concurrent surgery for other injuries. Thus, this was a very different population to the other trials in this review. Starr 2006 was at unclear risk of bias for most domains but at high risk of detection bias for subjective outcomes.

Starr 2006 found no notable differences in outcome between the two groups. However, there was a very high rate of elective removal of implants for pain (8/17 (47%) versus 5/17 (29%)) compared with the other trials. Overall, Starr 2006 was too small to conclude that the lack of differences between the two groups is a true finding.

Proximal femoral nail antirotation (PFNA) versus Targon PF nail

The quasi-randomised trial (Wild 2010) for this comparison was at high risk of selection bias and at high risk of detection bias for subjective outcomes. This was a poorly reported trial, including the failure to provide separate group data for mortality or complete data for re-operations.

Wild 2010 found no difference between the two groups in functional outcome; nor were there statistically significant between-group differences in fracture fixation complications.

PFNA versus Gamma 3 nail

Both trials (Vaquero 2012; Xu 2010a) for this comparison were at high risk of detection bias for subjective outcomes and high risk of attrition bias.

No statistically significant differences between implants were found in a variety of functional scores including the Harris Hip Score, SF-36 mental and physical health scores, a mobility score or recovery of pre-operative weight bearing ability, hip range of movement, in hip or thigh pain, in fracture fixation complications or re-operations (four re-operations occurred in the PFNA group, two operations occurred in the Gamma 3 group). No significant difference in mortality was observed between the groups in Vaquero 2012. Separate group data for mortality were not provided in the other study (Xu 2010a). No significant difference was seen in post-operative complications or length of stay. Intra-operative blood loss was lower in the PFNA group though this did not translate to a significant difference in the amount of participants transfused or the mean number of units transfused.

Dynamic versus static locked intramedullary nail

The single trial (Hardy 2003) making this comparison was at unclear risk of bias for most domains. Though none of the differences between the two groups reached statistical significance, Hardy 2003 suggested that lower incidence of cortical hypertrophy of the bone at the level of the distal locking screws in the dynamic group was linked with the lower number of participants with mid-thigh pain in the dynamic group.

Sliding versus non-sliding Gamma 3 nail

The single trial (Zhu 2012) was at unclear risk of bias for most domains. This trial, which aimed to avoid osteoporotic fractures, included participants aged less than 60 years with intertrochanteric fractures. This is a different population to all the other trials in this review (except Starr 2006).

Zhu 2012 reported no significant differences in terms of the Harris hip scores, fracture fixation complications, length of stay and operative details such as operative time and blood loss. A significant leg length discrepancy was reported in Group C (most unstable fractures, AO A2.2, 2.3) with the mean difference being 0.38 mm. This is not a clinically significant leg length discrepancy.

InterTan nail versus PFNA II nail

The single trial (Zhang 2013) was at low risk of bias for most domains, but at high risk of bias for reporting of subjective outcomes. No significant differences were reported for the majority of domains including mortality, functional scores (Harris hip score, walking ability score), fracture fixation complications, post-operative complications and length of hospital stay. Although participants in the PFNA II group were four times more likely to experience thigh pain, the implications of this were not clear and not apparent from the Harris hip score. Similarly, the implications of the fracture healing occurring on average three weeks earlier in the InterTan nail group were unclear as was the actual assessment of this outcome. InterTan nailing surgery took longer, with greater fluoroscopy exposure.

Long versus standard (short) PFNA nail

The single trial (Okcu 2013) was at low or unclear risk of bias for individual domains. This small trial, which reported results for 33 participants with reverse oblique fractures, was described as a "pilot" and no power analysis being conducted beforehand. No significant differences were found for the majority of outcomes including mortality, functional scores (Harris hip score, Parker and Palmer mobility score), fracture fixation complications and re-operation. There was no significant difference in the length of hospital stay. As expected, overall operating and fluoroscopy times were shorter in the standard PFNA group; reaming of the femoral canal is rarely required with this implant.

Overall completeness and applicability of evidence

Nine of the 12 comparisons in the review were made in single trials, whose populations ranged from 34 participants to 215 participants. The maximum number of participants available in any pooled analysis for the two remaining comparisons was 910 and 197 respectively. There was no pooling of functional outcomes, such as Harris hip scores, which were under-reported and recorded. For each comparison, there were insufficient patient numbers to rule out important differences, particularly in final outcomes, between the implants under test.

The trial populations were generally representative of the populations with these fractures. As indicated above, Starr 2006 and Zhu 2012 were two exceptions to this with an upper age limit of 50 years being applied in Starr 2006 and 60 years being applied in Zhu 2012. Starr 2006 was also exceptional in its inclusion of a few subtrochanteric fractures. The other exception is Okcu 2013, which included reverse oblique fractures only. Particular emphasis was made in Zhang 2013 on the use of nails that reflect a difference in geometry between Asian and Caucasian femur geometry.

It is noteworthy that this review is predominantly a set of comparisons of intramedullary nails from different manufacturers. Newer nails have different features aimed at enhancing stability and reducing known complications (such as operative or later femoral shaft fractures). But as well as testing for improved performance of these different features in the clinical setting, it could be con-

jectured that it is also the market place that has set the research agenda and the associated aims of these generally underpowered trials.

As stated above, functional outcomes were under-recorded and reported. Several trials failed to report separate statistics for mortality. We have already alerted the reader to the unusually high re-operation rates in the PFN versus Gamma nail comparison and also the very high rate of elective removal of implants for pain in Starr 2006.

Quality of the evidence

As summarised above for the individual comparisons, all trials were at unclear risk of bias for several domains and most trials were at high risk of detection bias for subjective outcomes. Poor reporting of methods of randomisation and participant flow were commonplace and resulted in concerns regarding both selection and attrition biases in several trials.

Proximal femoral nail (PFN) versus the Gamma nail

The quality of the evidence for this comparison was downgraded three levels for function (one for limitations in design and implementation that related to potential risk of bias; one for imprecision; and one because data were only available from one trial); two levels for mortality (one for limitations in design and implementation that related to potential risk of bias; and one because data were absent from one trial and a substantial number of participants for another trial) and two levels for fracture fixation complications and re-operation (one for limitations in design and implementation that related to potential risk of bias; and one for either imprecision or that substantial amounts of data were absent).

ACE trochanteric nail versus the Gamma nail

The quality of the evidence for this comparison was downgraded three levels for all primary outcomes (one for limitations in design and implementation that related to potential risk of bias; one for imprecision; and one because data were only available from one trial or were highly unrepresentative of the general population).

PFNA versus the Gamma 3 nail

The quality of evidence for this comparison was downgraded three levels for mortality and function (one for limitation in design and implementation that related to potential risk of bias in multiple areas including allocation, blinding, attritional and reporting bias; one for imprecision of results due to small numbers of trial participants; and one because data were only available from one trial for the majority of these outcomes). The quality of evidence for fracture fixation complications was downgraded two levels (one for limitation in design that related to potential risk of bias; and one for imprecision related to the small number of participants in each trial or the substantial loss to follow-up).

Remaining comparisons

With one exception, the quality of the evidence for each comparison involving single trials was downgraded three levels for all outcomes. This generally included the downgrading by one for limitations in design and implementation that related to potential risk of bias; one for imprecision; and one because data were from one underpowered trial. The consistent finding of poorer mobility for the ENDOVIS nail when compared with the IMHS was considered to merit an upgrading by one point.

This overall, reflected a triple downgrading; we judged the evidence to be of very low quality, which indicates that we are very uncertain about the estimates for all outcomes. For the first comparison, however, there was a double downgrading for mortality. For the first (PFN versus the Gamma nail) and third (PFNA versus the Gamma 3 nail) comparisons there was a double downgrading for fracture fixation complications. For these, we judged the evidence to be low quality and thus we consider that further research is very likely to change the estimated effect and affect our confidence in this result.

Potential biases in the review process

While our search was comprehensive, it is possible that we have failed to identify some trials, especially those reported in conference proceedings only. Changing methodology and authorship between updates can be challenging and while we have taken a systematic approach, extra vigilance and checks have been required to ensure a satisfactory transition and consistency. Inevitably, the risk of bias judgements of similar aspects of trial quality do not neatly correspond to the previous ratings for previous trials; this difference is probably greater given that risk of bias assessment was done by a different pair of reviewers. The restructuring of the Types of outcome measures and reporting of the results presented the greatest challenge. Rather than completely rewrite the previous review, we took a pragmatic decision to reorder the categories of outcomes and highlight the primary outcomes.

AUTHORS' CONCLUSIONS

Implications for practice

There was insufficient evidence from randomised trials to determine if there are important differences in patient outcomes between the different designs of proximal femoral intramedullary nail produced by different manufacturers when used for the fixation of unstable, or stable, trochanteric fractures.

Implications for research

Given the evidence indicating the current superiority of the sliding hip screw (SHS) over intramedullary nails for trochanteric fractures (Parker 2010), it is debatable whether studies comparing different types or aspects of intramedullary nail design should be undertaken. Nonetheless, while we suggest that further development and modification of cephalocondylic nails for these fractures is not a priority, any new developments should be evaluated using robust methodology with adequate patient numbers and the collection of functional outcomes. We suggest the choice of comparator of any such trial should be the SHS.

ACKNOWLEDGEMENTS

We would like to thank the following for their comments and help at editorial and external review of the review and subsequent updates: Piet de Boer, Rebecca Coghlan, Lindsey Elstub, Bill Gillespie, Lesley Gillespie, Peter Herbison, Rajan Madhok and Janet Wale. We thank Lesley Gillespie and Joanne Elliott for help with the search for trials and the search strategy.

We would like to thank the following for their comments at editorial review of the protocol: Rebecca Coghlan, Lesley Gillespie and Rajan Madhok. We also thank Luisa Fernandez Mauleffinch for the translation of Marques 2005.

We are very grateful to Qi Zhuo for providing an English translation of Yang 2011.

REFERENCES

References to studies included in this review

De Grave 2012 *{published data only}*
De Grave W, Tampere T, Byn P, Van Overschelde J, Pattyn C, Verdonk R. Intramedullary fixation of intertrochanteric hip fractures: a comparison of two implant designs. A prospective randomised clinical trial. *Acta Orthopaedica Belgica* 2012;**78**(2):192–8.

Efstathopoulos 2007 *{published data only}*
Efstathopoulos N, Nikolaou V, Lazarettos J, Psixas X, Xypnitos F, Papachristou G. Intramedullary fixation of pertrochanteric hip fractures: A comparison of two implant designs. *Journal of Bone and Joint Surgery - British Volume* 2006;**88 Suppl 1**:70.
* Efstathopoulos NE, Nikolaou VS, Lazarettos JT. Intramedullary fixation of intertrochanteric hip fractures: A comparison of two implant designs. *International Orthopaedics* 2007;**31**(1):71–6.

Fritz 1999 *{published data only}*
Fritz T, Hiersemann K, Krieglstein C, Friedl W. Prospective randomized comparison of gliding nail and gamma nail in the therapy of trochanteric fractures. *Archives of Orthopaedic and Trauma Surgery* 1999;**119**(1):1–6.

Hardy 2003 *{published data only}*
Hardy DC, Drossos K. Slotted intramedullary hip screw nails reduce proximal mechanical unloading. *Clinical Orthopaedics and Related Research* 2003;**(406)**:176–84.

Herrera 2002 *{published and unpublished data}*
Herrera A. Personal communication 28 September 2004.
* Herrera A, Domingo LJ, Calvo A, Martinez A, Cuenca J. A comparative study of trochanteric fractures treated with the Gamma nail or the proximal femoral nail. *International Orthopaedics* 2002;**26**(6):365–9.

Makridis 2010 *{published data only}*
Makridis K, Georgoussis M, Mandalos V, Daniilidis N, Kourkoubellas S, Badras L. A prospective randomised study about two intramedullary devises for treating trochanteric fractures. *Journal of Bone and Joint Surgery - British Volume* 2011;**93 Suppl 3**:365.
* Makridis K, Vasileios G, Georgoussis M, Mandalos V, Kontogeorgakos V, Badras L. Comparing two intramedullary devices for treating trochanteric fractures: A prospective study. *Journal of Orthopaedic Surgery and Research* 2010;**5**(9):1–8. [DOI: 10.1186/1749-799X-5-9]

Marques 2005 *{published and unpublished data}*
Marques F. Personal communication 18 May 2005.
* Marques F, Leon A, Mestre C, Balliester J, Caceres E. Prospective comparative study of the intertrochanteric Gamma nail and AO proximal femoral nail in the treatment of unstable intertrochanteric fractures [Estudio prospectivo comparativo entre el clavo gamma trocanterico y el clavo femoral proximal AO (PFN) en el tratamiento de las fracturas trocantericas inestables]. *Revista de Ortopedia y Traumatologia* 2005;**49**(1):11–6.

Okcu 2013 *{published data only}*
Okcu G, Ozkayin N, Okta C, Topcu I, Aktuglu K. Which implant is better for treating reverse obliquity fractures of the proximal femur: A standard or long nail?. *Clinical Orthopaedics and Related Research* 2013;**471**(9):2768–75.

Papasimos 2005 *{published data only}*
Papasimos S, Koutsojannis CM, Panagopoulos A, Megas P, Lambiris E. A randomised comparison of the AMBI, TGN and PFN for treatment of unstable trochanteric fractures. *Archives of Orthopaedic and Trauma Surgery* 2005;**125**(7):462–8.

Schipper 2004 *{published data only}*
Schipper I. Personal communication 19 January 2006.
* Schipper IB, Steyerberg EW, Castelein RM, van der Heijden FH, den Hoed PT, Kerver AJ, et al.Treatment of unstable trochanteric fractures. Randomised comparison of the gamma nail and the proximal femoral nail. *Journal Bone and Joint Surgery - British Volume* 2004;**86**(1):86–94.

Starr 2006 *{published data only}*
Starr A. Personal communication 23 July 2007.
* Starr AJ, Hay MT, Reinert CM, Borer DS, Christensen KC. Cephalomedullary nails in the treatment of high-energy proximal femur fractures in young patients: A prospective, randomized comparison of trochanteric versus piriformis fossa entry portal. *Journal of Orthopaedic Trauma* 2006;**20**(4):240–6.

Vaquero 2012 *{published data only}*
Hanson BP, Vaquero Martin J. Proximal Femoral Nail Antirotation™ (PFNA) versus Gamma Nail 3™ (Gamma3) for intramedullary nailing of unstable trochanteric fractures (PROGAINT-ES). www.clinicaltrials.gov/show/NCT00736684 (accessed 4 January 2013).
* Vaquero J, Munoz J, Prat S, Ramirez C, Aguado HJ, Moreno E, et al.Proximal Femoral Nail Antirotation versus Gamma 3 nail for intramedullary nailing of unstable trochanteric fractures. A randomised comparative study. *Injury* 2012;**43**(S2):S47–54.

Vidyadhara 2007 *{published and unpublished data}*
Vidyadhara S. Personal communication 8 August 2007.
* Vidyadhara S, Roa SK. One and two femoral neck screws with intramedullary nails for unstable trochanteric fractures of femur in the elderly-Randomised clinical trial. *Injury* 2007;**38**(7):806–14.

Wild 2010 *{published data only}*
Wild M, Jungbluth P, Thelen S, Laffree Q, Gehrmann S, Betsch M, et al.The dynamics of proximal femoral nails: a clinical comparison between PFNA and Targon PF. *Orthopedics* 2010;**33**:8.

Xu 2010a *{published data only}*
Xu Y, Geng D, Yang H, Wang X, Zhu G. Treatment of unstable proximal femoral fractures: comparison of the proximal femoral nail antirotation and gamma nail 3. *Orthopedics* 2010;**33**(7):473. [DOI: 10.3928/01477447-20100526-03]

Zhang 2013 *{published data only}*
Zhang S, Zhang K, Jia Y, Yu B, Feng W. InterTan nail versus proximal femoral nail antirotation-asia in the treatment of unstable trochanteric fractures. *Orthopedics* 2013;**36**(3):e288–94.

Zhu 2012 *{published data only}*
Zhu Y, Meili S, Zhang C, Luo C, Zeng BF. Is the lag screw sliding effective in the intramedullary nailing in A1 and A2 AO-OTA intertrochanteric fractures? A prospective study of sliding and none-sliding lag screw in Gamma-III nail. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2012;**20**:60.

References to studies excluded from this review

Cao 2009 *{published data only}*
Cao LH, Liu XW, Su JC, Zhang CC. Dynamic hip screw, Gamma nail and proximal femoral nail in treating intertrochanteric fractures in the elderly: A prospective randomized biocompatibility study of 95 patients. [Chinese]. *Journal of Clinical Rehabilitative Tissue Engineering Research* 2009;**13**(17):3342–6.

Dall'Oca 2010 *{published data only}*
Dall'Oca C, Maluta T, Moscolo A, Lavini F, Bartolozzi. Cement augmentation of intertrochanteric fractures stabilised with intramedullary nailing. *Injury* 2010;**41**(11):1150–5.

Gahr 2003 *{published data only}*
Gahr RH, Pawelka A. Employing a modified gamma nail for the treatment of proximal femoral fractures [Einsatz eines modifizierten Gammanagels bei der versorgung proximaler femurfrakturen. Neuer "long gamma nail" 10 mm vs."long gamma nail" 11 mm–eine prospektive studie]. *Unfallchirurg* 2003;**106**(7):550–5.

Huang 2012 *{published data only}*
Huang FT, Lin KC, Yang SW, Renn JH. Comparitive study of the proximal nail antirotation versus the recomstruction nail in the treatment of comminuted proximal femoral fracture. *Orthopedics* 2012;**35**(1):e41–7.

Merenyi 1995 *{published data only}*
Merenyi G, Zagh I, Kovacs A. Gamma nail versus Ender nails and angle-plate in the proximal fractures of the femur - a randomised prospective study [abstract]. *Journal of Bone and Joint Surgery - British Volume* 1995;**77**(Suppl 3):215.

NTR1133 *{unpublished data only}*
* Bek AM. Intramedullary nailing of proximal femur fractures: Gamma 3 nail versus Fixion Proximal Femur Nailing System. www.trialregister.nl/trialreg/admin/rctview.asp?TC=1133 (accessed 4 January 2013).
Bek J. Personal communication 13 January 2013.

Ouyang 2010 *{published data only}*
Ouyang ZH, Huang JR, Xiang XJ, Bin H. Effect and complications of metallic implant for internal fixation of upper femoral shaft fractures: Randomized comparison among three groups. *Journal of Clinical Rehabilitative Tissue Engineering Research* 2010;**14**(30):5674–7.

Pan 2009 *{published data only}*
Pan SH, Liu XW, Zhang CC, Xu SG, Fu QG. [Implantation of Gamma nail and proximal femoral nail for the treatment of femoral intertrochanteric fractures in the elderly: a randomized follow-up for 131 cases]. *Journal of Clinical Rehabilitative Tissue Engineering Research* 2009;**13**(39):7647–50.

Suckel 2006 *{published data only}*
Suckel A, Munst P, Mocke U. Rotationally stable, intramedullary osteosynthesis of proximal extra-articular femur fractures [Die rotationsstabile intramedullare osteosynthese von proximalen extraartikularen femurfrakturen]. *Zeitschrift fur Orthopadie und Ihre Grenzgebiete* 2006;**144**(5):532–8.

Wagner 1998 *{published data only}*
Wagner R, Blattert TR, Weckbach A. Solution to the problem of extra-articular, femoral hip fracture by the "sliding screw-nail principle". Results of 2 different systems (classical nail and gamma nail) [Problemlosung

der extraartikularen, koxalen femurfraktur durch das "Gleitschrauben–Nagel–Prinzip". Ergebnisse zweier verschiedener systeme (classic nail und gamma–nagel)]. *Unfallchirurg* 1998;**101**(12):894–900.

Xu 2010b ***{published and unpublished data}***

Xu Y. Personal communication 15 April 2013.

* Xu Y, Dechun G, Huilin Y, Guangming Z, Xianbin W. Comparative study of trochanteric fracture with the proximal femoral nail antirotation and the third generation of gamma nail. *Injury* 2010;**41**(12):1234–8.

Yang 2011 ***{published data only}***

Yang N, Sun TS, Guo YZ, Zhang ZC, Wang XW. Intramedullary hip screw versus proximal femoral nail for intertrochanteric fracture: A randomized controlled study. *Journal of Clinical Rehabilitative Tissue Engineering Research* 2011;**15**(17):3093–7.

References to studies awaiting assessment

Mora 2011 ***{published data only}***

Mora A, Marimon I, Rius M, Brill W, Corral A, Gaya S, et al.PFN versus PFNA in treatment of trochanteric femoral fractures: a prospective study (abstract). *Journal of Bone and Joint Surgery - British Volume* 2011;**93 Supp 2**:136.

Park 2010 ***{published data only}***

Park JH, Lee YS, Park JW, Wang JH, Kim JG. A comparative study of screw and helical proximal femoral nails for the treatment of intertrochanteric fractures. *Orthopedics* 2010; **33**(2):81–5.

Stern 2011 ***{published data only}***

Stern R, Lubbeke A, Suva D, Miozzari H, Hoffmeyer P. Prospective randomised study comparing screw versus helical blade in the treatment of low-energy trochanteric fractures. *International Orthopaedics* 2011;**35**(12):1855–6.

References to ongoing studies

NCT01437176 ***{unpublished data only}***

Tang P. Treatment of intertrochanteric fracture with new type of intramedullary nail. www.clinicaltrials.gov/show/NCT01437176 (accessed 1 April 2013).

Additional references

Anglen 2008

Anglen JO, Weinstein JN. Nail or plate fixation of intertrochanteric hip fractures: Changing pattern of practice - A review of the American Board of Orthopaedic Surgery database. *Journal of Bone and Joint Surgery - American Volume* 2008;**90**(4):700–7.

Bjorgul 2007

Bjorgul K, Reikeras O. Incidence of hip fracture in south eastern Norway: a study of 1730 cervical and trochanteric fractures. *International Orthopaedics* 2007;**31**(5):665–9.

Higgins 2003

Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;**327**: 557–60.

Higgins 2011

Higgins JPT, Altman DG, Sterne JAC (editors). Chapter 8: Assessing risk of bias in included studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Karagas 1996

Karagas MR, Lu-Yao GL, Barrett JA, Beach ML, Baron JA. Heterogeneity of hip fracture: age, race, sex, and geographic patterns of femoral neck and trochanteric fractures among the US elderly. *American Journal of Epidemiology* 1996;**143** (7):677–82.

Lefebvre 2011

Lefebvre C, Manheimer E, Glanville J. Chapter 6: Searching for studies. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Muller 1991

Muller ME. Appendix A. The comprehensive classification of fractures of long bones. In: Allgower M editor(s). *Manual of internal fixation: techniques recommended by the AO-ASIF Group*. 3rd Edition. Berlin: Springer-Verlag, 1991:118–50.

NHFD 2013

Johansen A, Wakeman R, Boulton C, Plant F, Roberts J, Williams A. *National Hip Fracture Database: National report 2013.* London: Royal College of Physicians, 2013.

Parker 1998

Parker MJ, Handoll HHG. Condylocephalic nails versus extramedullary implants for extracapsular hip fractures. *Cochrane Database of Systematic Reviews* 1998, Issue 4. [DOI: 10.1002/14651858.CD000338]

Parker 2010

Parker MJ, Handoll HHG. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2010, Issue 9. [DOI: 10.1002/14651858.CD000093.pub5]

RevMan 2014

The Nordic Cochrane Centre, The Cochrane Collaboration. Review Manager (RevMan). 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.

Schünemann 2011

Schünemann HJ, Oxman AD, Vist GE, Higgins JPT, Deeks JJ, Glasziou P, et al.Chapter 12: Interpreting results and drawing conclusions. In: Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from www.cochrane-handbook.org.

Zlowodzki 2008

Zlowodzki M, Brink O, Switzer J, Wingerter S, Woodall J Jr, Petrisor BA, et al.The effect of shortening and varus

collapse of the femoral neck on function after fixation of intracapsular fracture of the hip: a multi-centre cohort study. *Journal of Bone and Joint Surgery - British Volume* 2008;**90**(11):1487–94.

References to other published versions of this review

Parker 2004

Parker MJ, Handoll HHG. Cephalocondylic intramedullary nails for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2004, Issue 4. [DOI: 10.1002/14651858.CD004961]

Parker 2005

Parker MJ, Handoll HHG. Intramedullary nails for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2005, Issue 2. [DOI: 10.1002/14651858.CD004961.pub2]

Parker 2006

Parker MJ, Handoll HHG. Intramedullary nails for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2006, Issue 3. [DOI: 10.1002/14651858.CD004961.pub3]

Parker 2008

Parker MJ, Handoll HHG. Intramedullary nails for extracapsular hip fractures in adults. *Cochrane Database of Systematic Reviews* 2008, Issue 4. [DOI: 10.1002/14651858.CD004961.pub3]

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

De Grave 2012

Methods	Randomised trial: method not stated Length of follow-up: 1 year
Participants	Orthopaedic Hospital, Ghent, Belgium 112 patients with pertrochanteric femoral fractures. 34% stable, 66% unstable fractures Mean age 74.9 years % male: 60 Number lost to follow-up: 6 (5%) Assigned: 51/61 [ACE trochanteric nail/Gamma 3 nail]
Interventions	ACE trochanteric nail versus Gamma 3 Nail The ACE trochanteric nail as a 16 mm proximal diameter, 180 or 200 mm length, 5° valgus curvature and a 10.5 mm diameter lag screw Additionally an optional antirotation lag-screw is available. This was used when rotational instability was expected The third generation Gamma Nail has 15.5 mm proximal diameter, 180 mm length and 4° valgus curvature with a single distal transverse locking screw and a 10.5 mm diameter lag screw
Outcomes	Mortality Superfical or deep wound infections Avascular necrosis Deep vein thrombosis Neurological injury Severe general complications (cardiac/pulmonary/thromboembolic/cerebrovascular/death) Penetration of lag screw Excessive displacement - medialisation of femoral shaft - breakage or loosening of the implant - intra-operative or post-operative fracture of the femoral shaft - non-union Function: Merle d'Aubigne hip score (pain, mobility, walking) Walking score
Study funding	No benefits or funds were received
Notes	9 different surgeons

Risk of bias

Bias	Authors' judgement	Support for judgement

De Grave 2012 (*Continued*)

Random sequence generation (selection bias)	Unclear risk	Randomisation methodology not described. "were on admission randomised to" some stratification seems to have taken place: in abstract "two groups were matched for age, fracture type and Merle D'Aubigne hip score
Allocation concealment (selection bias)	Unclear risk	No mention of concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. No mention of blinding otherwise (participants etc)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Outcomes included Merle D'Aubigne scores
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though uncertain risk of bias for these outcomes
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	6 patients lost to follow-up. Uncertain from which groups. Overall a low attrition rate
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	6 patients lost to follow-up. Uncertain from which groups. Mortality was balanced between groups but denominators not available
Selective reporting (reporting bias)	Unclear risk	No protocol though outcomes mentioned in methods appear to be reported but incompletely in terms of denominators
Other bias	Low risk	Minimal between-group differences in baseline characteristics (age, sex, fracture type, Merle D'Aubigne score)
Other performance bias (e.g. differential expertise bias)	Low risk	"A senior orthopaedic resident performed the operations." Care programmes appear similar
Other sources of bias (funding)	Low risk	Clarification of funding (none) is provided

Efstathopoulos 2007

Methods	Randomised trial: sealed envelopes Length of follow-up: mean 8 months (range 6 to 12 months)
Participants	Orthopaedic hospital, Athens, Greece 112 people aged 65 or over with a trochanteric proximal femoral fracture (Jensen types I and II : stable (18%), or III and IV: unstable (82%)) Age: mean 78 years (range 69 to 89 years) % male: 29 Number lost to follow-up: 5 (4.5%) Assigned: 56/56 [ACE trochanteric nail / trochanteric Gamma nail]
Interventions	ACE trochanteric nail versus a trochanteric Gamma nail. The ACE nail was 11 mm diameter, inserted without reaming and with one proximal screw and one distally locking screw The Gamma nail was 11 mm distal diameter, and inserted with reaming and had one distal locking screw
Outcomes	Length of surgery Units of blood transfused Number of patients transfused Radiographic screening time Cut-out of implant Operative fracture of femur Later fracture of the femur Non-union Re-operation Wound infection Deep wound infection Deep vein thrombosis All medical complications Length of hospital stay Mortality Mobility
Study funding	No mention of funding or a conflict of interest
Notes	The trial report clearly states that there were no fracture healing complications: the outcome of no re-operations was inferred from this

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	"were randomised upon their admission using a sealed envelope method." Unclear what the actual randomisation process was

Efstathopoulos 2007 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	"were randomised upon their admission using a sealed envelope method." Not clear if envelopes were opaque or not
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons not blinded but unclear risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No subjective outcomes
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding but uncertain what is risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	Data available for all patients
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	Few (5) patients lost to follow-up Modest imbalance in groups (47 versus 41)
Selective reporting (reporting bias)	Unclear risk	No study protocol but it appears that all outcomes discussed in the methods were reported on
Other bias	Low risk	No ASA data available for one group, otherwise comparable baseline characteristics
Other performance bias (e.g. differential expertise bias)	Low risk	"2 experienced surgeons" performed the cases. Time to surgery and post-operative protocols appear similar
Other sources of bias (funding)	Unclear risk	No mention of funding or conflict of interest

Fritz 1999

Methods	Randomised trial: method not stated except that it was "non-stratified" Length of follow-up: 6 months
Participants	Orthopaedic hospital, Heidelberg, Germany 80 people with an unstable trochanteric proximal femoral fracture Age: mean 83 years % male: 14 Number lost to follow-up: 1 (1.3%) Assigned: 40/40 [Gliding nail / Gamma nail]

Fritz 1999 (*Continued*)

Interventions	Gliding nail (125 degree) versus a standard (130 degree) Gamma nail For the gliding nail, the lag screw of the standard Gamma nail was replaced by a double T profile blade All nails were 220 mm long and 12 mm in diameter. A double distal locking was aimed for in all cases
Outcomes	Length of surgery Operative blood loss Operative fracture Cut-out of implant Later fracture of the femur Re-operation Medical complications Pneumonia Cerebrovascular accident Decubitus ulcers Length of hospital stay Limb shortening Rotational deformity Mortality Residence Mobility Pain Function: Merle d' Aubigne score
Study funding	There was no mention of funding or a conflict of interest
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not clear what the exact methodology was "according to a non-stratified randomisation"
Allocation concealment (selection bias)	Unclear risk	No details given
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No mention of blinding. Not possible to blind surgeons
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Outcomes included Merle D'Aubigne score

Fritz 1999 (*Continued*)

Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding but uncertain risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	All short (perioperative) data available
Incomplete outcome data (attrition bias) Longer-term outcome	Low risk	2% lost to follow-up. 12% died
Selective reporting (reporting bias)	Unclear risk	No protocol. No major concerns over outcomes presented
Other bias	Low risk	Baseline characteristics similar between groups
Other performance bias (e.g. differential expertise bias)	Unclear risk	No difference in surgeons' expertise. An experienced surgeon either performed the procedure or assisted. Post-op programmes though not described in detail seem to be different "dependent on the preoperative condition of the patient and not the fixation system"
Other sources of bias (funding)	Unclear risk	No mention of funding or conflict of interest

Hardy 2003

Methods	Randomised trial: method not stated Length of follow-up: mean 37 months (range 12 to 49 months)
Participants	Orthopaedic hospital, Brussels, Belgium 81 people with an unstable trochanteric proximal femoral fracture (fracture types featuring loss of medial support: Jensen types IV and V; or reversed oblique fracture lines) Age: mean 77 years % male: 38 Number lost to follow-up: 1 (1.3%) Assigned: 42/39 [Dynamic / Static locking]
Interventions	Intramedullary hip screw (IMHS) with a slotted hole to allow for dynamic distal locking of the nail with one screw versus a standard IMHS statically locked with two distal locking screws All nails were 12 mm in diameter, with a 135 degree angle between the nail and lag screw, and 4 degree valgus angle

Hardy 2003 (*Continued*)

Outcomes	Length of surgery Operative blood loss Haemoglobin level Volume of blood transfused Cut-out of implant Later fracture of the femur Re-operation Mortality Pain Mobility score Independence (Jensen's autonomy index) Limb shortening Subsidence of the nail Cortical hypertrophy
Study funding	No mention of conflict of interest or funding
Notes	One patient allocated dynamic locking was excluded because the nail was erroneously locked with two screws

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No mention of the blinding process "the remaining 81 patients were allocated randomly..."
Allocation concealment (selection bias)	Unclear risk	No mention of concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No blinding. Not possible to blind surgeons. Uncertain risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No blinding. They do say however that for pain, examinations were repeated and cross matched with family members
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No blinding though is not required for objectives such as mortality
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	No lost data
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	1 patient lost to follow-up. Mobility score not provided ("similar ion both groups"). No statistical analysis on many of the out-

Hardy 2003 (*Continued*)

		comes such as pain, leg length discrepancy and mortality
Selective reporting (reporting bias)	Unclear risk	No protocol and some data (mobility score) not provided
Other bias	Low risk	Similar baseline characteristics in terms of age, gender, mobility and fracture type
Other performance bias (e.g. differential expertise bias)	Unclear risk	Slightly more junior operators in group B. Same care pathway
Other sources of bias (funding)	Unclear risk	No mention of funding or conflict of interest

Herrera 2002

Methods	Quasi-randomised trial: based on odd and even record numbers Length of follow-up: 12 months minimum
Participants	Orthopaedic hospital, Zaragoza, Spain 250 people with a trochanteric proximal femoral fracture: A1, A2 or A3 (stable and unstable). Pathological fractures included Age: mean 79 years % male: 28 Number lost to follow-up: not stated Assigned: 125/125 [PFN / Gamma nail]
Interventions	Proximal femoral nail (PFN): usually 130 degree, 10 mm (inserted without reaming) versus a Gamma nail (usually a 130 degree, 11 mm) inserted with reaming With 3 exceptions (in the Gamma nail group) nails were locked distally using one or two screws
Outcomes	Length of surgery Operative blood loss Blood transfusion Cut-out of implant Operative fracture of femur (greater trochanter) Later fracture of the femur Secondary varus (> 10%) Breakage of implant Poor reduction of fracture Migration of the proximal nail screw(s) Non-union (and time to healing) Re-operation Seroma Haematoma Superficial wound infection

	Deep wound infection Length of hospital stay Pressure sores Pulmonary embolism Acute post-operative confusion Digestive haemorrhage Acute kidney failure Muscle pain "due to point effect" Mortality Recovery of walking ability
Study funding	No details given on funding or a conflict of interest
Notes	Information on method of randomisation received from Dr Herrera (28/09/04)

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Assignment based on add and even record numbers - thus quasi-randomised
Allocation concealment (selection bias)	High risk	Quasi-randomised - no concealment reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. No mention of blinding of participants or assessors. Uncertain risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Outcomes included time to fracture healing, fracture reduction and final walking ability
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though may not be relevant for these outcomes
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	Short-term data appears complete though for some outcomes, totals given rather than individual group results: e.g. length of stay, time to commence weight bearing
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	Unclear if any attrition from the study. 21% mortality
Selective reporting (reporting bias)	High risk	No protocol though some outcomes mentioned in the methods are not reported on: e.g. mental function, leg length discrepancy

Herrera 2002 (*Continued*)

		and axes of the affected limb
Other bias	Unclear risk	Baseline medical problems are similar but data for age and gender not available for each group
Other performance bias (e.g. differential expertise bias)	Unclear risk	No mention of number of surgeons or expertise. Care programmes appear similar
Other sources of bias (funding)	Unclear risk	No mention of funding or conflict of interest

Makridis 2010

Methods	Randomised trial: sealed envelopes containing cards Length of follow-up: 12 months
Participants	Orthopaedic Hospital, Polimeri, Greece 215 patients aged 60 or over with pertrochanteric fracture after a low energy fall. 35% stable, 65% unstable Age: mean age 83.7 years (range 69 to 99) % male: 31 Number lost to follow-up: no mention of attrition from study Assigned: 105/110 [ENDOVIS nail / Intramedullary hip screw]
Interventions	ENDOVIS nail versus intramedullary hip screw (IMHS) ENDOVIS: 13 mm proximal and 10 mm distal diameter, 195 mm in length. Inserted without reaming. Two holes for cephalic screw and one for distal screw IMHS: cannulated intramedullary nail inserted through greater trochanter. Used with AMBI/CLASSIC lag screw, compression screw and 4.5 mm locking screws. Sleeve (to prevent rotation while allowing lag screw to slide) passes through the nail and over the lag screw. Two angles and four distal diameters available. Proximal diameter 17.5 mm, 210 mm in length Distal locking was made preferably with 2 screws
Outcomes	Length of surgery Operative blood loss Units of blood transfused Intra-operative complications - missing proximal hole - misplaced proximal screws - failure distal locking - femoral shaft medialisation - cut-out of implant - Z-phenomenon - reverse Z-phenomenon - proximal screw back out - joint penetration

	- periprosthetic fracture - nail breakage Wound infection Post-operative haemoglobin level Mobility score at discharge (Palmer-Parker mobility score) Length of hospital stay (not reported) Mortality
Study funding	Authors declare no competing interests
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Randomly dispersed "by the use of sealed envelopes containing cards"
Allocation concealment (selection bias)	Unclear risk	No mention of opacity of the sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons could not be blinded. Participants not blinded
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding. Unclear risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	Short-term data appear complete
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	No mention of attrition from study; mortality at 1 year reported
Selective reporting (reporting bias)	Unclear risk	No study protocol but outcomes discussed in methods reported
Other bias	Low risk	Similar baseline characteristics in the two groups. Similar pre- and post-op care programmes

Makridis 2010 (*Continued*)

Other performance bias (e.g. differential expertise bias)	Unclear risk	No mention of surgeon number or expertise
Other sources of bias (funding)	Low risk	Authors declare no competing interests

Marques 2005

Methods	Quasi-randomised trial: based on odd and even record numbers Length of follow-up: 12 months
Participants	Orthopaedic hospital, Barcelona, Spain 156 people with an unstable trochanteric proximal femoral fracture (AO types 31 A2 and A3) Age: mean 82 years % male: 24 Number lost to follow-up: 25 (16%) Assigned: 79/77 [PFN / Gamma nail]
Interventions	Proximal femoral nail (PFN) versus a trochanteric Gamma nail The PFN was 10 mm diameter, inserted without reaming, and had two distally locking screws The Gamma nail was 11 mm distal diameter, and inserted with reaming and had one distal locking screw With 3 exceptions (in the Gamma nail group) nails were locked distally using one or two screws
Outcomes	Length of surgery Haemoglobin level Number of patients transfused Radiographic screening time Cut-out of implant Operative fracture of femur Later fracture of the femur Re-operation Haematoma Deep wound infection Length of hospital stay Pressure sores Pulmonary embolism Deep vein thrombosis Pneumonia Mortality Pain in thigh
Study funding	No funding was received for the study

Notes	Additional information supplied by Dr Marques included exact numbers of people with key outcomes. It should be noted, however, that the percentages given in the paper are generally inconsistent with the data provided by Dr Marques

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Randomisation was performed "according to their hospital number"
Allocation concealment (selection bias)	High risk	No details given; but quasi-randomised
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No mention of blinding of participants. Surgeons could not be blinded
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. One subjective outcome: pain in thigh. Uncertain risk of bias for this
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding. Unclear risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	No mention of attrition from study
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	No mention of attrition from study. Unlikely that all participants were followed up
Selective reporting (reporting bias)	High risk	No study protocol. Not all outcomes discussed in the methods were reported on: e.g. fracture reduction
Other bias	Low risk	Baseline characteristics were similar in the two groups
Other performance bias (e.g. differential expertise bias)	Unclear risk	Staff, senior and junior resident staff. More junior residents in Gamma nail group. Appears similar post operative mobility plan for both groups (weight bearing as tolerated) but no explicit description of other pre-op, intra-op or post op care plans
Other sources of bias (funding)	Low risk	No funding was received for the study

Okcu 2013

Methods	Randomised trial: computer randomisation Length of follow-up: mean 14 months (range 12 to 20 months)
Participants	Orthopaedic Hospital, Manisa, Turkey Orthopaedic Hospital, Izmir, Turkey 40 participants with reverse oblique type trochanteric fracture Age: mean 79 years (range 67 to 95) % male (of 33 survivors): 24 Number lost to follow-up: 7 (17.5%); all deaths Assigned: 22/18 [Long PFNA/standard PFNA] In analyses: 18/15
Interventions	Long proximal femoral nail antirotation (PFNA) versus standard PFNA Long PFNA: 34 to 42 cm length; diameter 9 and 10 mm and a neck shaft angle of 130 degrees; locked distally two 5 mm screws Standard PFNA: 24 cm length; diameter 10, 11 and 12 mm and a neck shaft angle of 130 degrees; locked distally one 5 mm screw
Outcomes	Length of surgery Fluoroscopy time Union (fracture consolidation) Re-operation Blade penetration Superficial wound infection Deep wound infection Malunion Length of hospital stay Mortality Harris hip score Parker and Palmer mobility score
Study funding	No funding was received for this study
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random allocation software used
Allocation concealment (selection bias)	Unclear risk	No mention of allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants were not blinded. Surgeons could not be blinded

Okcu 2013 (*Continued*)

Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Outcome assessment of mobility and Harris hip score blinded
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding but independent assessor
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	Similar losses in both groups from mortality (4 versus 3) but results provided only for survivors
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	Similar losses in both groups from mortality (4 versus 3) but results provided only for survivors
Selective reporting (reporting bias)	Unclear risk	No protocol but outcomes reported in methods appear to be reported
Other bias	Low risk	Similar baseline characteristics; although data provided only for survivors the common fracture type, exclusion criteria, and similarity of age characteristics in those randomised and analysed indicate that this is unlikely to be a source of bias
Other performance bias (e.g. differential expertise bias)	Low risk	Three 'experienced' trauma surgeons. Same pre- and post-operative care
Other sources of bias (funding)	Low risk	No funding bias as declared by authors

Papasimos 2005

Methods	Randomised trial: method not stated Length of follow-up: mean 12 months
Participants	Orthopaedic hospital, Patras Hellas, Greece 80 of 141 people with an unstable trochanteric proximal femoral fracture (see Notes) Age (of 80 participants): mean 81 years % male (of 80): 41 Number lost to follow-up (of 141): 11 (7.8%) Assigned: ?/? [PFN / Gamma nail] In analyses: 40/40 [PFN / Gamma nail]
Interventions	Proximal femoral nail (PFN) versus a trochanteric Gamma nail 11 or 12 mm diameter PFN with distal locking in 37 out of 40 participants 135 degree trochanteric Gamma nail with 17 mm proximal diameter and 11 mm distal diameter and distal locking in all 40 participants

Outcomes	Length of surgery Operative blood loss Radiographic screening time Operative fracture (some of greater trochanter) Cut-out of implant Later fracture of the femur Non-union Re-operation Superficial wound infection Haematoma Medical complications Chest infection Pneumonia Mental disturbances Deep vein thrombosis Pulmonary embolism Urinary infection Length of hospital stay Time to fracture consolidation Function: Salvati and Wilson score
Study funding	No mention of funding or a conflict of interest
Notes	There were 141 people randomised into this trial but the intervention groups for the 10 participants who died before one year and the 11 who were lost to follow-up were not identified. Forty of the 120 participants included in the trial analyses were treated with a sliding hip screw. The results for this group are included in the Cochrane review 'Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults'

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No indication of how randomisation was performed "were strictly randomised"
Allocation concealment (selection bias)	Unclear risk	No details given
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No mention of blinding. Not possible to blind surgeons
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No details given. Subjective outcomes included mobility score, ease of reduction, nature of procedure. Radigraphs were assessed by the operating consultants and two

Papasimos 2005 (*Continued*)

		experienced residents
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Not blinded but unclear significance
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	No details on which groups the 11 patients who were lost to follow-up or 10 patients who had died were in
Incomplete outcome data (attrition bias) Longer-term outcome	High risk	11/141 lost to follow-up. No details on which groups the 11 patients who were lost to follow-up or of the 10 patients who had died
Selective reporting (reporting bias)	Unclear risk	No protocol though all the outcomes mentioned in the methods are reported
Other bias	Unclear risk	Groups similar in baseline characteristics but data not available for 21 participants
Other performance bias (e.g. differential expertise bias)	Unclear risk	Level of experience of 4 surgeons not stated but less experience with PFN noted. Care programmes are the same
Other sources of bias (funding)	Unclear risk	No mention of funding or a conflict of interest

Schipper 2004

Methods	Randomised trial: numbered and blinded envelopes with computer generated randomisation code Length of follow-up: 4 months for whole trial population; 12 months for those with non-consolidated fractures at 4 months
Participants	Multi-centre study conducted in 9 orthopaedic hospitals, The Netherlands 424 people with an unstable trochanteric proximal femoral fracture. Age 60 or above Age: mean 82 years % male: 18 Number lost to follow-up: 12 at 4 months (2.8%) Assigned: 211/213 [PFN/Gamma nail]
Interventions	Proximal femoral nail (PFN) versus a standard (130 degree,11 mm) mark 3 Gamma nail The PFN was 130 degree, 10 or 11 mm, and inserted without reaming. The Gamma nail was inserted with reaming All nails were locked distally in a static mode

Schipper 2004 (*Continued*)

Outcomes	Length of surgery Operative blood loss Cut-out of implant Operative fracture of femur Later fracture of the femur Technical difficulty during surgery Breakage of implant Suboptimal screw position Malrotation Need of open reduction Poor reduction of fracture Migration of the proximal nail screw(s) Union (fracture consolidation) Re-operation Superficial wound infection Deep wound infection Time to full weight bearing Length of hospital stay Pressure sores Pneumonia Thromboembolic complications Cardiovascular, urogenital, neurological, gastrointestinal and psychiatric complications Mortality Harris hip score
Study funding	The study was supported by an implant company (Stryker) involved in the manufacture of one of the nails (Gamma nail) used in the trial
Notes	Follow-up of the full trial population was up to 4 months. As per protocol, only those with incomplete radiological consolidation of their fractures at 4 months (85 versus 83) were followed up until 12 months. Additional clarification on results supplied by trialists

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	The randomisation order was computer-generated based on randomly permutated blocks of four and six patients
Allocation concealment (selection bias)	Low risk	Numbered and blinded envelopes
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. Unclear risk of bias

Schipper 2004 (*Continued*)

Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Subjective difficulty and quality of reduction as determined by surgeon not blinded. Unclear significance. Radiologists and research coordinator not blinded
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though uncertain risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	Low number (6/424) lost to follow-up at 4 weeks. Otherwise, complete data
Incomplete outcome data (attrition bias) Longer-term outcome	High risk	22 lost to follow-up in total. 342 followed to 4 months. But only 140 (incorrect in text) followed up to 1 year
Selective reporting (reporting bias)	Unclear risk	No protocol but all outcomes mentioned in the methods are reported on
Other bias	Low risk	No differences in baseline characteristics (age, sex, ASA and fracture type)
Other performance bias (e.g. differential expertise bias)	Unclear risk	Performed by surgeons with at experience of at least five procedures (unclear if this is enough experience). Not stated how many surgeons: 74% operations by residents. Similar post-operative care described
Other sources of bias (funding)	High risk	Supported by Stryker Howmedica and Mathys Medical Netherland. Authors received benefits which were directed to research fund etc. Stryker manufactures the Gamma nail used in the trial

Starr 2006

Methods	Randomised trial: numbered sealed envelopes (some attempt made to obscure allocation but of uncertain effectiveness) Length of follow-up: minimum 12 months (range 12 to 29 months)
Participants	Orthopaedic hospital, Dallas, USA 34 people (aged 10 to 50 years) with an extracapsular proximal femoral fracture caused by high energy trauma (15% stable trochanteric, 62% unstable trochanteric, 24% subtrochanteric fractures) Age: mean 34 years (range 19 to 50 years) % male: 35 Number lost to follow-up: 6 (18%) Assigned: 17/17 [Russell Taylor/long Gamma nail]

Starr 2006 (*Continued*)

Interventions	Russell Taylor Recon or Delta Intramedullary nail versus a long Gamma intramedullary nail The Russell Taylor nails were 10 to 14 mm distal diameter and had two proximal screws The Gamma nails were 11 mm distal diameter All nails were statically locked
Outcomes	Length of surgery Operative blood loss Cut-out of implant Operative fracture of the femur Later fracture of the femur Non-union Re-operation Wound infection Deep would infection Mortality Harris hip score Mobility Unable to do the same work Hip and knee range of movement
Study funding	Funding from a local research fund. No funding from industry
Notes	Extra information including method of randomisation and fracture distribution was supplied by trialists Three patients had open fractures and 17 (9 versus 8) had concurrent surgery for other injuries

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No clear details given. "Randomisation was carried out by use of envelopes opened"
Allocation concealment (selection bias)	Unclear risk	No details given: use of envelopes
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No mention of blinding. Surgeons not blinded for operative difficulty. Participants not blinded for pain. Implication of this is uncertain
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Not blinded

Starr 2006 (*Continued*)

Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No blinding though uncertain risk of bias for these outcomes
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	All data available
Incomplete outcome data (attrition bias) Longer-term outcome	Low risk	6 patients (2 versus 4) lost to follow-up (82% follow-up). 1 prisoner had incomplete follow-up
Selective reporting (reporting bias)	Unclear risk	No protocol though all outcomes discussed in the methods appear to be reported in full
Other bias	Low risk	No difference between the two groups in baseline characteristics
Other performance bias (e.g. differential expertise bias)	Low risk	4 attending surgeons performed all cases. Care programmes same in both groups
Other sources of bias (funding)	Low risk	Funding from a local research fund. No funding from industry

Vaquero 2012

Methods	Randomised trial: computer generated randomisation and sealed envelopes Length of follow-up: 12 months
Participants	Multi-centre study conducted in 6 orthopaedic hospitals in Spain: 2 in Madrid, 1 in Barcelona, 1 in Palencia, 1 in San Sebastian, and 1 in Santander 64 patients with isolated, unstable, closed or type 1 open trochanteric fracture (AO 31-A2 or 31-A3) Age: mean 84 years (range 69 to 98 years). % male: 13 Number lost to follow-up: 26 + 9 drop-outs (also 4 deaths) Assigned: 33/31 [PFNA/Gamma Nail]
Interventions	Proximal Femoral Nail Antirotation versus Gamma 3 Nail PFNA were 200 mm length and 11 mm diameter Gamma 3 nails were 180 mm length and 11 mm diameter. Both implants have neck shaft angles of 125 or 130 degrees and were inserted percutaneously with reaming in the majority of cases (>70%)
Outcomes	Length of surgery Technical problem at surgery/Surgical procedure change Fluoroscopy time Operative blood loss Length of stay

	Mobility Return to previous living status ADL independence (Katz index, EQ-5D index) Pain at fracture site, middle thigh and knee Implant loosening Cut-out of implant Implant breakage Loss of reduction Fracture impaction Delayed healing Non-union Peri-prosthetic fracture Superficial wound infection Deep wound infection Wound haematoma Fracture fixation failure Mortality Harris hip score SF-36 Physical Health SF-36 Mental Health Sangha Score Anatomical reduction status/Rotational deformity
Study funding	Financial Grant from Synthes. Authors state that there are no conflicts of interest that could inappropriately influence their work
Notes	Significant loss to follow-up of 39/64 patients (including 4 known deaths)

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer generated randomisation sequence
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes. No mention of opacity.
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons could not be blinded. Unclear risk of bias.
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding of assessors assessing functional scores such as SF-36, Haris hip score etc)
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding except for final classification of complications at end of follow-up. This was done using anonymised data by the principal clinical investigator.

Vaquero 2012 (*Continued*)

		Uncertain risk of bias for other outcomes such as operative time
Incomplete outcome data (attrition bias) Short-term outcome	High risk	Significant 21/64 (33%) short-term drop out at 3 months; 3 of these were due to deaths (5%). Some imbalance between groups
Incomplete outcome data (attrition bias) Longer-term outcome	High risk	Significant attrition bias 22/33 lost PFNA (4 known to have died) 17/31 lost Gamma (0 deaths known about)
Selective reporting (reporting bias)	Unclear risk	All outcomes described in methods appear to be reported on, though no specific protocol available
Other bias	Low risk	Groups similar in a wide variety of demographic variables Pre and post op care similar
Other performance bias (e.g. differential expertise bias)	Unclear risk	No mention of surgeon number or experience ('from six different hospitals')
Other sources of bias (funding)	High risk	Funded by grant from Synthes which manufactures the PFNA. Authors state there are no conflicts of interest that could inappropriately influence their work

Vidyadhara 2007

Methods	Randomised trial: computer generated random numbers table Length of follow-up: 24 months
Participants	Orthopaedic hospital, Karnataka, India 73 people with an unstable trochanteric proximal femoral fracture (AO types 31 A2.2, A2.3, A3.1, A3.2 and A3.3) Age: mean 69 years (range 61 to 89 years) % male: 51 Number lost to follow-up: none Assigned: 36/37 [ACE trochanteric nail / AP Gamma nail]
Interventions	ACE trochanteric nail versus an AP (Asian/Pacific) Gamma nail Nails of 130 degree angle and 200 mm length used in both groups. Both nails locked distally with the upper screw. The proximal antirotation screw was used in all cases of the ACE nail

Vidyadhara 2007 (*Continued*)

Outcomes	Length of surgery Operative blood loss Cut-out of implant Later fracture of the femur Non-union Re-operation All wound infection Deep wound infection Deep vein thrombosis Shortening Pain (at 1 month) Mortality Harris hip score Mobility Limp Difficulty in squatting
Study funding	No mention of funding or a conflict of interest
Notes	Extra information, including no loss to follow up or deaths, supplied by trialists

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer-generated random number table
Allocation concealment (selection bias)	Unclear risk	No mention of concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No mention of blinding. Surgeons could not be blinded
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention blinding. Subjective outcomes included pain, limp and Harris hip score
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding but uncertain risk of bias
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	All data available
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	No mortality or attrition data given. Longer-term outcomes presented as averages

Vidyadhara 2007 (*Continued*)

Selective reporting (reporting bias)	Unclear risk	No protocol but all outcomes discussed in the methods are reported
Other bias	Low risk	Baseline characteristics similar in both groups
Other performance bias (e.g. differential expertise bias)	Low risk	All performed by one surgeon. Same programme of care
Other sources of bias (funding)	Unclear risk	No mention of funding or a conflict of interest

Wild 2010

Methods	Quasi-randomised trial: based on admission sequence No mention of concealment Length of follow-up: 12 months
Participants	Heinrich Heine hospital, Dusseldorf, Germany 80 patients with a pertrochanteric fracture (AO type 31 A2) Age: 82.5 years (range 51 to 101) % male: 30 Number lost to follow-up: 4 (also 18 deaths) Assigned: 40/40 [PFNA/Targon]
Interventions	Proximal femoral nail antirotation (PFNA) nail versus a Targon PF nail The PFNA is a monoaxial rotation-stabilising nail which has a neck blade designed to improve fixation The Targon PF nail is biaxial with an additional antirotation pin and a barrel aimed at facilitating sliding of the femoral neck screw No further details
Outcomes	Operative time Intra-operative fluoroscopy time Perioperative mortality Hip joint range of motion Modified Harris hip score Femoral neck component cut-out Femoral neck component change (re-operation) Post-operative wound infection Periprosthetic fracture Implant breakage Radiographic union Dynamisation as measured by sliding of the femoral neck components (not reported in review) Quality of reduction (not reported in review)
Study funding	No conflict of interest noted

Notes		
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Inappropriate randomisation based on admission sequence
Allocation concealment (selection bias)	High risk	Quasi-randomised. No mention of concealment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. No mention of blinding otherwise. Uncertain risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Outcomes included Harris hip score and radiographic outcomes
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though uncertain risk of bias for these outcomes
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	All data available
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	22 not available at 12 months: 4 lost to follow-up and 18 deaths. Although 11 in each groups, the group allocation of the 18 deaths was not given
Selective reporting (reporting bias)	Unclear risk	No protocol though outcomes mentioned in methods are reported in full
Other bias	Unclear risk	Baseline characteristics similar but no baseline mobility status documented. No details of exclusion criteria (22 patients)
Other performance bias (e.g. differential expertise bias)	Unclear risk	2 experienced surgeons. No mention of care programme for either group
Other sources of bias (funding)	Low risk	No relevant financial relationships to disclose

Xu 2010a

Methods	Randomised trial carried using consecutive numbered and sealed envelopes based on a computer generated list Length of follow-up: 17.68 months (12 to 27)
Participants	First Affiliated Hospital of Soochow University, Suzhou, China 136 patients unstable trochanteric fractures (31 A2 (116) or 31 A3 (19)) Age: mean 76 years % male: 40 Number lost to follow-up: 28 (21%) Assigned: 66/70 [PFNA/Gamma Nail 3]
Interventions	Proximal femoral nail antirotation (PFNA) versus a Gamma 3 nail PFNA: solid titanium nail 170 or 240 mm in length, mediolateral curvature of 6 degrees, diameter of 10 or 11 mm. Inserted without reaming of the canal. The helical blade was inserted into the neck without drilling. The distal screw could be locked either dynamically or statically. The neck shaft angle was 130 degrees Gamma 3 nail: 170 mm in length, had a lower mediolateral curvature of 40 degrees and a diameter of 11 mm. Reaming of the femur was performed prior to insertion. One distal locking screw was placed
Outcomes	Intra-operative blood loss Blood transfusion Operating time Flouroscopy time Fracture reduction Length of hospital stay Time to fracture healing Femoral shaft fracture Implant failure Implant cutout Medical complications Wound complications Femoral shaft shortening Proximal screw migration Hip and thigh pain Mortality Recovery of pre-operative weight bearing ability Walking ability score Range of hip flexion
Study funding	No conflict of interest disclosed
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Xu 2010a (*Continued*)

Random sequence generation (selection bias)	Low risk	"use of consecutive numbered and sealed envelopes based on a computer generated list"
Allocation concealment (selection bias)	Unclear risk	Unclear if envelopes were opaque or not
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. Uncertain risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Subjective outcomes included mobility score and quality of reduction
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though uncertain risk for these outcomes
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	All data available
Incomplete outcome data (attrition bias) Longer-term outcome	High risk	28/136 unavailable for long-term follow-up due to illness/moving. Together with 15 deaths (groups not specified), 43 unavailable in total (32%). Variable follow-up
Selective reporting (reporting bias)	Unclear risk	No protocol though outcomes in methods appear to be reported completely
Other bias	Low risk	Similar baseline characteristics in the two groups
Other performance bias (e.g. differential expertise bias)	Low risk	Similar care programmes. All surgeons had experience with at least 5 procedures
Other sources of bias (funding)	Low risk	Disclosure of no conflict of interest at the end of the references

Zhang 2013

Methods	Randomised trial: computer generated randomisation list. Numbered and sealed envelopes Length of follow-up: mean 18.6 months (range 12 to 30 months)
Participants	Nanfang Hospital, Southern Medical University, Guangzhou, China The Second Affiliated Hospital of Inner Mongolia Medical University, Hohhot, China 113 people with unstable trochanteric femoral fractures caused by low energy trauma (AO classification A2.1-3.3). Informed consent

Zhang 2013 (*Continued*)

	Age: mean 73 years % male: 37 Number lost to follow-up: 5 (4%) (all were too ill) Assigned: 57/56 [InterTan nail / PFNA-II]
Interventions	InterTan nail versus Proximal Femoral Nail Antirotation (PFNA-II) InterTan nail: 180 mm long; trapezoidal proximal end with diameter decreasing from 15.25 x 16.25 mm proximally to 11 mm distally; 2 cephalocervical screws proximally (11 mm lag and 7 mm compression screw) PFNA-II: solid titanium nail, 170 - 200 mm long and 9, 10 or 11mm diameter Both nails were inserted percutaneously in the majority of participants. Open surgery was done for 8 InterTan and 4 PFNA-II nails
Outcomes	Intra-operative blood loss Operating time Flouroscopy time Fracture reduction results (not reported in review) Length of hospital stay Implant position (optimal or suboptimal) (not reported in review) Intra-operative complications -Femoral shaft fracture -Lateral greater trochanter fracture -Distal interlocking problem -Penetration trochanter by proximal nail Post-operative complications -Wound infection (superficial and deep) -Haematoma -Cutout -Lateral migration of hip screw -Femoral neck shortening -Hip and thigh pain -Delayed union -Re-operation -Medical complications: DVT, PE, cardiovascular disorder, pressure sore, UTI Mortality Walking ability score Range of motion hip Harris hip score
Study funding	No relevant financial relationships to disclose
Notes	The PFNA-II nail was designed to fit the different femur geometry in Asians

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomisation based on a computer generated list

Zhang 2013 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	"use of consecutive numbered and sealed envelopes." Unclear if envelopes were opaque. The sealed envelopes were opened by the surgeon pre-operatively (timing unclear)
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not possible to blind surgeons. Unclear risk of bias
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding of assessors for outcomes such as Haris hip score, hip pain, walking ability score
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding, though uncertain risk of bias for outcomes such as mortality, length of stay, operative time, blood loss, implant position
Incomplete outcome data (attrition bias) Short-term outcome	Low risk	Short-term outcomes appear complete
Incomplete outcome data (attrition bias) Longer-term outcome	Low risk	Five (4.4%) lost to follow-up; 15 (13.3%) died in the follow-up period. Losses balanced in the two groups
Selective reporting (reporting bias)	Unclear risk	No protocol but all outcomes mentioned in the methods appear reported on
Other bias	Low risk	No differences in baseline characteristics (age, sex, weight, fracture type)
Other performance bias (e.g. differential expertise bias)	Low risk	Two surgeons with experience unclear, but "At least 5 procedures independently with either PFNA-II or InterTan nail" Similar pre-operative and post-operative care
Other sources of bias (funding)	Low risk	No conflict of interest identified at the beginning of the paper

Zhu 2012

Methods	Randomised trial: sealed envelopes Length of follow-up: mean 12 months
Participants	Shanghai Sixth People's Hospital, Shanghai, China 80 people with intertrochanteric fractures (AO classification A1 and A2) Age: 46 (inclusion criteria: 18 to < 60 years) % male: 67.5% Number lost to follow-up: 0, but 3 complications Assigned 40/40 [Sliding/Non-sliding Gamma 3 nail]
Interventions	Gamma 3 nail: sliding versus non-sliding lag screw. Gamma 3 nail: 180 mm titanium alloy with type II proximal anodization; distal diameter 15.5 mm and 11 mm. Reaming of medullary canal 'generally performed' before insertion. Distal locking screw used Sliding lag screw: non-tightening of set screw Non-sliding lag screw: tightening of set screw
Outcomes	Operating time Intra-operative blood loss Transfusion Fracture reduction results (not reported in review) Length of hospital stay (days) Bone union Healing time (months) Lag screw sliding distance (not reported in review) Femoral shaft fracture (timing not clear) Cutout Leg length discrepancy Harris Hip Score
Study funding	No significant financial support confirmed by authors
Notes	The trial aimed to exclude patients with osteoporosis

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Randomisation was achieved by 'drawing an unseen card from a sealed envelope'
Allocation concealment (selection bias)	Unclear risk	'Unseen card from sealed envelope.'Unclear what unseen means; no mention of opacity of envelope
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons could not be blinded. Unclear risk of bias

Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding of assessors for outcomes such as Haris hip score, healing time
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	No mention of blinding though uncertain risk
Incomplete outcome data (attrition bias) Short-term outcome	Unclear risk	Only those without complications analysed
Incomplete outcome data (attrition bias) Longer-term outcome	Unclear risk	The flow diagram in the report indicates that three non-sliding group participants were excluded from the analysis because of complications. The effect on the results for Haris hip score are unclear but we judged that these were unlikely to be important
Selective reporting (reporting bias)	Unclear risk	No protocol but all outcomes mentioned in methods and aims at end of introduction reported on
Other bias	Low risk	Similar baseline characteristics
Other performance bias (e.g. differential expertise bias)	Low risk	All cases performed by the same surgeon. No stated differences in the pre- and post-operative care programmes
Other sources of bias (funding)	Low risk	No conflict of interest identified at the end of the paper

DVT: deep vein thrombosis
IMHS: intramedullary hip screw
PE: pulmonary embolism
PFN: proximal femoral nail
UTI: urinary tract infection

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

Study	Reason for exclusion
Cao 2009	This was excluded in the Gamma nail review (Parker 2010) for the following reasons: "This was reported as a randomised trial of 95 patients with trochanteric fractures treated with either a Gamma nail, proximal femoral nail or a dynamic hip screw. The English abstract implied that the population was randomly divided according to the Evans classification system. Overall, there was limited reporting of the study methodology within the paper such that it was not possible to determine clearly if it was a randomised controlled trial or an observational study. The study was excluded because it was uncertain that it was a randomised controlled trial"
Dall'Oca 2010	This is a trial comparing the Gamma nail with and without cement augmentation in the treatment of unstable intertrochanteric fractures. It was excluded as it did not compare two different nails but rather the same nail with and without cement augmentation
Gahr 2003	This quasi-randomised trial of 50 participants with a proximal femoral fracture treated alternatively with either the long Gamma nail of 10 mm diameter or a long Gamma nail of 11 mm diameter. The trial report in German with English abstract reported outcomes until hospital discharge (mean 19 days). The follow-up was incomplete but no further report has been identified. There was no response from the contact author (latest: March 2006). The trial was excluded on the basis of inadequacy of follow-up and limited reporting of outcomes
Huang 2012	This retrospective study compared the PFNA nail with the reconstruction nail. It was excluded as it was a not a randomised trial
Merenyi 1995	This conference abstract suggested a randomised trial comparing three "different types of Gamma nail" versus Ender nails versus angle plates. Previous correspondence with the authors indicated there was no randomisation of patients only a 'random' selection of patients which had been previously treated with one of the different types of implant
NTR1133	The trial registration document reported a trial comparing the Fixion Proximal Femur Nailing System versus Gamma 3 nail that aimed to recruit 244 patients with proximal femur fractures with AO-classification 31 A1.1 - A3.3; age >18 years The contact author was contacted on 10/01/2013 and responded on 13/01/2013 that the trial was never published: "The trial is as far as I know never published, because we do not work with that type of intramedullary nails anymore." There was no response to our subsequent request for further information (26/01/2013)
Ouyang 2010	This trial reported on 92 participants with an upper femoral shaft fracture where patients were divided into three groups dependent on their preferences. The type of treatments used were an interlocking intramedullary nail, compression plate or Plum nail. The study was excluded as there was inadequate information within the article to determine if this was a randomised controlled trial. However, it seems more likely that it was based on preferences
Pan 2009	A related article by the same team was excluded in the Gamma nail review (Parker 2010). This was reported as a randomised trial of 131 patients with a trochanteric fractures treated with either a Gamma nail or a proximal femoral nail. There was limited reporting of the study methodology within the paper such that it was not possible to determine clearly if it was a randomised controlled trial or an observational study. The study was excluded because it was uncertain that it was a randomised controlled trial
Suckel 2006	This was a comparative study of 240 patients with extra-articular femur fractures: 124 were treated with a proximal femoral nail and 116 with a gliding nail. The study was excluded as there was no randomisation of patients

(*Continued*)

Wagner 1998	Translation from German of the methods of this comparative study of the intramedullary hip screw with the Gamma nail established that it was not a randomised trial
Xu 2010b	Overlapping recruitment period, same authors and implants as Xu 2010a but this included stable fractures as well. Response to our request for clarification was "It is true that there is unstable fractures in both the Injury paper and in the Orthopaedics paper and to be honest, some of the unstable patients reported in the Injury paper are also included in the Orthopaedics paper." This was excluded to avoid duplication of participant data
Yang 2011	This randomised trial, which compared the proximal femoral nail (PFN) versus the intramedullary hip screw in 215 patients (105 versus 110) with intertrochanteric fractures, was initially included upon receiving a translation. However, the extent of similarity between Makridis 2010, which compared the ENDOVIS nail versus the intramedullary hip screw in 215 patients (105 versus 110), and Yang 2011 in the trial population and results (e.g. same statistics for mobility and haemoglobin levels) and figures are very unusual. Additionally, those figures reported to be of the PFN appeared more like the ENDOVIS nail. The trial report was excluded because of the serious doubts of its authenticity engendered by these discoveries

Characteristics of studies awaiting assessment *[ordered by study ID]*

Mora 2011

Methods	Randomised Follow-up until fracture healed
Participants	Unknown location 208 patients with an acute trochanteric femoral fracture (AO/ASIF A1, A2 and A3)
Interventions	Proximal Femoral Nail Antirotation (PFNA) versus Proximal Femoral Nail (PFN)
Outcomes	Intra- and post-operative complications: cut-out, cut-in
Notes	Abstract available: http://www.bjjprocs.boneandjoint.org.uk/content/93-B/SUPP_II/136.5 No publication found

Park 2010

Methods	Randomised according to "admission sequence". The exact details are unclear with the authors referencing another trial rather than giving brief details of their methods. Furthermore, there is some concern regarding the imbalance in the group numbers (17 versus 23). We sent a request to the trial investigators on 27/5/2014 for them to clarify the exact randomisation methodology Follow-up at 4 years (minimum 1.5 years)
Participants	Ansan, Korea 40 patients with intertrochanteric fractures
Interventions	Proximal femoral nail (PFN) versus PFNA (proximal femoral nail antirotation)

Park 2010 (*Continued*)

Outcomes	Operation time, blood loss, time to ambulation, time to union, complications, post-operative function and mobility using social function scores and mobility scores
Notes	There is no mention of randomisation/random allocation in the title or abstract of the report of this study, which was not identified as an eligible study in the screening process. Prior to submission, one author (MJP) questioned whether the full report should be checked. This refers to it being randomised in the Methods but the imbalance in the numbers in the two groups (17 versus 23) raises questions about the trial methods. Our attempt to contact the trial investigators for clarification was unsuccessful

Stern 2011

Methods	Randomised: "computer-generated random numbers placed in sealed opaque envelopes" Follow-up at one year
Participants	Geneva, Switzerland 168 patients with trochanteric fractures
Interventions	Gamma 3 Trochanteric Nail versus PFNA (proximal femoral nail antirotation)
Outcomes	Re-operations, nonunion, superficial wound infection, cutout
Notes	The study compared screw (dynamic hip screw and Gamma nail) versus helical blade implants (dynamic hip system blade versus PFNA), but randomised separately by nail and hip system. The results were reported for the screw versus blade comparison. Separate data for the nail comparison requested from the trial authors on 22/05/14

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

NCT01437176

Trial name or title	Treatment of intertrochanteric fracture with new type of intramedullary nail
Methods	Randomised One year follow-up
Participants	Patients 18 years of age or older with a stable intertrochanteric hip fracture, ambulatory prior to fracture. Plan to enrol 36 patients
Interventions	New type of intramedullary nail versus Proximal femoral nail antirotation (PFNA) nail
Outcomes	Fracture healing Complications (non-union. implant breakage/failure, infection, DVT) Revision surgery Quality of life score (SF-36; FIM) Mortality

NCT01437176 (*Continued*)

Starting date	September 2011
Contact information	Peifu Tang, Chinese PLA General Hospital, Beijing, China pftang301@126.com
Notes	Study was still recruiting in February 2013

DATA AND ANALYSES

Comparison 1. Proximal femoral nail (PFN) versus Gamma nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality	3		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
1.1 At 4 months	1	424	Risk Ratio (M-H, Fixed, 95% CI)	1.27 [0.82, 1.96]
1.2 At 12 months	3	830	Risk Ratio (M-H, Fixed, 95% CI)	1.08 [0.82, 1.41]
2 Final functional outcomes	3		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Pain at follow up	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Symptoms or restriction from the hip	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Incomplete recovery of walking ability (including death)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Harris hip scores (0 to 100: high values = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
3.1 At 4 weeks	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 At 4 months	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 At 1 year	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Intra-operative complications	4		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
4.1 Changed method of fixation	1	424	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.17, 3.34]
4.2 Open reduction	1	424	Risk Ratio (M-H, Fixed, 95% CI)	2.15 [0.95, 4.86]
4.3 Poor reduction	2	504	Risk Ratio (M-H, Fixed, 95% CI)	2.01 [0.62, 6.57]
4.4 Difficult surgery	2	504	Risk Ratio (M-H, Fixed, 95% CI)	1.46 [0.98, 2.19]
4.5 Difficult proximal or distal screw insertion	1	424	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.36, 2.83]
4.6 Intra-operative comminution of the fracture around the trochanteric region	2	330	Risk Ratio (M-H, Fixed, 95% CI)	0.3 [0.12, 0.73]
4.7 Operative fracture of the femur	4	910	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.07, 1.63]
4.8 Suboptimal position of fixation devices	1	424	Risk Ratio (M-H, Fixed, 95% CI)	1.23 [0.77, 1.95]
5 Fracture healing complications	4		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
5.1 Cut-out	4	910	Risk Ratio (M-H, Fixed, 95% CI)	0.71 [0.39, 1.30]
5.2 Later fracture of femur	4	910	Risk Ratio (M-H, Fixed, 95% CI)	0.82 [0.24, 2.84]
5.3 Implant breakage	3	754	Risk Ratio (M-H, Fixed, 95% CI)	0.34 [0.01, 8.21]
5.4 Non-union/pseudoarthrosis	3	754	Risk Ratio (M-H, Fixed, 95% CI)	0.60 [0.14, 2.50]
5.5 Secondary varus (> 10%)	1	250	Risk Ratio (M-H, Fixed, 95% CI)	4.5 [0.99, 20.41]
5.6 Fracture site collapse due to screw migration	1	250	Risk Ratio (M-H, Fixed, 95% CI)	2.5 [0.81, 7.76]
5.7 Medial or lateral hip screw migration	1	424	Risk Ratio (M-H, Fixed, 95% CI)	6.06 [1.37, 26.74]
5.8 Muscle pain due to 'point effect'	1	250	Risk Ratio (M-H, Fixed, 95% CI)	0.57 [0.17, 1.90]

6 Re-operation	4	910	Risk Ratio (M-H, Fixed, 95% CI)	1.25 [0.83, 1.90]
7 Wound complications	4		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
7.1 Seroma	1	250	Risk Ratio (M-H, Fixed, 95% CI)	0.90 [0.51, 1.60]
7.2 Haematoma	4	910	Risk Ratio (M-H, Fixed, 95% CI)	0.97 [0.62, 1.51]
7.3 Superficial infection	3	754	Risk Ratio (M-H, Fixed, 95% CI)	0.65 [0.32, 1.29]
7.4 Deep infection	3	830	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.34, 2.95]
8 Post-operative complications	3		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
8.1 Pneumonia	2	236	Risk Ratio (M-H, Fixed, 95% CI)	2.93 [0.12, 70.72]
8.2 Pressure sores	2	406	Risk Ratio (M-H, Fixed, 95% CI)	1.08 [0.51, 2.30]
8.3 Deep vein thrombosis	2	236	Risk Ratio (M-H, Fixed, 95% CI)	1.65 [0.22, 12.29]
8.4 Pulmonary embolism	3	486	Risk Ratio (M-H, Fixed, 95% CI)	1.5 [0.25, 8.85]
8.5 Acute post-operative mental confusion	2	330	Risk Ratio (M-H, Fixed, 95% CI)	0.78 [0.44, 1.39]
8.6 Urinary infection	2	330	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.44, 2.84]
8.7 Digestive haemorrhage	1	250	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.10]
8.8 Acute kidney failure	1	250	Risk Ratio (M-H, Fixed, 95% CI)	0.5 [0.05, 5.44]
9 Length of hospital stay (days)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
10 Operative details: length of surgery and blood loss	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
10.1 Length of surgery (minutes)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.2 Blood loss (mL)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
11 Number of patients transfused	2		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Comparison 2. ACE trochanteric nail versus Gamma nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality	2	185	Risk Ratio (M-H, Fixed, 95% CI)	1.0 [0.15, 6.85]
2 Final functional outcomes	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Hip pain at 1 month	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Limp	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Difficulty in squatting	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Mobility score (0: no difficulties to 9: most difficulties)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4 Harris hip score (1 to 100: high values = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4.1 At 4 months	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 At 1 year	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.3 At 2 years	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Fracture healing complications	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
5.1 Operative fracture of femur	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.2 Later fracture of femur	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.3 Cut-out	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.34 [0.01, 8.14]
5.4 Non-union	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.5 All fracture healing complications	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.34 [0.01, 8.14]

5.6 Re-operation	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.34 [0.01, 8.14]
6 Wound complications	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
6.1 All wound infection	2	185	Risk Ratio (M-H, Fixed, 95% CI)	1.33 [0.31, 5.69]
6.2 Deep wound infection	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7 Post-operative complications	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
7.1 Deep vein thrombosis	2	185	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.01]
7.2 All medical complications	1	88	Risk Ratio (M-H, Fixed, 95% CI)	1.24 [0.67, 2.27]
8 Anatomical restoration	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
8.1 Shortening (1 cm or more)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
9 Operative details: length of surgery, blood loss and radiographic screening time	2		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
9.1 Length of surgery (minutes)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.2 Operative blood loss (mls)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.3 Units of blood transfused	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.4 Radiographic screening time (minutes)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
10 Number of patients transfused	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Comparison 3. ACE trochanteric nail versus the Gamma 3 nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality at 1 year	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Fracture healing complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Fixation failure (cut-out or redisplacement)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Non-union	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Wound infection	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.4 Re-operation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Post-operative complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Deep vein thrombosis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Peripheral nerve injury	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 4. Gliding nail versus Gamma nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality at 6 months	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Residence and unfavourable outcome (geriatric institution or death) at 6 months	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Living in a geriatric institution	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

2.2 Unfavourable outcome (institutionalised or dead)	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Fracture fixation complications	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Operative fracture of femur	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Later fracture of femur	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Cut-out	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Technical complications of fixation	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.5 Re-operation	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Post-operative complications	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4.1 Participants with a complication	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Pressure sores (decubitus)	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.3 Pneumonia	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.4 Cerebrovascular accident	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.5 Apoplexy	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.6 Forearm fracture	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Anatomical deformity	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
5.1 Leg shortening > 2 cm	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.2 External rotation > 20 degrees	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.3 Internal rotation > 20 degrees	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 5. ENDOVIS nail versus intramedullary hip screw (IMHS)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Unable to walk (bedridden) post-operatively	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Mortality	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 During hospital stay	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 At 1 year	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Fracture fixation complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Joint penetration	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Periprosthetic fracture	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Nail breakage	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.5 MIssed proximal hole	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.6 Misplaced proximal screws	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.7 Failure of distal locking	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.8 Z-phenomenon	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.9 Reverse Z-phenomenon	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.10 Proximal screw back-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.11 Femoral shaft medialization	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.12 Femoral shaft fracture	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.13 Infection	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

3.14 Re-operation	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Number of patients transfused	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Comparison 6. Russell-Taylor Recon nail versus long Gamma nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Final outcome measures	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 Mortality	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 Non-independent ambulator	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.3 Unable to do the same work	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2 Fracture healing and wound healing complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Operative fracture of femur	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Later fracture of femur	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.4 Non-union	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.5 All fracture healing complications	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.6 Wound infection (any type)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.7 Deep wound infection	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.8 Re-operation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 7. PFNA versus Targon PF nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Fracture fixation complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 Femoral neck cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 Re-operation to change femoral neck components	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.3 Periprosthetic fracture	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.4 Implant breakage	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.5 Fracture nonunion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.6 Infection (superficial)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 8. PFNA versus Gamma 3 nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality (12 months)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Harris hip score (1 to 100; higher values = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.1 6 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 12 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Mobility at 12+ months (Parker and Palmer mobility score: 0 to 9: best)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4 Recovery of pre-operative mobility (12+ months)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
5 SF-36 Physical Health (0 to 100; higher scores = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
5.1 6 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.2 12 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
6 SF-36 Mental Health (0 to 100; higher scores = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
6.1 6 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.2 12 months post-operative score	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
7 Katz ADL score at 12 months (0 to 6; higher score = best function)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
8 Range of hip flexion (degrees)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
9 Thigh pain at 12 months (Numeric pain scale, 1 to 10, higher scores = most pain)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
10 Hip or thigh pain (12+ months)	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
11 Fracture fixation complications	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
11.1 Intra-operative femoral shaft fracture	2	197	Risk Ratio (M-H, Fixed, 95% CI)	2.12 [0.20, 22.85]
11.2 Cut-out	2	197	Risk Ratio (M-H, Fixed, 95% CI)	4.84 [0.24, 96.89]
11.3 Later femoral shaft fracture	2	197	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.15, 6.92]
11.4 Deep wound infection	1	61	Risk Ratio (M-H, Fixed, 95% CI)	4.84 [0.24, 96.89]
11.5 Superficial wound infection	2	197	Risk Ratio (M-H, Fixed, 95% CI)	2.39 [0.36, 15.92]
11.6 Wound haematoma	2	197	Risk Ratio (M-H, Fixed, 95% CI)	0.77 [0.27, 2.21]
11.7 Proximal screw/blade migration	1	136	Risk Ratio (M-H, Fixed, 95% CI)	2.12 [0.55, 8.14]
11.8 Delayed healing	1	61	Risk Ratio (M-H, Fixed, 95% CI)	0.97 [0.31, 3.01]

11.9 Non-union	2	197	Risk Ratio (M-H, Fixed, 95% CI)	1.45 [0.26, 8.09]
11.10 Implant breakage	1	61	Risk Ratio (M-H, Fixed, 95% CI)	0.32 [0.01, 7.63]
11.11 Failure of fixation	1	61	Risk Ratio (M-H, Fixed, 95% CI)	2.26 [0.64, 7.93]
12 Post-operative complications	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
12.1 Number with "general" complications (mainly need for transfusion)	1	61	Risk Ratio (M-H, Fixed, 95% CI)	0.97 [0.60, 1.56]
12.2 Chest infection	1	136	Risk Ratio (M-H, Fixed, 95% CI)	1.33 [0.37, 4.73]
12.3 Decubitus ulcer	1	136	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.15, 7.31]
12.4 Urinary tract infection	1	136	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.15, 7.31]
13 Sangha Score at 1 year (1 to 6; higher score = more comorbidity)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
14 Length of stay (days)	2	197	Mean Difference (IV, Fixed, 95% CI)	-0.17 [-0.63, 0.29]
15 Femoral shortening	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
16 Operative details	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
16.1 Operating time (minutes)	2	197	Mean Difference (IV, Fixed, 95% CI)	-3.03 [-6.88, 0.82]
16.2 Fluoroscopy time (minutes)	1	136	Mean Difference (IV, Fixed, 95% CI)	-0.5 [-0.88, -0.12]
16.3 Intra-operative blood loss (mL)	1	136	Mean Difference (IV, Fixed, 95% CI)	-55.30 [-94.70, -15.90]
17 Number of patients transfused	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Comparison 9. Dynamic versus static locked intramedullary nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality at 1 year	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Pain and cortical hypertrophy	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Mid-thigh pain	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Cortical hypertrophy	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Fracture fixation complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Later fracture of the femur	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Technical complications of fixation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Re-operation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Leg shortening (mm) in those able to undergo a radiographic assessment	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
5 Operative details	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
5.1 Length of surgery (minutes)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.2 Intra-operative blood loss (minutes)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5.3 Haemoglobin level: 48 hours post-op (g/dL)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

5.4 Transfused packed blood cells	1	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 10. Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Harris hip score (0 to 100: high values = best function)	1	80	Mean Difference (IV, Fixed, 95% CI)	-1.27 [-4.98, 2.43]
1.1 Group A (AO A1.1, 1.2, 1.3)	1	11	Mean Difference (IV, Fixed, 95% CI)	-2.25 [-10.07, 5.57]
1.2 Group B (AO A2.1)	1	28	Mean Difference (IV, Fixed, 95% CI)	-0.80 [-8.24, 6.64]
1.3 Group C (AO A2.2, 2.3)	1	41	Mean Difference (IV, Fixed, 95% CI)	-1.08 [-6.19, 4.03]
2 Fracture fixation complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Femoral shaft fracture (timing not known)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Non-union at 6 months	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.4 Non-union at 12 months	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Average healing time (months)	1	80	Mean Difference (IV, Fixed, 95% CI)	-0.06 [-0.55, 0.43]
3.1 Group A (AO A1.1,1.2,1.3)	1	11	Mean Difference (IV, Fixed, 95% CI)	0.0 [-0.84, 0.84]
3.2 Group B (AO, A2.1)	1	28	Mean Difference (IV, Fixed, 95% CI)	0.0 [-0.65, 0.65]
3.3 Group C (AO, A2.2,2.3)	1	41	Mean Difference (IV, Fixed, 95% CI)	-0.62 [-2.25, 1.01]
4 Operative details	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4.1 Operation time (mins)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Intra-operative blood loss (mL)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Length of stay (days)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
6 Leg length discrepancy (mm) ('Group C' - unstable fractures - only)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected

Comparison 11. InterTan nail versus the PFNA II nail

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality (1 year)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Final functional outcomes	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.1 Harris hip score (1 to 100; high values = best function)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Walking ability score (0 to 9; high value = best function)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Hip and thigh pain	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Hip pain	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

3.2 Thigh pain	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Fracture fixation complications	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4.1 Cutout	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Femoral shaft fracture (post-operative)	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.3 Femoral shaft fracture (intra-operative)	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.4 Lateral greater trochanter fracture	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.5 Proximal end of nail penetrating trochanter	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.6 Distal interlocking problem	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.7 Blade migration	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.8 Re-operation	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Time to fracture healing (weeks)	1	Mean Difference (IV, Fixed, 95% CI)	Totals not selected
6 Post-operative complications	1	Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
6.1 Superficial wound infection	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.2 Deep infection	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.3 Deep venous thrombosis	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.4 Pulmonary embolism	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.5 Pressure sore	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.6 Urinary tract infection	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7 Length of stay (days)	1	Mean Difference (IV, Fixed, 95% CI)	Totals not selected
8 Operative details	1	Mean Difference (IV, Fixed, 95% CI)	Totals not selected
8.1 Operative time (min)	1	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
8.2 Blood loss (mL)	1	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
8.3 Fluoroscopy time (seconds)	1	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

Comparison 12. Long versus standard proximal femoral nail antirotation (PFNA nail)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality (1 year)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2 Final functional outcomes	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.1 Harris hip score (1 to 100, top score = best function)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Parker and Palmer mobility score (0 to 9, top score = best function)	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Fracture fixation complications	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Re-operation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Blade cut-out	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Wound infection (deep)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Wound infection (superficial)	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

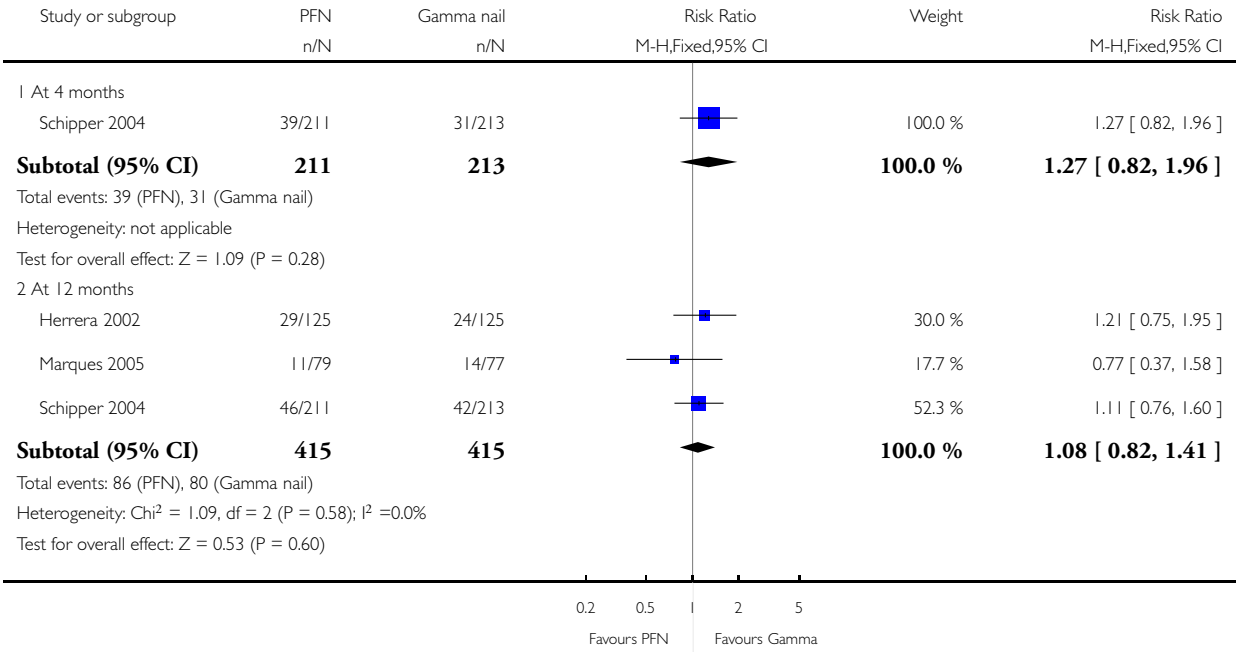
3.5 Non-union	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.6 Malunion	1	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 1.1. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 1 Mortality.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 1 Mortality



Analysis 1.2. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 2 Final functional outcomes.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 2 Final functional outcomes

Study or subgroup	PFN n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Pain at follow up				
Marques 2005	6/79	14/77		0.42 [0.17, 1.03]
2 Symptoms or restriction from the hip				
Schipper 2004	16/73	16/67		0.92 [0.50, 1.69]
3 Incomplete recovery of walking ability (including death)				
Herrera 2002	63/125	61/125		1.03 [0.80, 1.33]

Analysis 1.3. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 3 Harris hip scores (0 to 100: high values = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 3 Harris hip scores (0 to 100: high values = best function)

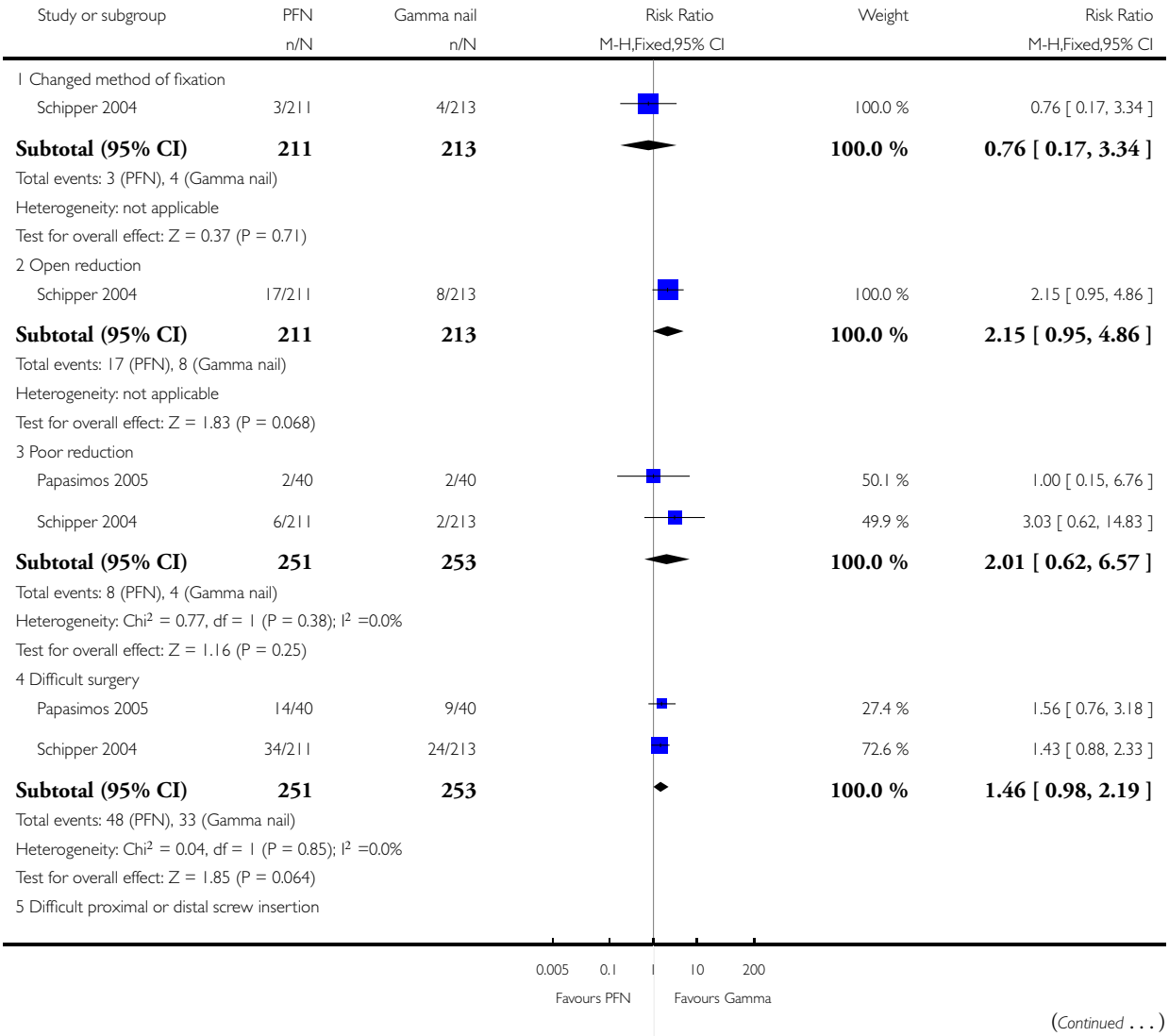
Study or subgroup	PFN N	Mean(SD)	Gamma nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 At 4 weeks						
Schipper 2004	140	52.6 (17.8)	139	53.9 (17.17)		-1.30 [-5.40, 2.80]
2 At 4 months						
Schipper 2004	133	61.9 (18.45)	130	62 (19.38)		-0.10 [-4.67, 4.47]
3 At 1 year						
Schipper 2004	73	66.8 (17.94)	64	69.5 (16)		-2.70 [-8.38, 2.98]

Analysis 1.4. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 4 Intra-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 4 Intra-operative complications



(*Continued . . .*)

(. . . *Continued*)

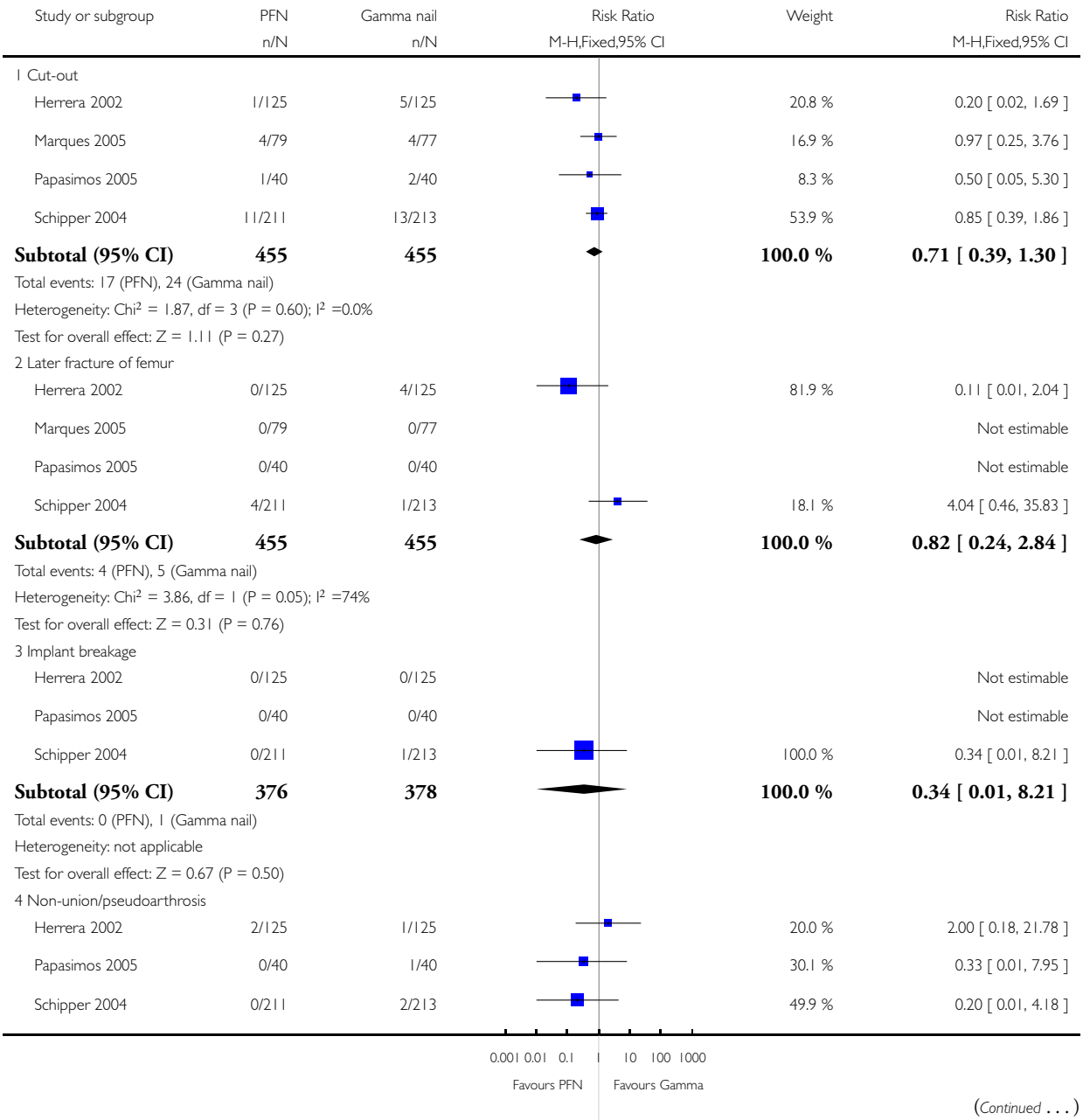
Study or subgroup	PFN n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Schipper 2004	7/211	7/213		100.0 %	1.01 [0.36, 2.83]
Subtotal (95% CI)	**211**	**213**		**100.0 %**	**1.01 [0.36, 2.83]**
Total events: 7 (PFN), 7 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.02 (P = 0.99)					
6 Intra-operative comminution of the fracture around the trochanteric region					
Herrera 2002	5/125	19/125		95.0 %	0.26 [0.10, 0.68]
Papasimos 2005	1/40	1/40		5.0 %	1.00 [0.06, 15.44]
Subtotal (95% CI)	**165**	**165**		**100.0 %**	**0.30 [0.12, 0.73]**
Total events: 6 (PFN), 20 (Gamma nail)					
Heterogeneity: Chi^2 = 0.82, df = 1 (P = 0.37); I^2 =0.0%					
Test for overall effect: Z = 2.67 (P = 0.0076)					
7 Operative fracture of the femur					
Herrera 2002	0/125	0/125			Not estimable
Marques 2005	1/79	2/77		33.7 %	0.49 [0.05, 5.26]
Papasimos 2005	0/40	1/40		24.9 %	0.33 [0.01, 7.95]
Schipper 2004	0/211	2/213		41.4 %	0.20 [0.01, 4.18]
Subtotal (95% CI)	**455**	**455**		**100.0 %**	**0.33 [0.07, 1.63]**
Total events: 1 (PFN), 5 (Gamma nail)					
Heterogeneity: Chi^2 = 0.20, df = 2 (P = 0.90); I^2 =0.0%					
Test for overall effect: Z = 1.36 (P = 0.17)					
8 Suboptimal position of fixation devices					
Schipper 2004	34/211	28/213		100.0 %	1.23 [0.77, 1.95]
Subtotal (95% CI)	**211**	**213**		**100.0 %**	**1.23 [0.77, 1.95]**
Total events: 34 (PFN), 28 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.86 (P = 0.39)					

Analysis 1.5. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 5 Fracture healing complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 5 Fracture healing complications



(*Continued* . . .)

(. . . *Continued*)

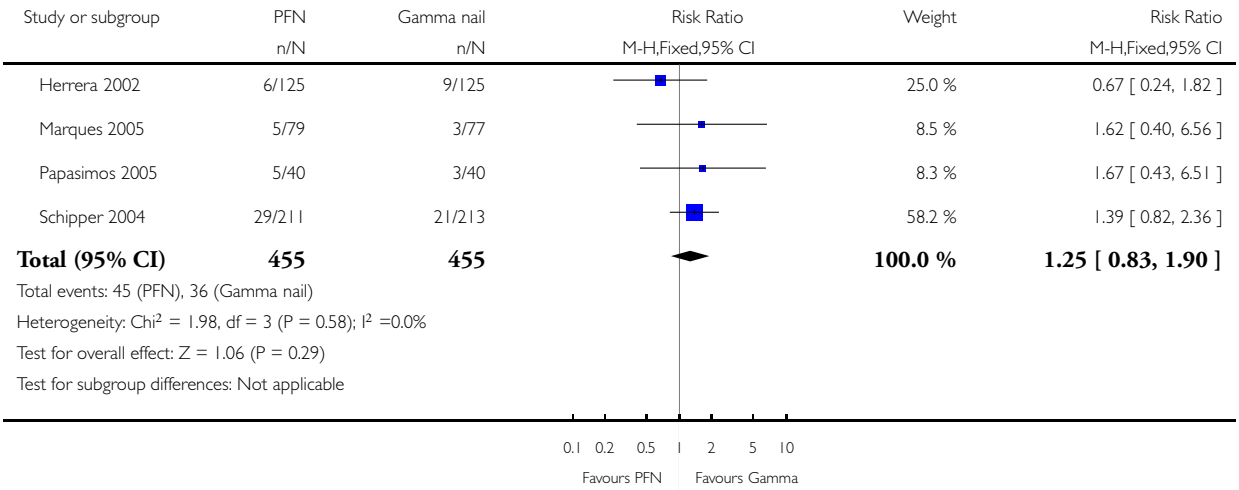
Study or subgroup	PFN n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Subtotal (95% CI)	**376**	**378**		**100.0 %**	**0.60 [0.14, 2.50]**
Total events: 2 (PFN), 4 (Gamma nail)					
Heterogeneity: Chi^2 = 1.60, df = 2 (P = 0.45); I^2 =0.0%					
Test for overall effect: Z = 0.70 (P = 0.49)					
5 Secondary varus (> 10%)					
Herrera 2002	9/125	2/125		100.0 %	4.50 [0.99, 20.41]
Subtotal (95% CI)	**125**	**125**		**100.0 %**	**4.50 [0.99, 20.41]**
Total events: 9 (PFN), 2 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 1.95 (P = 0.051)					
6 Fracture site collapse due to screw migration					
Herrera 2002	10/125	4/125		100.0 %	2.50 [0.81, 7.76]
Subtotal (95% CI)	**125**	**125**		**100.0 %**	**2.50 [0.81, 7.76]**
Total events: 10 (PFN), 4 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 1.59 (P = 0.11)					
7 Medial or lateral hip screw migration					
Schipper 2004	12/211	2/213		100.0 %	6.06 [1.37, 26.74]
Subtotal (95% CI)	**211**	**213**		**100.0 %**	**6.06 [1.37, 26.74]**
Total events: 12 (PFN), 2 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 2.38 (P = 0.017)					
8 Muscle pain due to 'point effect'					
Herrera 2002	4/125	7/125		100.0 %	0.57 [0.17, 1.90]
Subtotal (95% CI)	**125**	**125**		**100.0 %**	**0.57 [0.17, 1.90]**
Total events: 4 (PFN), 7 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.91 (P = 0.36)					

Analysis 1.6. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 6 Re-operation.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 6 Re-operation

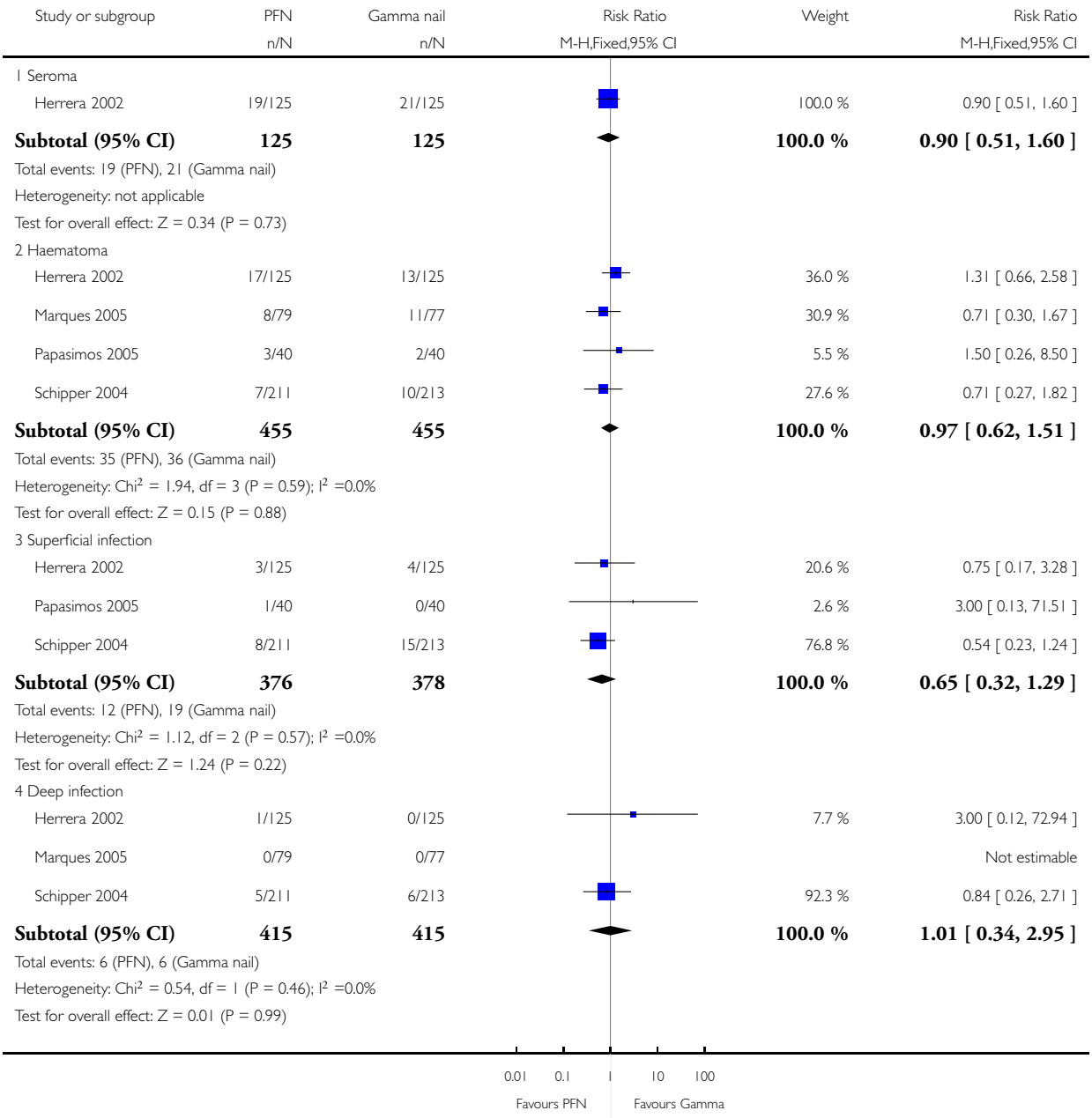


Analysis 1.7. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 7 Wound complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 7 Wound complications

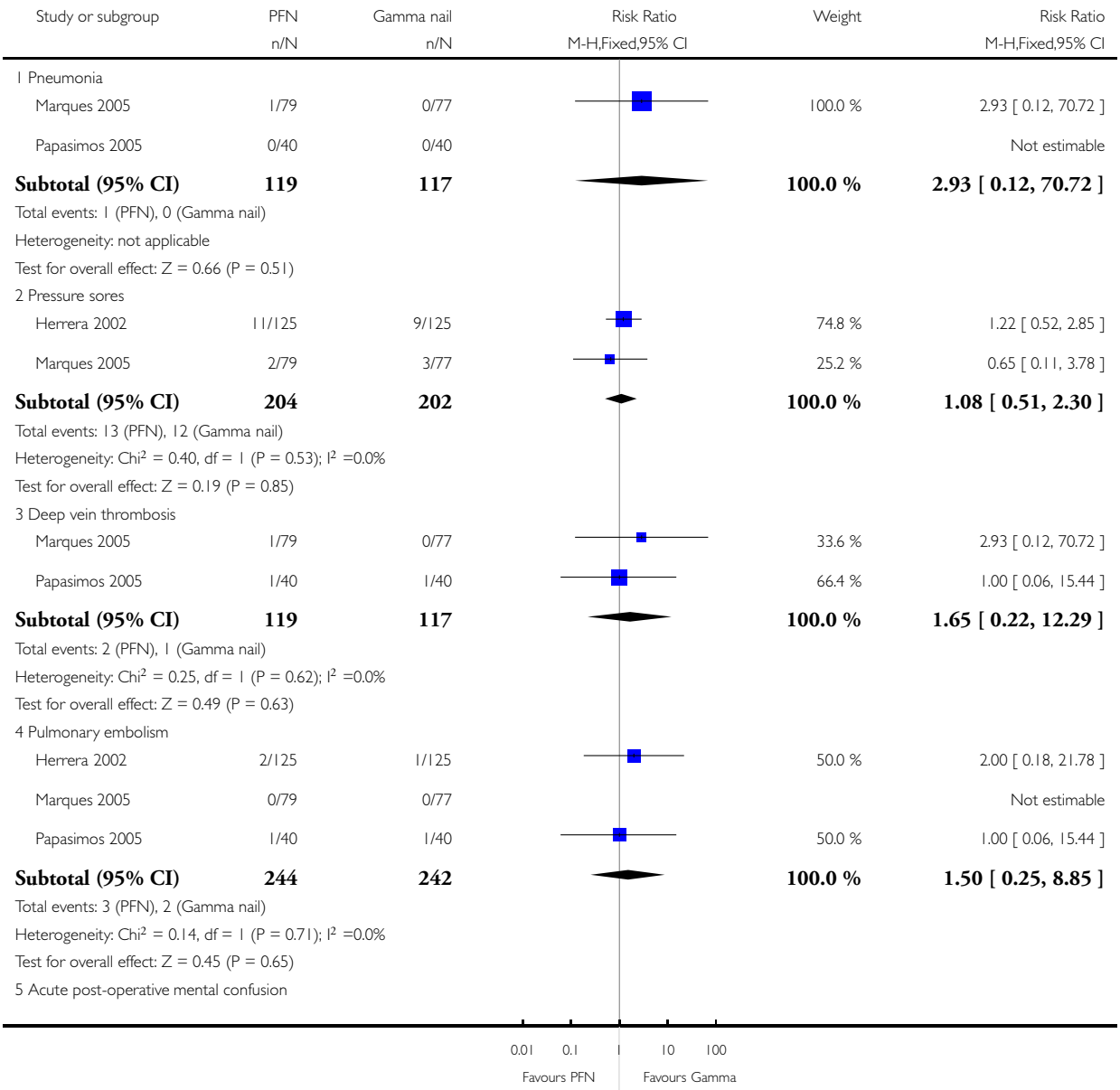


Analysis 1.8. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 8 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

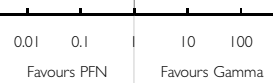
Outcome: 8 Post-operative complications



(*Continued . . .*)

(. . . *Continued*)

Study or subgroup	PFN n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Herrera 2002	15/125	20/125		87.0 %	0.75 [0.40, 1.40]
Papasimos 2005	3/40	3/40		13.0 %	1.00 [0.21, 4.66]
Subtotal (95% CI)	**165**	**165**		**100.0 %**	**0.78 [0.44, 1.39]**
Total events: 18 (PFN), 23 (Gamma nail)					
Heterogeneity: Chi^2 = 0.12, df = 1 (P = 0.73); I^2 =0.0%					
Test for overall effect: Z = 0.83 (P = 0.40)					
6 Urinary infection					
Herrera 2002	8/125	6/125		75.0 %	1.33 [0.48, 3.73]
Papasimos 2005	1/40	2/40		25.0 %	0.50 [0.05, 5.30]
Subtotal (95% CI)	**165**	**165**		**100.0 %**	**1.13 [0.44, 2.84]**
Total events: 9 (PFN), 8 (Gamma nail)					
Heterogeneity: Chi^2 = 0.56, df = 1 (P = 0.45); I^2 =0.0%					
Test for overall effect: Z = 0.25 (P = 0.80)					
7 Digestive haemorrhage					
Herrera 2002	0/125	1/125		100.0 %	0.33 [0.01, 8.10]
Subtotal (95% CI)	**125**	**125**		**100.0 %**	**0.33 [0.01, 8.10]**
Total events: 0 (PFN), 1 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.67 (P = 0.50)					
8 Acute kidney failure					
Herrera 2002	1/125	2/125		100.0 %	0.50 [0.05, 5.44]
Subtotal (95% CI)	**125**	**125**		**100.0 %**	**0.50 [0.05, 5.44]**
Total events: 1 (PFN), 2 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.57 (P = 0.57)					



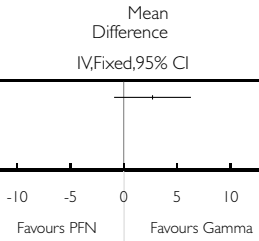
Analysis 1.9. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 9 Length of hospital stay (days).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 9 Length of hospital stay (days)

Study or subgroup	PFN N	Mean(SD)	Gamma N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Schipper 2004	211	21.7 (20.34)	213	19 (17.51)		2.70 [-0.91, 6.31]



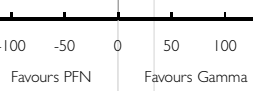
Analysis 1.10. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 10 Operative details: length of surgery and blood loss.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 10 Operative details: length of surgery and blood loss

Study or subgroup	PFN N	Mean(SD)	Gamma nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Length of surgery (minutes)						
Schipper 2004	211	60 (29.05)	213	60 (29.19)		0.0 [-5.54, 5.54]
2 Blood loss (mL)						
Schipper 2004	211	220 (199.84)	213	287 (262.7)		-67.00 [-111.40, -22.60]



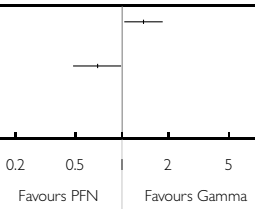
Analysis 1.11. Comparison 1 Proximal femoral nail (PFN) versus Gamma nail, Outcome 11 Number of patients transfused.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 1 Proximal femoral nail (PFN) versus Gamma nail

Outcome: 11 Number of patients transfused

Study or subgroup	PFN n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Herrera 2002	65/125	47/125		1.38 [1.04, 1.83]
Marques 2005	29/79	41/77		0.69 [0.48, 0.99]



Analysis 2.1. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 1 Mortality.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 1 Mortality

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Efstathopoulos 2007	2/56	2/56		100.0 %	1.00 [0.15, 6.85]
Vidyadhara 2007	0/36	0/37			Not estimable
Total (95% CI)	**92**	**93**		**100.0 %**	**1.00 [0.15, 6.85]**
Total events: 2 (ACE nail), 2 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.0 (P = 1.0)					
Test for subgroup differences: Not applicable					

Analysis 2.2. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 2 Final functional outcomes.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 2 Final functional outcomes

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Hip pain at 1 month				
Vidyadhara 2007	2/36	4/37		0.51 [0.10, 2.63]
2 Limp				
Vidyadhara 2007	2/36	3/37		0.69 [0.12, 3.86]
3 Difficulty in squatting				
Vidyadhara 2007	11/36	10/37		1.13 [0.55, 2.33]

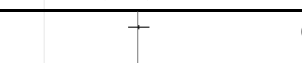
Analysis 2.3. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 3 Mobility score (0: no difficulties to 9: most difficulties).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 3 Mobility score (0: no difficulties to 9: most difficulties)

Study or subgroup	ACE nail N	Mean(SD)	Gamma nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Efstathopoulos 2007	47	7.1 (2.5)	41	7 (2.1)		0.10 [-0.86, 1.06]



Analysis 2.4. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 4 Harris hip score (1 to 100: high values = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 4 Harris hip score (1 to 100: high values = best function)

Study or subgroup	ACE nail N	Mean(SD)	Gamma nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 At 4 months						
Vidyadhara 2007	36	93 (3)	37	91 (2)		2.00 [0.83, 3.17]
2 At 1 year						
Vidyadhara 2007	36	96 (1)	37	95 (2)		1.00 [0.28, 1.72]
3 At 2 years						
Vidyadhara 2007	36	95 (1)	37	94 (2)		1.00 [0.28, 1.72]

Analysis 2.5. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 5 Fracture healing complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 5 Fracture healing complications

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Operative fracture of femur					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	0/37			Not estimable
Subtotal (95% CI)	**92**	**93**			**Not estimable**
Total events: 0 (ACE nail), 0 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: not applicable					
2 Later fracture of femur					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	0/37			Not estimable
Subtotal (95% CI)	**92**	**93**			**Not estimable**
Total events: 0 (ACE nail), 0 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: not applicable					
3 Cut-out					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	1/37		100.0 %	0.34 [0.01, 8.14]
Subtotal (95% CI)	**92**	**93**		**100.0 %**	**0.34 [0.01, 8.14]**
Total events: 0 (ACE nail), 1 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.66 (P = 0.51)					
4 Non-union					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	0/37			Not estimable
Subtotal (95% CI)	**92**	**93**			**Not estimable**
Total events: 0 (ACE nail), 0 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: not applicable					
5 All fracture healing complications					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	1/37		100.0 %	0.34 [0.01, 8.14]

(*Continued* . . .)

(. . . *Continued*)

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Subtotal (95% CI)	**92**	**93**		**100.0 %**	**0.34 [0.01, 8.14]**
Total events: 0 (ACE nail), 1 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.66 (P = 0.51)					
6 Re-operation					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	1/37		100.0 %	0.34 [0.01, 8.14]
Subtotal (95% CI)	**92**	**93**		**100.0 %**	**0.34 [0.01, 8.14]**
Total events: 0 (ACE nail), 1 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.66 (P = 0.51)					

Analysis 2.6. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 6 Wound complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 6 Wound complications

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 All wound infection					
Efstathopoulos 2007	4/56	3/56		100.0 %	1.33 [0.31, 5.69]
Vidyadhara 2007	0/36	0/37			Not estimable
Subtotal (95% CI)	**92**	**93**		**100.0 %**	**1.33 [0.31, 5.69]**
Total events: 4 (ACE nail), 3 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.39 (P = 0.70)					
2 Deep wound infection					
Efstathopoulos 2007	0/56	0/56			Not estimable
Vidyadhara 2007	0/36	0/37			Not estimable

(*Continued* . . .)

(. . . *Continued*)

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Subtotal (95% CI)	**92**	**93**			**Not estimable**
Total events: 0 (ACE nail), 0 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: not applicable					

Analysis 2.7. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 7 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 7 Post-operative complications

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Deep vein thrombosis					
Efstathopoulos 2007	0/56	1/56		100.0 %	0.33 [0.01, 8.01]
Vidyadhara 2007	0/36	0/37			Not estimable
Subtotal (95% CI)	**92**	**93**		**100.0 %**	**0.33 [0.01, 8.01]**
Total events: 0 (ACE nail), 1 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.68 (P = 0.50)					
2 All medical complications					
Efstathopoulos 2007	17/47	12/41		100.0 %	1.24 [0.67, 2.27]
Subtotal (95% CI)	**47**	**41**		**100.0 %**	**1.24 [0.67, 2.27]**
Total events: 17 (ACE nail), 12 (Gamma nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.68 (P = 0.50)					

Analysis 2.8. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 8 Anatomical restoration.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 8 Anatomical restoration

Study or subgroup	ACE nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Shortening (1 cm or more)				
Vidyadhara 2007	1/36	2/37		0.51 [0.05, 5.42]

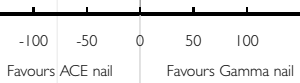
Analysis 2.9. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 9 Operative details: length of surgery, blood loss and radiographic screening time.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 9 Operative details: length of surgery, blood loss and radiographic screening time

Study or subgroup	ACE nail N	Mean(SD)	Gamma nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Length of surgery (minutes)						
Efstathopoulos 2007	56	54 (15)	56	51 (11)		3.00 [-1.87, 7.87]
2 Operative blood loss (mls)						
Vidyadhara 2007	36	63 (12)	37	50 (15)		13.00 [6.78, 19.22]
3 Units of blood transfused						
Efstathopoulos 2007	56	2 (1.7)	56	2.3 (1.6)		-0.30 [-0.91, 0.31]
4 Radiographic screening time (minutes)						
Efstathopoulos 2007	56	2.5 (1.7)	56	2.2 (1.8)		0.30 [-0.35, 0.95]

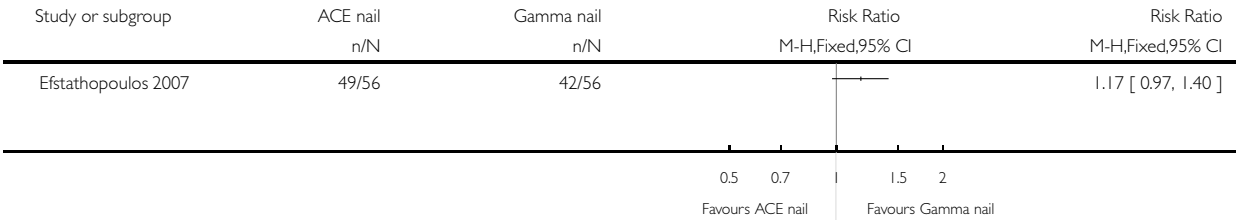


Analysis 2.10. Comparison 2 ACE trochanteric nail versus Gamma nail, Outcome 10 Number of patients transfused.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 2 ACE trochanteric nail versus Gamma nail

Outcome: 10 Number of patients transfused

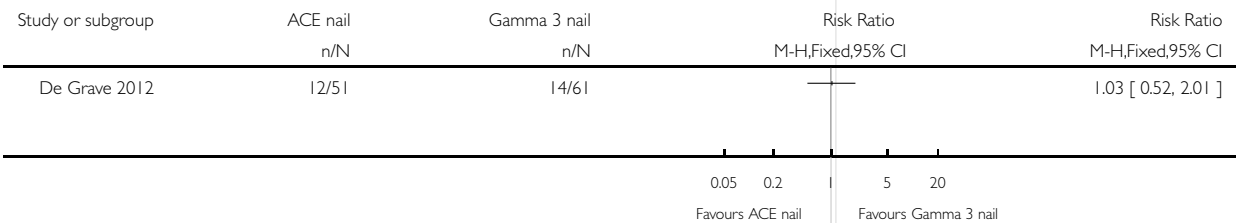


Analysis 3.1. Comparison 3 ACE trochanteric nail versus the Gamma 3 nail, Outcome 1 Mortality at 1 year.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 3 ACE trochanteric nail versus the Gamma 3 nail

Outcome: 1 Mortality at 1 year



Analysis 3.2. Comparison 3 ACE trochanteric nail versus the Gamma 3 nail, Outcome 2 Fracture healing complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 3 ACE trochanteric nail versus the Gamma 3 nail

Outcome: 2 Fracture healing complications

Study or subgroup	ACE nail n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Fixation failure (cut-out or redisplacement)				
De Grave 2012	2/51	2/61		1.20 [0.17, 8.19]
2 Non-union				
De Grave 2012	0/51	0/61		Not estimable
3 Wound infection				
De Grave 2012	0/51	0/61		Not estimable
4 Re-operation				
De Grave 2012 (1)	2/51	2/61		1.20 [0.17, 8.19]

(1) All reoperations involved hip arthroplasty

Analysis 3.3. Comparison 3 ACE trochanteric nail versus the Gamma 3 nail, Outcome 3 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 3 ACE trochanteric nail versus the Gamma 3 nail

Outcome: 3 Post-operative complications

Study or subgroup	ACE nail n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Deep vein thrombosis				
De Grave 2012	0/51	0/61		Not estimable
2 Peripheral nerve injury				
De Grave 2012 (1)	0/51	1/61		0.40 [0.02, 9.55]

(1) This resulted in 'foot drop'

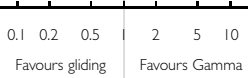
Analysis 4.1. Comparison 4 Gliding nail versus Gamma nail, Outcome 1 Mortality at 6 months.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 4 Gliding nail versus Gamma nail

Outcome: 1 Mortality at 6 months

Study or subgroup	Favours gliding n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Fritz 1999	5/40	6/40		0.83 [0.28, 2.51]



Analysis 4.2. Comparison 4 Gliding nail versus Gamma nail, Outcome 2 Residence and unfavourable outcome (geriatric institution or death) at 6 months.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 4 Gliding nail versus Gamma nail

Outcome: 2 Residence and unfavourable outcome (geriatric institution or death) at 6 months

Study or subgroup	Gliding nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Living in a geriatric institution				
Fritz 1999	14/34	19/34		0.74 [0.45, 1.22]
2 Unfavourable outcome (institutionalised or dead)				
Fritz 1999	20/40	24/40		0.83 [0.56, 1.24]

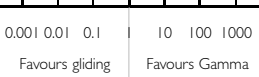
Analysis 4.3. Comparison 4 Gliding nail versus Gamma nail, Outcome 3 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 4 Gliding nail versus Gamma nail

Outcome: 3 Fracture fixation complications

Study or subgroup	Gliding nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Operative fracture of femur				
Fritz 1999	1/40	0/40		3.00 [0.13, 71.51]
2 Later fracture of femur				
Fritz 1999	1/40	0/40		3.00 [0.13, 71.51]
3 Cut-out				
Fritz 1999	0/40	3/40		0.14 [0.01, 2.68]
4 Technical complications of fixation				
Fritz 1999	2/40	3/40		0.67 [0.12, 3.78]
5 Re-operation				
Fritz 1999	3/40	4/40		0.75 [0.18, 3.14]



Analysis 4.4. Comparison 4 Gliding nail versus Gamma nail, Outcome 4 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 4 Gliding nail versus Gamma nail

Outcome: 4 Post-operative complications

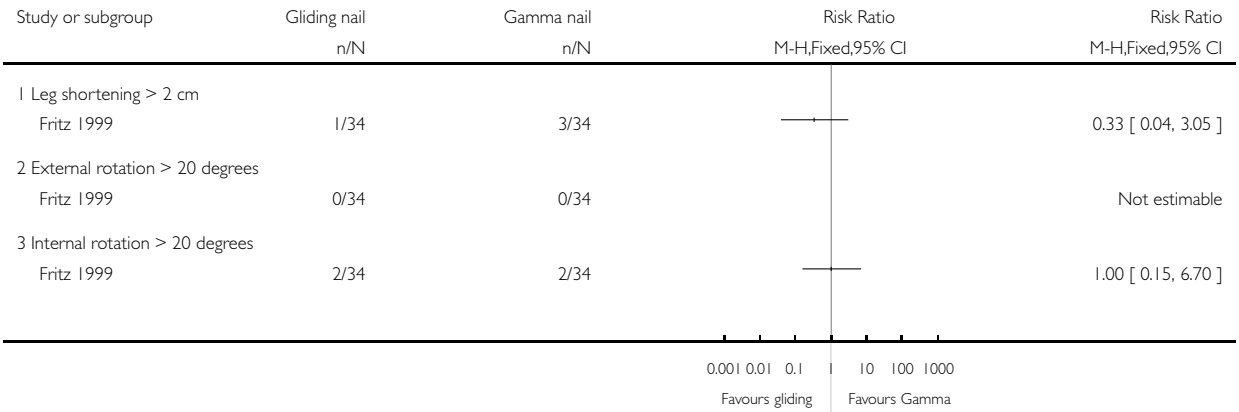
Study or subgroup	Gliding nail n/N	Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Participants with a complication				
Fritz 1999	9/40	6/40		1.50 [0.59, 3.82]
2 Pressure sores (decubitus)				
Fritz 1999	2/40	2/40		1.00 [0.15, 6.76]
3 Pneumonia				
Fritz 1999	1/40	1/40		1.00 [0.06, 15.44]
4 Cerebrovascular accident				
Fritz 1999	2/40	1/40		2.00 [0.19, 21.18]
5 Apoplexy				
Fritz 1999	1/40	0/40		3.00 [0.13, 71.51]
6 Forearm fracture				
Fritz 1999	1/40	0/40		3.00 [0.13, 71.51]

Analysis 4.5. Comparison 4 Gliding nail versus Gamma nail, Outcome 5 Anatomical deformity.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 4 Gliding nail versus Gamma nail

Outcome: 5 Anatomical deformity

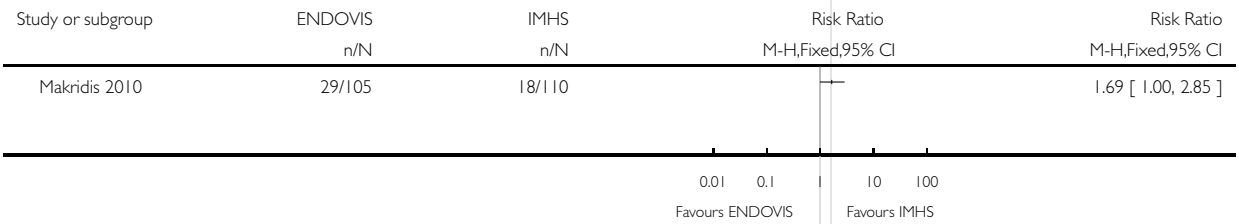


Analysis 5.1. Comparison 5 ENDOVIS nail versus intramedullary hip screw (IMHS), Outcome 1 Unable to walk (bedridden) post-operatively.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 5 ENDOVIS nail versus intramedullary hip screw (IMHS)

Outcome: 1 Unable to walk (bedridden) post-operatively



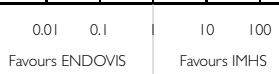
Analysis 5.2. Comparison 5 ENDOVIS nail versus intramedullary hip screw (IMHS), Outcome 2 Mortality.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 5 ENDOVIS nail versus intramedullary hip screw (IMHS)

Outcome: 2 Mortality

Study or subgroup	ENDOVIS n/N	IMHS n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 During hospital stay				
Makridis 2010	3/105	2/110		1.57 [0.27, 9.22]
2 At 1 year				
Makridis 2010	16/105	17/110		0.99 [0.53, 1.85]



Analysis 5.3. Comparison 5 ENDOVIS nail versus intramedullary hip screw (IMHS), Outcome 3 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 5 ENDOVIS nail versus intramedullary hip screw (IMHS)

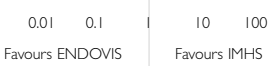
Outcome: 3 Fracture fixation complications

Study or subgroup	ENDOVIS n/N	IMHS n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Joint penetration				
Makridis 2010	3/105	0/110		7.33 [0.38, 140.22]
2 Periprosthetic fracture				
Makridis 2010	0/105	1/110		0.35 [0.01, 8.47]
3 Nail breakage				
Makridis 2010	1/105	1/110		1.05 [0.07, 16.53]
4 Cut-out				
Makridis 2010	3/105	1/110		3.14 [0.33, 29.74]
5 MIssed proximal hole				

(*Continued* . . .)

(. . . *Continued*)

Study or subgroup	ENDOVIS n/N	IMHS n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Makridis 2010	2/105	0/110		5.24 [0.25, 107.79]
6 Misplaced proximal screws				
Makridis 2010	8/105	1/110		8.38 [1.07, 65.86]
7 Failure of distal locking				
Makridis 2010	4/105	1/110		4.19 [0.48, 36.88]
8 Z-phenomenon				
Makridis 2010	1/105	0/110		3.14 [0.13, 76.27]
9 Reverse Z-phenomenon				
Makridis 2010	1/105	0/110		3.14 [0.13, 76.27]
10 Proximal screw back-out				
Makridis 2010	5/105	0/110		11.52 [0.64, 205.77]
11 Femoral shaft medialization				
Makridis 2010	5/105	0/110		11.52 [0.64, 205.77]
12 Femoral shaft fracture				
Makridis 2010	0/105	1/110		0.35 [0.01, 8.47]
13 Infection				
Makridis 2010	2/105	2/110		1.05 [0.15, 7.30]
14 Re-operation				
Makridis 2010 (1)	5/105	2/110		2.62 [0.52, 13.21]



(1) ENDOVIS: cut-out (3); Z-phenomena (2); IMHS: cut-out (1); shaft fracture (1)

Analysis 5.4. Comparison 5 ENDOVIS nail versus intramedullary hip screw (IMHS), Outcome 4 Number of patients transfused.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 5 ENDOVIS nail versus intramedullary hip screw (IMHS)

Outcome: 4 Number of patients transfused

Study or subgroup	ENDOVIS n/N	IMHS n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Makridis 2010	28/105	29/110		1.01 [0.65, 1.58]

Analysis 6.1. Comparison 6 Russell-Taylor Recon nail versus long Gamma nail, Outcome 1 Final outcome measures.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 6 Russell-Taylor Recon nail versus long Gamma nail

Outcome: 1 Final outcome measures

Study or subgroup	Recon nail n/N	Long Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Mortality				
Starr 2006	0/17	0/17		Not estimable
2 Non-independent ambulator				
Starr 2006	0/15	1/13		0.29 [0.01, 6.60]
3 Unable to do the same work				
Starr 2006	2/15	2/13		0.87 [0.14, 5.32]

Analysis 6.2. Comparison 6 Russell-Taylor Recon nail versus long Gamma nail, Outcome 2 Fracture healing and wound healing complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 6 Russell-Taylor Recon nail versus long Gamma nail

Outcome: 2 Fracture healing and wound healing complications

Study or subgroup	Recon nail n/N	Long Gamma nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Operative fracture of femur				
Starr 2006	0/17	0/17		Not estimable
2 Later fracture of femur				
Starr 2006	0/17	0/17		Not estimable
3 Cut-out				
Starr 2006	0/17	0/17		Not estimable
4 Non-union				
Starr 2006	0/17	0/17		Not estimable
5 All fracture healing complications				
Starr 2006	0/17	0/17		Not estimable
6 Wound infection (any type)				
Starr 2006	0/17	1/17		0.33 [0.01, 7.65]
7 Deep wound infection				
Starr 2006	0/17	0/17		Not estimable
8 Re-operation				
Starr 2006	8/17	5/17		1.60 [0.66, 3.91]

Analysis 7.1. Comparison 7 PFNA versus Targon PF nail, Outcome 1 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 7 PFNA versus Targon PF nail

Outcome: 1 Fracture fixation complications

Study or subgroup	PFNA n/N	Targon n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Femoral neck cut-out				
Wild 2010	3/40	2/40		1.50 [0.26, 8.50]
2 Re-operation to change femoral neck components				
Wild 2010	2/40	0/40		5.00 [0.25, 100.97]
3 Periprosthetic fracture				
Wild 2010	1/40	0/40		3.00 [0.13, 71.51]
4 Implant breakage				
Wild 2010	0/40	0/40		Not estimable
5 Fracture nonunion				
Wild 2010	0/40	1/40		0.33 [0.01, 7.95]
6 Infection (superficial)				
Wild 2010	4/40	2/40		2.00 [0.39, 10.31]

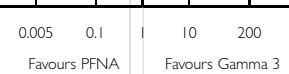
Analysis 8.1. Comparison 8 PFNA versus Gamma 3 nail, Outcome 1 Mortality (12 months).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 1 Mortality (12 months)

Study or subgroup	PFNA n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Vaquero 2012	4/31	0/30		8.72 [0.49, 155.27]



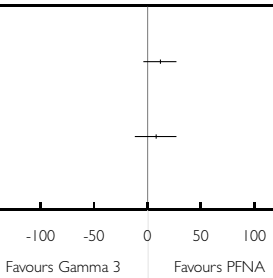
Analysis 8.2. Comparison 8 PFNA versus Gamma 3 nail, Outcome 2 Harris hip score (1 to 100; higher values = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 2 Harris hip score (1 to 100; higher values = best function)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 6 months post-operative score						
Vaquero 2012	15	68 (18.7)	11	56.5 (21.5)		11.50 [-4.34, 27.34]
2 12 months post-operative score						
Vaquero 2012	11	72.6 (20)	10	65.1 (25.4)		7.50 [-12.19, 27.19]



Analysis 8.3. Comparison 8 PFNA versus Gamma 3 nail, Outcome 3 Mobility at 12+ months (Parker and Palmer mobility score: 0 to 9: best).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 3 Mobility at 12+ months (Parker and Palmer mobility score: 0 to 9: best)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Xu 2010a	46	6.3 (2.03)	47	6.1 (1.37)		0.20 [-0.51, 0.91]

Analysis 8.4. Comparison 8 PFNA versus Gamma 3 nail, Outcome 4 Recovery of pre-operative mobility (12+ months).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 4 Recovery of pre-operative mobility (12+ months)

Study or subgroup	PFNA n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Xu 2010a	29/46	32/47		0.93 [0.69, 1.24]

Analysis 8.5. Comparison 8 PFNA versus Gamma 3 nail, Outcome 5 SF-36 Physical Health (0 to 100; higher scores = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 5 SF-36 Physical Health (0 to 100; higher scores = best function)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 6 months post-operative score						
Vaquero 2012	16	36.1 (8.6)	13	32.9 (8.6)		3.20 [-3.09, 9.49]
2 12 months post-operative score						
Vaquero 2012	10	36.6 (12.3)	11	35 (10.8)		1.60 [-8.34, 11.54]

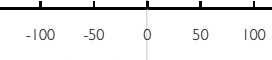
Analysis 8.6. Comparison 8 PFNA versus Gamma 3 nail, Outcome 6 SF-36 Mental Health (0 to 100; higher scores = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 6 SF-36 Mental Health (0 to 100; higher scores = best function)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 6 months post-operative score						
Vaquero 2012	16	41.5 (12)	13	41.3 (8.6)		0.20 [-7.31, 7.71]
2 12 months post-operative score						
Vaquero 2012	10	47.8 (11.3)	11	46.3 (12.8)		1.50 [-8.81, 11.81]



Analysis 8.7. Comparison 8 PFNA versus Gamma 3 nail, Outcome 7 Katz ADL score at 12 months (0 to 6; higher score = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 7 Katz ADL score at 12 months (0 to 6; higher score = best function)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Vaquero 2012	10	4 (2.4)	12	3.6 (2.3)		0.40 [-1.58, 2.38]

Analysis 8.8. Comparison 8 PFNA versus Gamma 3 nail, Outcome 8 Range of hip flexion (degrees).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 8 Range of hip flexion (degrees)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Xu 2010a	46	98.3 (14.2)	47	94.9 (15.1)		3.40 [-2.56, 9.36]

Analysis 8.9. Comparison 8 PFNA versus Gamma 3 nail, Outcome 9 Thigh pain at 12 months (Numeric pain scale, 1 to 10, higher scores = most pain).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 9 Thigh pain at 12 months (Numeric pain scale, 1 to 10, higher scores = most pain)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Vaquero 2012	10	1 (1.3)	12	1.5 (1.8)		-0.50 [-1.80, 0.80]

Analysis 8.10. Comparison 8 PFNA versus Gamma 3 nail, Outcome 10 Hip or thigh pain (12+ months).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 10 Hip or thigh pain (12+ months)

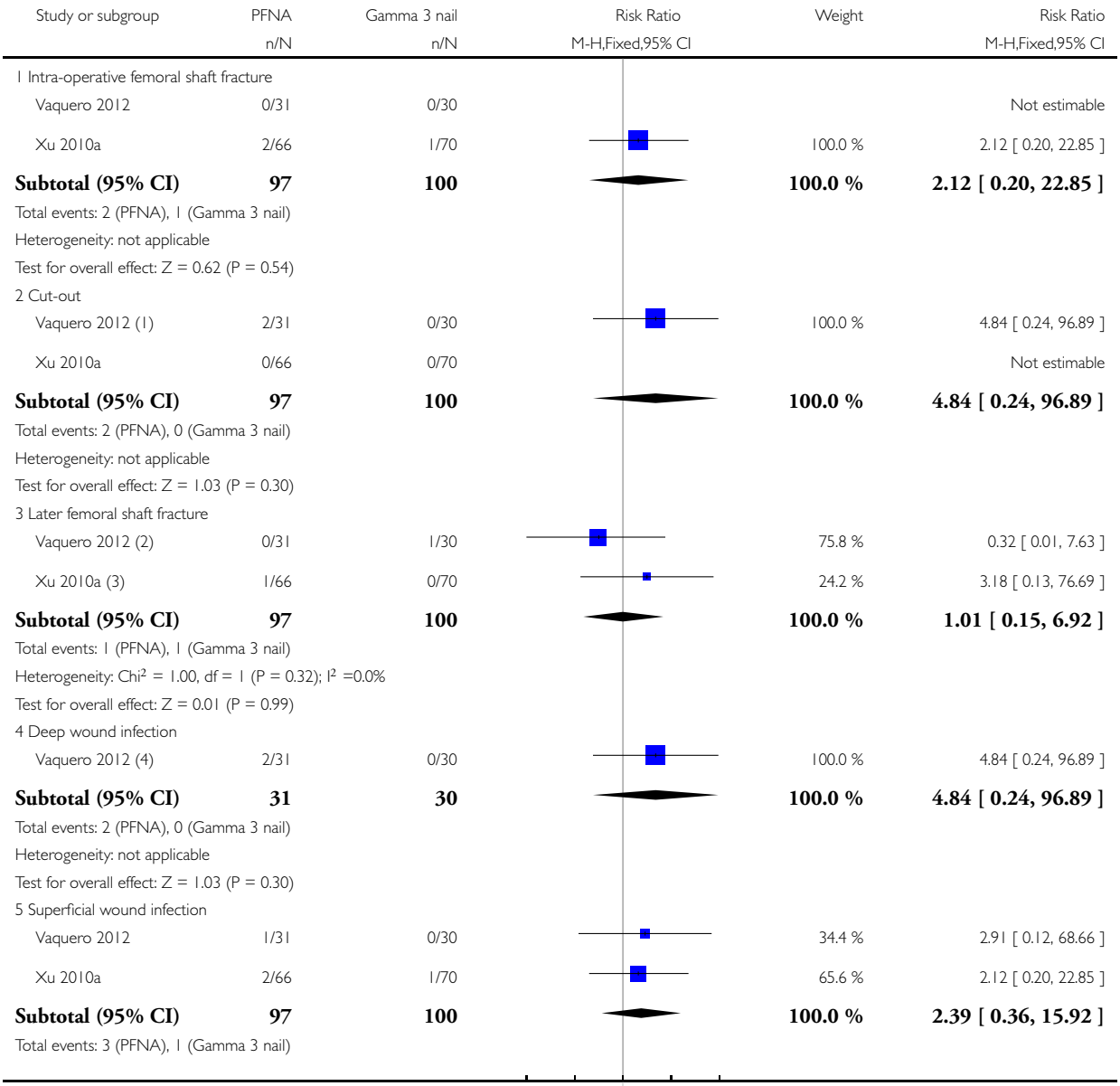
Study or subgroup	PFNA n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Xu 2010a	19/46	11/47			1.76 [0.95, 3.29]
Subtotal (95% CI)	**0**	**0**			**0.0 [0.0, 0.0]**
Total events: 19 (PFNA), 11 (Gamma 3 nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.0 (P < 0.00001)					

Analysis 8.11. Comparison 8 PFNA versus Gamma 3 nail, Outcome 11 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

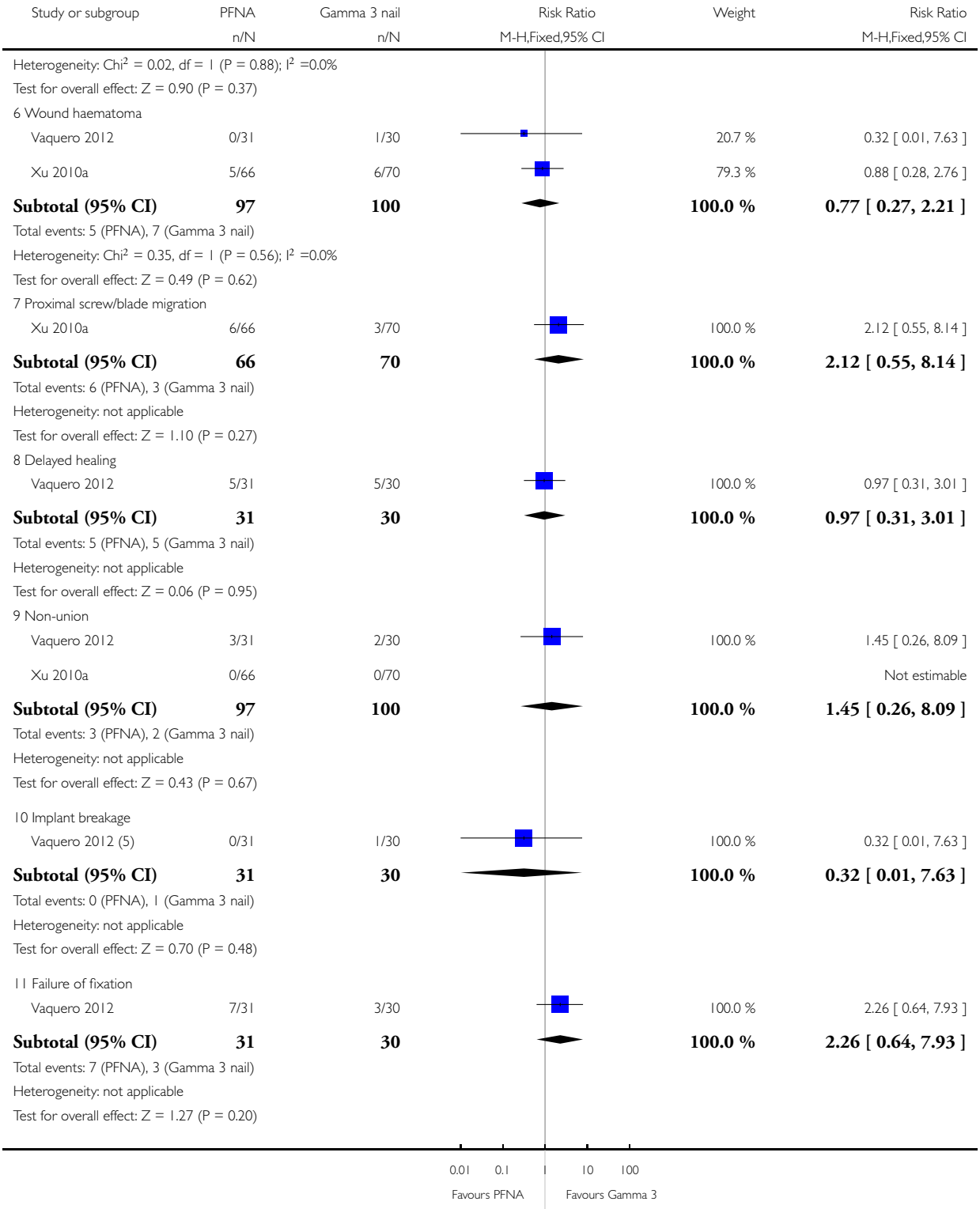
Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 11 Fracture fixation complications



(*Continued . . .*)

(. . . *Continued*)



(1) Both re-operated

(2) Re-operated

(3) This occurred at 1 month and was treated with a plate

(4) One patient died from sepsis

(5) Re-operated

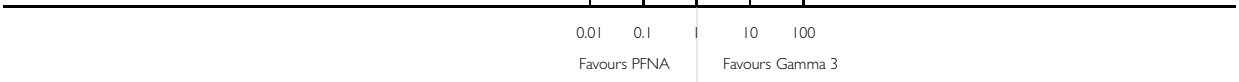
Analysis 8.12. Comparison 8 PFNA versus Gamma 3 nail, Outcome 12 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 12 Post-operative complications

Study or subgroup	PFNA n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Number with "general" complications (mainly need for transfusion)					
Vaquero 2012	16/31	16/30		100.0 %	0.97 [0.60, 1.56]
Subtotal (95% CI)	**31**	**30**		**100.0 %**	**0.97 [0.60, 1.56]**
Total events: 16 (PFNA), 16 (Gamma 3 nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.13 (P = 0.89)					
2 Chest infection					
Xu 2010a	5/66	4/70		100.0 %	1.33 [0.37, 4.73]
Subtotal (95% CI)	**66**	**70**		**100.0 %**	**1.33 [0.37, 4.73]**
Total events: 5 (PFNA), 4 (Gamma 3 nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.43 (P = 0.66)					
3 Decubitus ulcer					
Xu 2010a	2/66	2/70		100.0 %	1.06 [0.15, 7.31]
Subtotal (95% CI)	**66**	**70**		**100.0 %**	**1.06 [0.15, 7.31]**
Total events: 2 (PFNA), 2 (Gamma 3 nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.06 (P = 0.95)					
4 Urinary tract infection					
Xu 2010a	2/66	2/70		100.0 %	1.06 [0.15, 7.31]
Subtotal (95% CI)	**66**	**70**		**100.0 %**	**1.06 [0.15, 7.31]**
Total events: 2 (PFNA), 2 (Gamma 3 nail)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.06 (P = 0.95)					



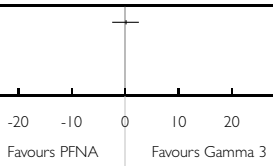
Analysis 8.13. Comparison 8 PFNA versus Gamma 3 nail, Outcome 13 Sangha Score at 1 year (1 to 6; higher score = more comorbidity).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 13 Sangha Score at 1 year (1 to 6; higher score = more comorbidity)

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Vaquero 2012	11	4.6 (2.8)	12	4.5 (3.2)		0.10 [-2.35, 2.55]

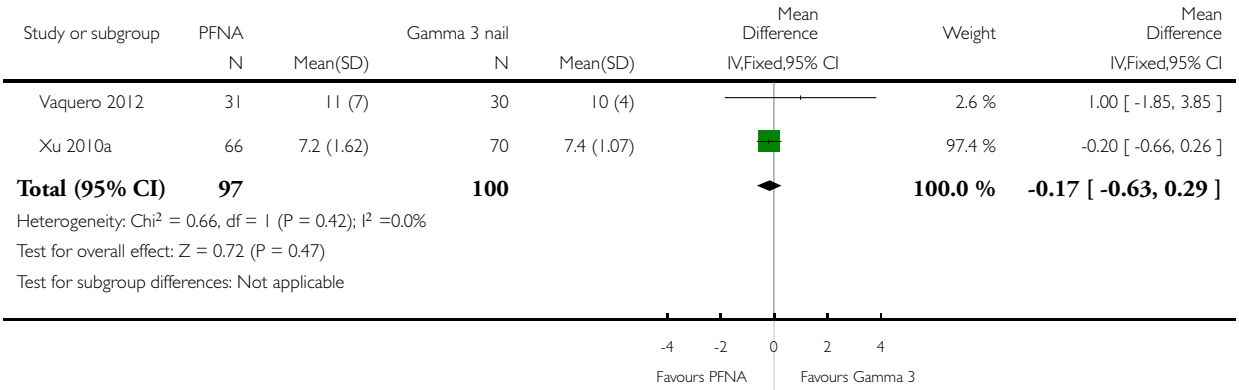


Analysis 8.14. Comparison 8 PFNA versus Gamma 3 nail, Outcome 14 Length of stay (days).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 14 Length of stay (days)

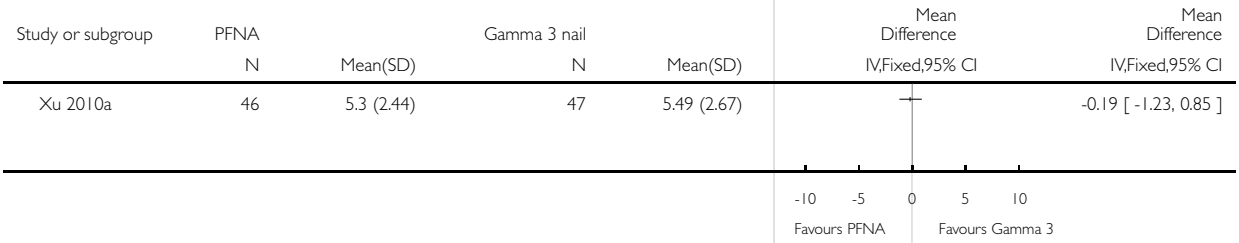


Analysis 8.15. Comparison 8 PFNA versus Gamma 3 nail, Outcome 15 Femoral shortening.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 15 Femoral shortening



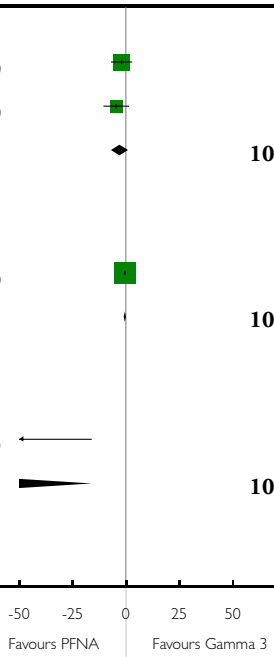
Analysis 8.16. Comparison 8 PFNA versus Gamma 3 nail, Outcome 16 Operative details.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 16 Operative details

Study or subgroup	PFNA N	Mean(SD)	Gamma 3 nail N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Operating time (minutes)							
Vaquero 2012	31	35 (10)	30	37 (10)		58.8 %	-2.00 [-7.02, 3.02]
Xu 2010a	66	64.1 (15.44)	70	68.6 (20.08)		41.2 %	-4.50 [-10.50, 1.50]
Subtotal (95% CI)	**97**		**100**			**100.0 %**	**-3.03 [-6.88, 0.82]**
Heterogeneity: Chi^2 = 0.39, df = 1 (P = 0.53); I^2 =0.0%							
Test for overall effect: Z = 1.54 (P = 0.12)							
2 Fluoroscopy time (minutes)							
Xu 2010a	66	2.7 (1.14)	70	3.2 (1.09)		100.0 %	-0.50 [-0.88, -0.12]
Subtotal (95% CI)	**66**		**70**			**100.0 %**	**-0.50 [-0.88, -0.12]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.61 (P = 0.0090)							
3 Intra-operative blood loss (mL)							
Xu 2010a	66	217.4 (110.49)	70	272.7 (123.83)		100.0 %	-55.30 [-94.70, -15.90]
Subtotal (95% CI)	**66**		**70**			**100.0 %**	**-55.30 [-94.70, -15.90]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.75 (P = 0.0059)							



Analysis 8.17. Comparison 8 PFNA versus Gamma 3 nail, Outcome 17 Number of patients transfused.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 8 PFNA versus Gamma 3 nail

Outcome: 17 Number of patients transfused

Study or subgroup	PFNA n/N	Gamma 3 nail n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Xu 2010a	24/66	31/70		0.82 [0.54, 1.24]

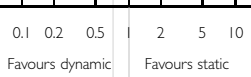
Analysis 9.1. Comparison 9 Dynamic versus static locked intramedullary nail, Outcome 1 Mortality at 1 year.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 9 Dynamic versus static locked intramedullary nail

Outcome: 1 Mortality at 1 year

Study or subgroup	Dynamic locking n/N	Static locking n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Hardy 2003	7/41	9/39		0.74 [0.31, 1.79]



Analysis 9.2. Comparison 9 Dynamic versus static locked intramedullary nail, Outcome 2 Pain and cortical hypertrophy.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 9 Dynamic versus static locked intramedullary nail

Outcome: 2 Pain and cortical hypertrophy

Study or subgroup	Dynamic locking n/N	Static locking n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Mid-thigh pain				
Hardy 2003	2/33	6/30		0.30 [0.07, 1.39]
2 Cortical hypertrophy				
Hardy 2003	1/34	6/30		0.15 [0.02, 1.15]

Analysis 9.3. Comparison 9 Dynamic versus static locked intramedullary nail, Outcome 3 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 9 Dynamic versus static locked intramedullary nail

Outcome: 3 Fracture fixation complications

Study or subgroup	Dynamic locking n/N	Static locking n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Later fracture of the femur				
Hardy 2003	0/41	1/39		0.32 [0.01, 7.57]
2 Cut-out				
Hardy 2003	1/41	0/39		2.86 [0.12, 68.10]
3 Technical complications of fixation				
Hardy 2003	1/41	1/39		0.95 [0.06, 14.69]
4 Re-operation				
Hardy 2003	1/41	3/39		0.32 [0.03, 2.92]

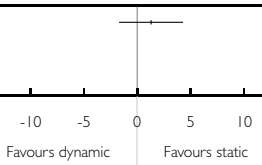
Analysis 9.4. Comparison 9 Dynamic versus static locked intramedullary nail, Outcome 4 Leg shortening (mm) in those able to undergo a radiographic assessment.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 9 Dynamic versus static locked intramedullary nail

Outcome: 4 Leg shortening (mm) in those able to undergo a radiographic assessment

Study or subgroup	Dynamic locking N	Mean(SD)	Static locking N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Hardy 2003	21	7.6 (5.37)	26	6.3 (5.07)		1.30 [-1.71, 4.31]



Analysis 9.5. Comparison 9 Dynamic versus static locked intramedullary nail, Outcome 5 Operative details.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 9 Dynamic versus static locked intramedullary nail

Outcome: 5 Operative details

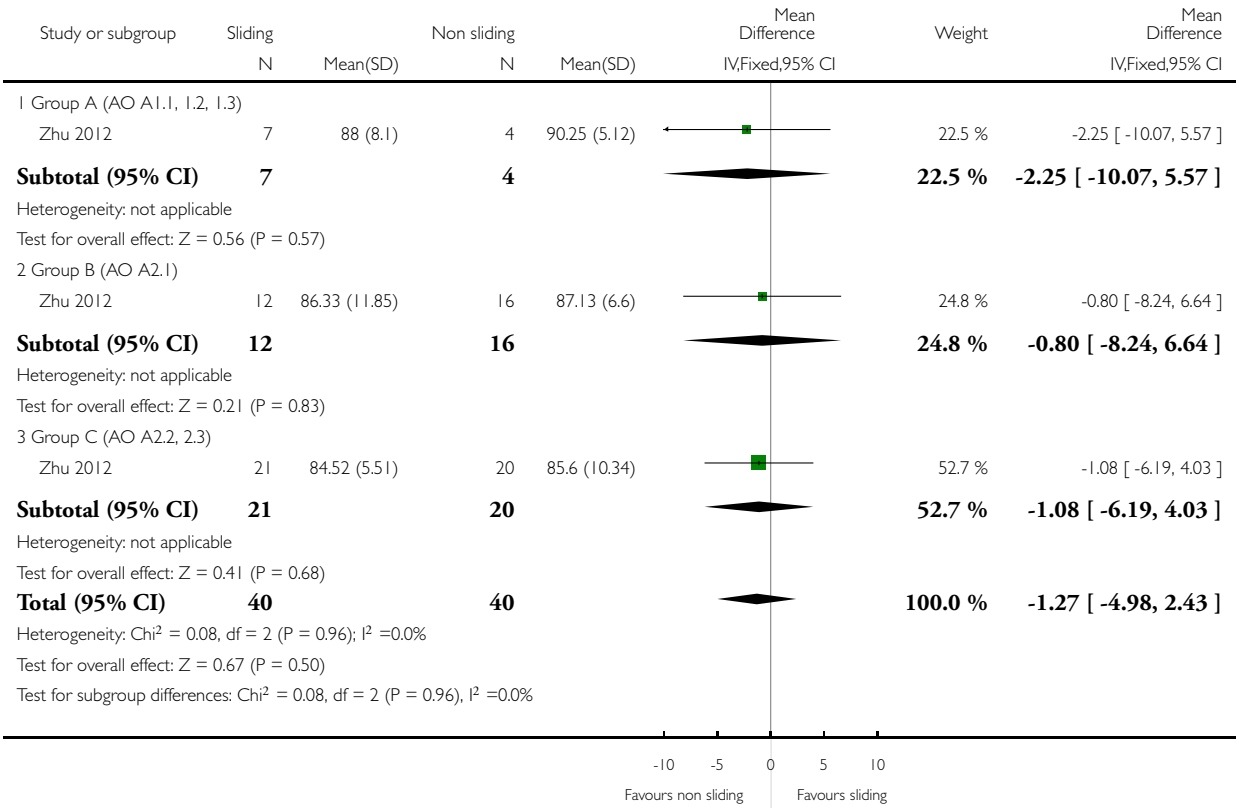
Study or subgroup	Dynamic locking N	Mean(SD)	Static locking N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Length of surgery (minutes)						
Hardy 2003	41	58.4 (17.9)	39	58.2 (14.8)		0.20 [-6.98, 7.38]
2 Intra-operative blood loss (minutes)						
Hardy 2003	41	142.4 (82.42)	39	133.6 (88.54)		8.80 [-28.73, 46.33]
3 Haemoglobin level: 48 hours post-op (g/dL)						
Hardy 2003	41	9.1 (1.05)	39	9.2 (1.32)		-0.10 [-0.62, 0.42]
4 Transfused packed blood cells						
Hardy 2003	41	0.9 (1.03)	39	1.1 (1.06)		-0.20 [-0.66, 0.26]

Analysis 10.1. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 1 Harris hip score (0 to 100: high values = best function).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 1 Harris hip score (0 to 100: high values = best function)



Analysis 10.2. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 2 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 2 Fracture fixation complications

Study or subgroup	Sliding n/N	Non sliding n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Femoral shaft fracture (timing not known)				
Zhu 2012 (1)	0/40	2/40		0.20 [0.01, 4.04]
2 Cut-out				
Zhu 2012 (2)	0/40	1/40		0.33 [0.01, 7.95]
3 Non-union at 6 months				
Zhu 2012	1/40	2/40		0.50 [0.05, 5.30]
4 Non-union at 12 months				
Zhu 2012	0/40	1/40		0.33 [0.01, 7.95]

(1) Both resolved with additional fixation

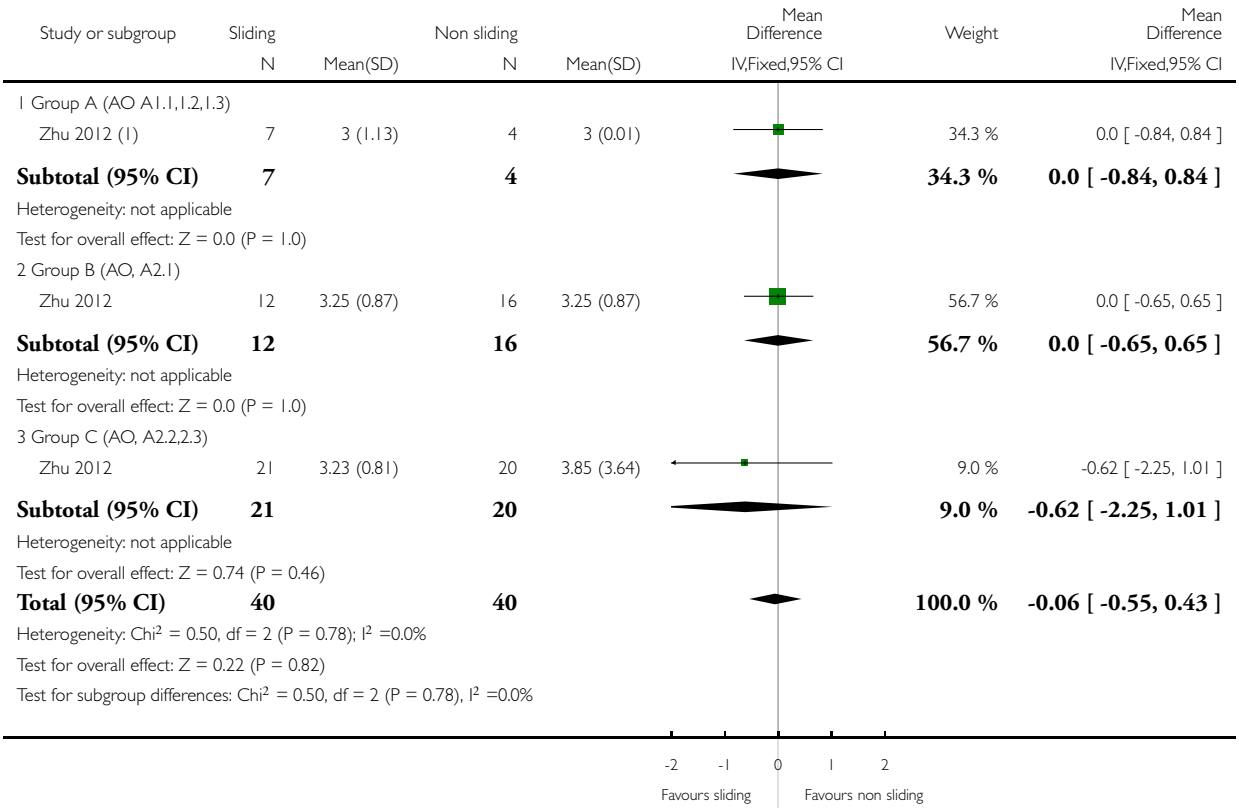
(2) Resolved with additional fixation

Analysis 10.3. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 3 Average healing time (months).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 3 Average healing time (months)



(1) SD in the non sliding group changed from 0 to 0.01

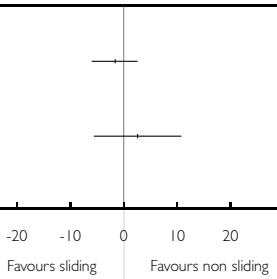
Analysis 10.4. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 4 Operative details.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 4 Operative details

Study or subgroup	Sliding N	Mean(SD)	Non sliding N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Operation time (mins)						
Zhu 2012	40	46.73 (10.37)	40	48.35 (9.23)		-1.62 [-5.92, 2.68]
2 Intra-operative blood loss (mL)						
Zhu 2012	40	141.1 (18.12)	40	138.5 (19.42)		2.60 [-5.63, 10.83]



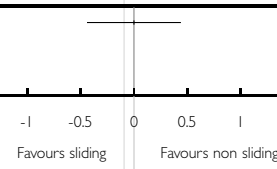
Analysis 10.5. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 5 Length of stay (days).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 5 Length of stay (days)

Study or subgroup	Sliding N	Mean(SD)	Non sliding N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Zhu 2012	40	4 (1)	40	4 (1)		0.0 [-0.44, 0.44]



Analysis 10.6. Comparison 10 Sliding versus non-sliding lag screw for Gamma 3 nail, Outcome 6 Leg length discrepancy (mm) ('Group C' - unstable fractures - only).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 10 Sliding versus non-sliding lag screw for Gamma 3 nail

Outcome: 6 Leg length discrepancy (mm) ('Group C' - unstable fractures - only)

Study or subgroup	Sliding		Non sliding		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI	IV,Fixed,95% CI
Zhu 2012	21	0.955 (0.024)	20	0.57 (0.019)		0.38 [0.37, 0.40]

Analysis 11.1. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 1 Mortality (1 year).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 1 Mortality (1 year)

Study or subgroup	InterTan nail	PFNA II	Risk Ratio	Risk Ratio
	n/N	n/N	M-H,Fixed,95% CI	M-H,Fixed,95% CI
Zhang 2013	8/57	7/56		1.12 [0.44, 2.89]

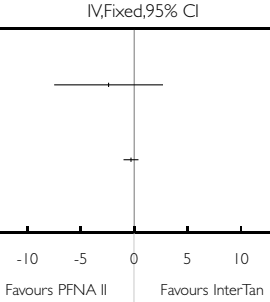
Analysis 11.2. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 2 Final functional outcomes.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 2 Final functional outcomes

Study or subgroup	InterTan nail N	Mean(SD)	PFNA II N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Harris hip score (1 to 100; high values = best function)						
Zhang 2013	47	80.2 (13.7)	46	82.6 (11.3)		-2.40 [-7.50, 2.70]
2 Walking ability score (0 to 9; high value = best function)						
Zhang 2013	47	5.8 (1.9)	46	6.1 (1.7)		-0.30 [-1.03, 0.43]



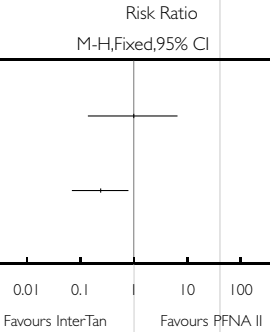
Analysis 11.3. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 3 Hip and thigh pain.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 3 Hip and thigh pain

Study or subgroup	InterTan nail n/N	PFNA II n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Hip pain				
Zhang 2013	2/47	2/46		0.98 [0.14, 6.66]
2 Thigh pain				
Zhang 2013	3/47	12/46		0.24 [0.07, 0.81]



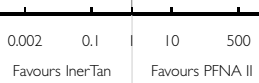
Analysis 11.4. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 4 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 4 Fracture fixation complications

Study or subgroup	InterTan nail n/N	PFNA II n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Cutout				
Zhang 2013	0/47	2/46		0.20 [0.01, 3.97]
2 Femoral shaft fracture (post-operative)				
Zhang 2013	0/47	1/46		0.33 [0.01, 7.81]
3 Femoral shaft fracture (intra-operative)				
Zhang 2013	1/57	2/56		0.49 [0.05, 5.27]
4 Lateral greater trochanter fracture				
Zhang 2013	6/57	1/56		5.89 [0.73, 47.40]
5 Proximal end of nail penetrating trochanter				
Zhang 2013	1/57	4/56		0.25 [0.03, 2.13]
6 Distal interlocking problem				
Zhang 2013	2/57	2/56		0.98 [0.14, 6.73]
7 Blade migration				
Zhang 2013	0/47	4/46		0.11 [0.01, 1.97]
8 Re-operation				
Zhang 2013	2/47	3/46		0.65 [0.11, 3.73]



Analysis 11.5. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 5 Time to fracture healing (weeks).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 5 Time to fracture healing (weeks)

Study or subgroup	InterTan nail N	Mean(SD)	PFNA II N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
Zhang 2013	47	14 (4.86)	46	17 (4.37)		-3.00 [-4.88, -1.12]

Analysis 11.6. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 6 Post-operative complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 6 Post-operative complications

Study or subgroup	InterTan nail n/N	PFNA II n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 Superficial wound infection				
Zhang 2013	3/47	2/46		1.47 [0.26, 8.38]
2 Deep infection				
Zhang 2013	2/47	1/46		1.96 [0.18, 20.85]
3 Deep venous thrombosis				
Zhang 2013	7/47	6/46		1.14 [0.42, 3.14]
4 Pulmonary embolism				
Zhang 2013	1/47	0/46		2.94 [0.12, 70.30]
5 Pressure sore				
Zhang 2013	3/47	4/46		0.73 [0.17, 3.10]
6 Urinary tract infection				
Zhang 2013	4/47	6/46		0.65 [0.20, 2.16]

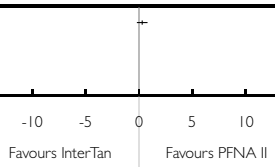
Analysis 11.7. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 7 Length of stay (days).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 7 Length of stay (days)

Study or subgroup	InterTan nail		PFNA II		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI	IV,Fixed,95% CI
Zhang 2013	57	8.33 (1.65)	56	8.03 (1.21)		0.30 [-0.23, 0.83]



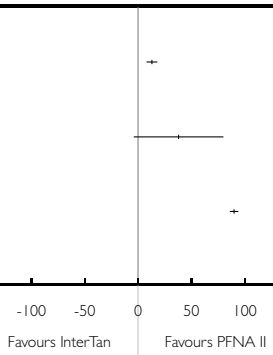
Analysis 11.8. Comparison 11 InterTan nail versus the PFNA II nail, Outcome 8 Operative details.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 11 InterTan nail versus the PFNA II nail

Outcome: 8 Operative details

Study or subgroup	InterTan nail N	Mean(SD)	PFNA II N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Operative time (min)						
Zhang 2013	57	66.5 (15.2)	56	53.7 (11.3)		12.80 [7.87, 17.73]
2 Blood loss (mL)						
Zhang 2013	57	235.3 (124.6)	56	197.5 (101.8)		37.80 [-4.12, 79.72]
3 Fluoroscopy time (seconds)						
Zhang 2013	57	216 (10.8)	56	126 (9.6)		90.00 [86.23, 93.77]



Analysis 12.1. Comparison 12 Long versus standard proximal femoral nail antirotation (PFNA nail), Outcome 1 Mortality (1 year).

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 12 Long versus standard proximal femoral nail antirotation (PFNA nail)

Outcome: 1 Mortality (1 year)

Study or subgroup	Long PFNA n/N	Standard PFNA n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Okcu 2013	4/22	3/18		1.09 [0.28, 4.26]

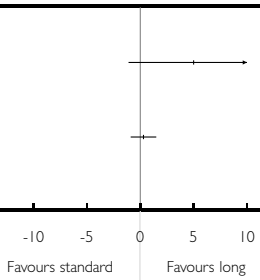
Analysis 12.2. Comparison 12 Long versus standard proximal femoral nail antirotation (PFNA nail), Outcome 2 Final functional outcomes.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 12 Long versus standard proximal femoral nail antirotation (PFNA nail)

Outcome: 2 Final functional outcomes

Study or subgroup	Long PFNA N	Mean(SD)	Standard PFNA N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 Harris hip score (1 to 100, top score = best function)						
Okcu 2013	18	79 (10)	15	74 (8)		5.00 [-1.14, 11.14]
2 Parker and Palmer mobility score (0 to 9, top score = best function)						
Okcu 2013	18	5.5 (1.7)	15	5.2 (1.9)		0.30 [-0.94, 1.54]

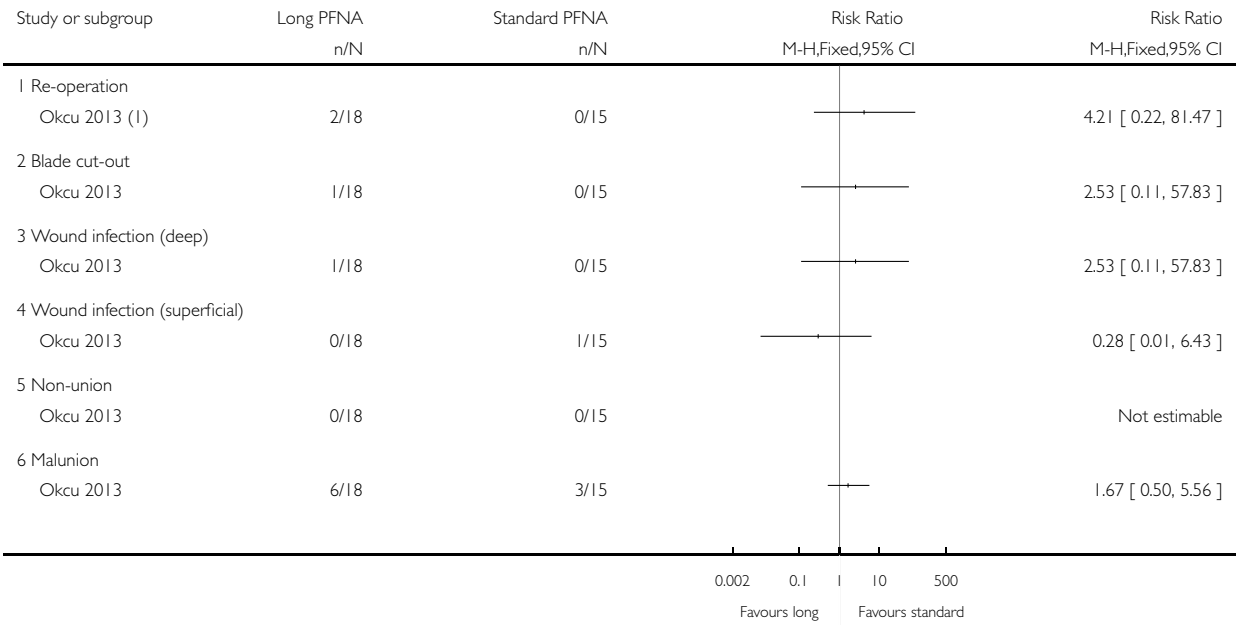


Analysis 12.3. Comparison 12 Long versus standard proximal femoral nail antirotation (PFNA nail), Outcome 3 Fracture fixation complications.

Review: Intramedullary nails for extracapsular hip fractures in adults

Comparison: 12 Long versus standard proximal femoral nail antirotation (PFNA nail)

Outcome: 3 Fracture fixation complications



(1) Re-operation required for 1 deep infection and 1 blade cut-out

ADDITIONAL TABLES

Table 1. Intramedullary nails evaluated by the included trials

Name	Description
Endovis nail	The Endovis nail (Citieffe Ltd) is available in 3 sizes (195 to 400 mm) and has a neck shaft angle of 130°. It has two cephalic screws for the femoral head to facilitate fracture compression. The distal section is slotted to produce a graduated variation of stiffness
Gamma nail	The Gamma nail (Stryker Ltd) was introduced in the late 1980s for the treatment of extracapsular hip fractures. The implant consists of a sliding lag screw which passes through a short intramedullary nail placed via the trochanteric entry point. One or two screws may be passed through the nail tip to secure it to the femoral shaft (distal locking). Theoretical advantages of this implant are due to a percutaneous insertion technique and include reduced blood loss, minimal soft tissue

Table 1. Intramedullary nails evaluated by the included trials (*Continued*)

	trauma and short operating time. Modifications to the design of the Gamma nail and its instrumentation have occurred since its introduction. The long Gamma nail has a range of different lengths from 280 to 460 mm with two distal locking screw options. An Asian-Pacific version of the nail is available for use in the Asian population and has reduced length, diameter and mediolateral angle to accommodate small femurs typically seen in this group
Gamma 3 nail	The Gamma 3 nail (Stryker Ltd) is the third generation of the gamma nail fixation system for proximal femoral fractures. It is a trochanteric entry nail with a reduced proximal nail diameter (15.5 mm versus 17 mm) to facilitate a shorter incision. Its length options range from 280 mm to 460 mm. Its neck shaft angle options include 120°, 125° and 130°. The lag screw shape has also been modified to provide superior cutting behaviour and greater resistance to cut-out. One trial in this review compared a sliding and a non-sliding lag screw mechanism in the Gamma 3 nail
Gliding nail	The gliding nail (Smith-Nephew) is a trochanteric entry nail designed to avoid the complications of implants such as the Gamma nail. It utilises a T-shaped femoral neck blade that has an extensive surface area relative to other intramedullary devices which provides good rotational stability and a high resistance to fatigue fracture. The T-shaped blade can slide through the nail, facilitating fracture compression and healing. The standard length is 220 mm with long nail options ranging from 340 mm to 440 mm. Blade shaft angles include 125° and 135°
Intramedullary hip screw (IMHS)	The IMHS (Smith and Nephew), length 210 mm, was introduced in 1991 for the treatment of extracapsular femoral fractures. Like the Gamma nail, it consists of a nail inserted via the greater trochanter into the medullary cavity. It utilises a single screw in the femoral head that can slide through a barrel in the nail allowing fracture compression. Three different neck angles are available, 125°, 130° and 135°. Nail lengths are available from 195 mm to 440 mm
Proximal femoral nail (PFN)	The PFN (Synthes Ltd), length 240 mm, was introduced in 1998 for the treatment of extracapsular fractures. Like the Gamma and IMHS, it consists of a nail inserted via the greater trochanter into the medullary cavity. Two lengths are available, 200 mm and 240 mm. Two proximal lag screws are passed up the femoral neck to the head. Distal locking can be performed in static or dynamic mode via two distal locking screws
Proximal femoral nail antirotation (PFNA)	The PFNA (Synthes Ltd), length 170 mm, 200 mm or 240 mm, is a modification of the PFN nail. It is similar to the PFN nail apart from not having two proximal lag screws, but instead a single helically-shaped blade which is designed to provide increased angular and rotational stability. The helical blade is designed to avoid bone loss that occurs during drilling and insertion of a standard hip screw. It has 2 distal locking screw options for either dynamic or static locking. Blade shaft angle options include 125°, 130° and 135°
Proximal femoral nail antirotation II (PFNA II)	The PFNA II (Synthes Ltd) is a modification of the PFNA nail to address the different proximal femoral anatomy of Asian patients. The PFNA has a large proximal diameter (17 mm) which was thought to account for the increase in

Table 1. Intramedullary nails evaluated by the included trials (*Continued*)

	femoral shaft fracture, lateral cortex splitting and thigh pain reported in Asian patients. The PFNA II has a smaller proximal diameter (16.5 mm versus 17 mm) and a flatter lateral shape (5° versus 6°)
Targon PF (proximal femoral) nail	The Targon PF nail (B Braun Ltd), length 220 mm, is inserted into the intramedullary cavity via a trochanteric entry point. Proximally, this nail has a sliding lag screw and an antirotation pin. The Targon PF nail facilitates fracture dynamisation via a gliding screw that glides through a sleeve that is attached to the nail, thereby avoiding protrusion of the screw into peritrochanteric tissues
ACE trochanteric nail	The ACE nail (Depuy) has a 10.5 mm lag screw and an optional antirotation lag screw. It has 2 distal holes for static or dynamic locking. Its proximal diameter is 16 mm and length is 180 mm or 200 mm
Russell-Taylor Recon nail	The Russel-Taylor Recon nail (Smith-Nephew) is an intramedullary nail that utilises a piriformis entry point. 2 screws are available for fixation in the femoral head. It is a full length femoral nail with no short versions available for proximal femoral fixation only
InterTan nail	The InterTan nail (Smith-Nephew) uses 2 cephalocervical screws in an integrated mechanism allowing intra-operative compression and rotational stability of the head-neck fragments. It has a cannulated set screw mechanism that allows for the device to be used in fixed angle mode or in sliding/compression mode. Its length ranges from 180 mm to 460 mm (long nail option)

APPENDICES

Appendix 1. Search strategies (2007 to present)

The Cochrane Library (Wiley Online Library)

#1 MeSH descriptor: [Hip Fractures] explode all trees (1048)
#2 ((hip* or femur* or femoral* or trochant* or pertrochant* or intertrochant* or subtrochant* or extracapsular*) near/4 fracture*):ti,ab,kw (Word variations have been searched) (2521)
#3 #1 or #2 (2521)
#4 (nail* or screw* or fix* or implant* or rod or rods):ti,ab,kw (Word variations have been searched) (25458)
#5 MeSH descriptor: [Internal Fixators] this term only (131)
#6 MeSH descriptor: [Bone Screws] this term only (513)
#7 MeSH descriptor: [Fracture Fixation, Internal] this term only (646)
#8 MeSH descriptor: [Fracture Fixation, Intramedullary] this term only (234)
#9 MeSH descriptor: [Bone Nails] this term only (321)
#10 #4 or #5 or #6 or #7 or #8 or #9 (25458)

#11 (intramedullar* or IM or cephalocondylic or condylocephalic or Cephalomedullary):ti,ab,kw (Word variations have been searched) (3196)
#12 #10 and #11 (584)
#13 ((ender or harris or gamma or interlocking or kuntscher* or targon or "proximal femoral" or holland or ACE) near/1 nail*):ti,ab,kw (Word variations have been searched) (199)
#14 (PFN or IMHS):ti,ab,kw (Word variations have been searched) (31)
#15 #12 or #13 or #14 (730)
#16 #3 and #15 (276) [Trials]

MEDLINE (Ovid Online)

1 exp Hip Fractures/ (17920)
2 ((hip* or femur* or femoral* or trochant* or pertrochant* or intertrochant* or subtrochant* or extracapsular*) adj4 fracture*).tw. (28221)
3 or/1-2 (32569)
4 (nail* or screw* or fix* or implant* or rod*1).tw. (610450)
5 Internal Fixators/ or Bone Screws/ or Fracture Fixation, Intramedullary/ or Fracture Fixation, Internal/ or Bone Nails/ (48592)
6 4 or 5 (625799)
7 (intramedullar* or IM or cephalocondylic or condylocephalic or Cephalomedullary).tw. (37594)
8 6 and 7 (8732)
9 ((ender or harris or gamma or interlocking or kuntscher* or targon or "proximal femoral" or holland or ACE) adj nail*).tw. (1513)
10 (PFN or IMHS).tw. (444)
11 8 or 9 or 10 (10003)
12 3 and 11 (2889)
13 Randomized controlled trial.pt. (395719)
14 Controlled clinical trial.pt. (90591)
15 randomized.ab. (311096)
16 placebo.ab. (166010)
17 Drug therapy.fs. (1786261)
18 randomly.ab. (219864)
19 trial.ab. (327892)
20 groups.ab. (1393917)
21 or/13-20 (3472807)
22 exp Animals/ not Humans/ (4093361)
23 21 not 22 (2978113)
24 12 and 23 (512)
25 (2007* or 2008* or 2009* or 2010* or 2011* or 2012* or 2013* or 2014*).ed. (7006243)
26 24 and 25 (255)

EMBASE (Ovid Online)

1 exp Hip Fracture/ (29018)
2 ((hip* or femur* or femoral* or trochant* or pertrochant* or intertrochant* or subtrochant* or extracapsular*) adj4 fracture*).tw. (33832)
3 1 or 2 (43367)
4 (nail* or screw* or fix* or implant* or rod*1).tw. (687437)
5 Bone Nail/ or Bone Screw/ or Fixation Device/ or Internal Fixator/ or Fracture Fixation/ (42147)
6 4 or 5 (702371)
7 (intramedullar* or IM or cephalocondylic or condylocephalic or Cephalomedullary).tw. (48037)
8 6 and 7 (9802)9 ((ender or harris or gamma or interlocking or kuntscher* or targon or "proximal femoral" or holland or ACE) adj nail*).tw. (1868)
10 (PFN or IMHS).tw. (538)
11 Ender Nail/ or Interlocking Nail/ or Intramedullary Nail/ (2394)

12 8 or 9 or 10 or 11 (12073)
13 3 and 12 (3690)
14 Randomized controlled trial/ (362850)
15 Clinical trial/ (891046)
16 Controlled clinical trial/ (407136)
17 Randomization/ (64351)
18 Single blind procedure/ (18704)
19 Double blind procedure/ (119415)
20 Crossover procedure/ (39341)
21 Placebo/ (231943)
22 Prospective study/ (259171)
23 ((clinical or controlled or comparative or placebo or prospective* or randomi#ed) adj3 (trial or study)).tw. (742676)
24 (random* adj7 (allocat* or allot* or assign* or basis* or divid* or order*)).tw. (181677)
25 ((singl* or doubl* or trebl* or tripl*) adj7 (blind* or mask*)).tw. (161639)
26 (cross?over* or (cross adj1 over*)).tw. (69389)
27 ((allocat* or allot* or assign* or divid*) adj3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*)).tw. (233163)
28 RCT.tw. (13327)
29 or/14-28 (1907125)
30 Case Study/ or Abstract Report/ or Letter/ (921006)
31 29 not 30 (1868931)
32 13 and 31 (634)
33 (2007* or 2008* or 2009* or 2010* or 2011* or 2012* or 2013* or 2014*).em. (8033361)
34 32 and 33 (301)

WHO International Clinical Trials Registry Platform

Search (11 January 2014) resulting in 76 trials) was: Nail AND fracture (in title) - ALL (recruitment status)

Appendix 2. Previous search strategies

The Cochrane Library (Wiley Interscience)

#1 MeSH descriptor Hip Fractures explode all trees
#2 ((hip* or femur* or femoral* or trochant* or pertrochant* or intertrochant* or subtrochant* or intracapsular* or extracapsular*) NEAR fracture*):ti,ab,kw
#3 (#1 OR #2)
#4 4 (pin* or nail* or screw* or plate* or arthroplasty* or fix* or prosthes*):ti,ab,kw
#5 MeSH descriptor Internal Fixators, this term only
#6 MeSH descriptor Bone Screws, this term only
#7 MeSH descriptor Fracture Fixation, Internal explode all trees
#8 MeSH descriptor Bone Plates, this term only
#9 MeSH descriptor Bone Nails, this term only
#10 MeSH descriptor Arthroplasty explode all trees
#11 (#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10)
#12 (#3 AND #11)

MEDLINE (Ovid Online)

1. exp Hip Fractures/
2. hip$ or femur$ or femoral$ or trochant$ or pertrochant$ or intertrochant$ or subtrochant$ or intracapsular$ or extracapsular$) adj4 fracture$).tw.

3. or/1-2
4. (pin$1 or nail$ or screw$1 or plate$1 or arthroplast$ or fix$ or prosthes$).tw.
5. Internal Fixators/ or Bone Screws/ or Fracture Fixation, Internal/ or Bone Plates/ or Bone Nails/
6. Arthroplasty/ or Arthroplasty, Replacement, Hip/
7. or/4-6
8. and/3,7

EMBASE (Ovid Online)

1. exp Hip Fracture/
2. ((hip$ or femur$ or femoral$ or trochant$ or pertrochant$ or intertrochant$ or subtrochant$ or intracapsular$ or extracapsular$) adj4 fracture$).tw.
3. or/1-2
4. (pin$1 or nail$ or screw$1 or plate$1 or arthroplast$ or fix$ or prosthes$).tw.
5. Bone Screws/ or Fracture Fixation/ or Bone Plate/ or Bone Nail/ or intramedullary nailing/
6. arthroplasty/ or hip arthroplasty/
7. or/4-6
8. and/3,7
9. exp Randomized Controlled trial/
10. exp Double Blind Procedure/
11. exp Single Blind Procedure/
12. exp Crossover Procedure/
13. Controlled Study/
14. or/9-13
15. ((clinical or controlled or comparative or placebo or prospective$ or randomi#ed) adj3 (trial or study)).tw.
16. (random$ adj7 (allocat$ or allot$ or assign$ or basis$ or divid$ or order$)).tw.
17. ((singl$ or doubl$ or trebl$ or tripl$) adj7 (blind$ or mask$)).tw.
18. (cross?over$ or (cross adj1 over$)).tw.
19. ((allocat$ or allot$ or assign$ or divid$) adj3 (condition$ or experiment$ or intervention$ or treatment$ or therap$ or control$ or group$)).tw.
20. or/15-19
21. or/14,20
22. limit 21 to human
23. and/8,22

Appendix 3. Report of search results in previous version of the review (Parker 2006)

For the second update of this review, of four newly identified studies, three (Efstathopoulos 2007; Starr 2006; Vidyadhara 2007) were included and one (Suckel 2006) was excluded. Overall, a total of 13 studies were considered, nine of which are included. Three others are excluded for reasons given in 'Characteristics of excluded studies'. One study (Gahr 2003a) remains in 'Studies awaiting assessment' pending the receipt of further information.

Appendix 4. Outcome categories used for presenting the results

Where practical, we presented the results for each comparison under five categories. The relationship between the outcomes listed in Types of outcome measures and these categories is shown below.

1. Final outcome measures
   - Functional outcomes
   - "Poor outcome"
   - Mobility, use of walking aids, presence of a limp
   - Hip, lower limb pain (chronic)
   - Other: Functional impairment

2. Fracture fixation complications
   - Serious adverse events and technical complications of fixation
   - Less serious local complications

3. Post-operative complications and hospital stay
   - Medical complications
   - Economic outcomes (hospital stay)

4. Anatomical restoration
   - Other: Anatomical restoration

5. Operative details
   - Other: Operative details

Appendix 5. Previous Types of outcome measures (up to 2012)

In the first (2005) and second (2006) versions of the review, the types of outcome measures were presented as follows:

1. Operative details
   - length of surgery (in minutes)
   - operative blood loss (in millilitres)
   - number of patients transfused
   - radiographic screening time (in seconds or minutes)

2. Fracture fixation complications
   - operative fracture of the femur (around or below the implant, but excluding comminution of the fracture site)
   - later fracture of the femur (around or below the implant)
   - cut-out of the implant from the femoral head
   - non-union of the fracture
   - breakage of the implant
   - all technical complications of fixation (sum of above six outcomes with the addition of any other major complications of fracture healing as specified in each study. Major complications were defined as those which generally required revision surgery or a change of surgical procedure during the primary operation, such as using a longer nail. Excluded from this are minor operative complications such as comminution of the fracture site during surgery)
   - other operative or fracture healing complications as detailed in individual studies
   - re-operation (within the follow-up period of the study)
   - superficial wound infection
   - deep wound infection (i.e. infection around the implant)
   - wound haematoma/seroma

3. Post-operative complications and hospital stay
   - pressure sores
   - pneumonia
   - thromboembolic complications (deep vein thrombosis or pulmonary embolism)
   - any medical complication (as detailed in each individual study, excluding wound infections)
   - length of hospital stay (in days)

4. Anatomical restoration
- leg shortening (preferably > 2 cm)
- varus deformity of the femoral neck
- external rotation deformity (preferably > 20 degrees)

5. Final outcome measures
- mortality (within the follow-up period of the study)
- pain (persistent pain at the final follow-up assessment)
- mobility and use of walking aids
- failure to return to prefracture residential status
- functional activities of daily living
- composite function and hip scores

WHAT'S NEW

Last assessed as up-to-date: 6 January 2014.

Date	Event	Description
9 September 2014	New citation required and conclusions have changed	The conclusions now apply to an increased number of comparisons of different nails Two new authors (JQ and EH) took on the main work of the update; the previous two authors continued their contribution
9 September 2014	New search has been performed	For this version of the review, published in Issue 9, 2014, we made the following changes. 1. We updated the search to January 2014. 2. We included eight new trials (De Grave 2012; Makridis 2010; Okcu 2013; Vaquero 2012; Wild 2010; Xu 2010a; Zhang 2013; Zhu 2012). There were seven new comparisons. 3. In accordance with Cochrane Collaboration policy, we included new methodology, including the assessment of risk of bias and quality of the evidence, the latter using GRADE

HISTORY

Protocol first published: Issue 4, 2004

Review first published: Issue 2, 2005

Date	Event	Description
31 July 2008	New search has been performed	For the second update, published in Issue 4, 2008, the following changes were made: (1) the search was updated to June 2007; (2) three newly identified studies (Efstathopoulos 2007, Starr 2006, Vidadhura 2007) were included resulting in the addition of two new comparisons; (3) one newly identified study (Suckel 2006) was excluded. There were no changes made to the conclusions.
30 July 2008	Amended	Converted to new review format.
17 May 2006	New search has been performed	For the first update, published in Issue 3, 2006, the following changes were made: (1) the search was updated to March 2006; (2) two new studies (Marques 2005; Papasimos 2005) were included; (3) additional data were included from Schipper 2004 after correspondence with trialists; (4) adjustments were made to text and tables to conform to revised methodology and the Cochrane Style Guide. There were no changes made to the conclusions.

CONTRIBUTIONS OF AUTHORS

Martyn Parker (MJP) initiated the review and wrote the first draft of the protocol. Helen Handoll (HH) revised the protocol. Both authors identified trials, selected trials for inclusion, performed data extraction and quality assessment of the included trials. MJP compiled the first draft of the review and the two previous review updates: these were then critically revised and completed by HH.

Joseph Queally (JQ) initiated this review update and, after achieving agreement with HH and MJP on the revised methods and restructuring, JQ and Ella Harris (EH), with intermittent input from HH, assessed all the studies and incorporated the new evidence into the review. The review was then critically revised and completed by HH and MJP. JQ is the guarantor of the review.

DECLARATIONS OF INTEREST

JQ: None known

EH: None known

HH: None known

MJP: Has received royalties from B.Braun Ltd related to the design and development of an implant used for the internal fixation of intracapsular hip fractures. This implant and fracture type is not considered in this review.

SOURCES OF SUPPORT

Internal sources

- University of Teesside, Middlesbrough, UK.
- Peterborough and Stamford Hospitals NHS Foundation Trust, UK.

External sources

- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Differences in version published 2014

1. In line with Collaboration recommendations, the review now assesses risk of bias.
2. In Types of interventions, we clarified our criteria for selecting the control groups in the various comparisons.
3. The types of outcome measures were restructured into primary, secondary, other and economic outcomes (*see* Appendix 5 for previous list). Given the correspondence between the previous and revised outcome measures was presentational rather than content, we opted to retain the five previous outcome categories (1. Operative details; 2. Fracture fixation complications; 3. Post-operative complications and hospital stay; 4. Anatomical restoration; 5. Final outcome measures) but to adjust their order (5; 2; 3; 4; 1) and clarify their relationship to the revised outcomes (*see* Appendix 4).
4. Assessment of quality of the evidence was done using GRADE.

Differences in version published 2006

1. The title of the review was changed in Issue 2, 2005 from that of the protocol (Cephalocondylic intramedullary nails for extracapsular hip fractures in adults) to the present title. This reflected the expansion of the scope to include condylocephalic nails.

INDEX TERMS

Medical Subject Headings (MeSH)

*Bone Nails; Fracture Fixation, Intramedullary [instrumentation; *methods]; Hip Fractures [*surgery]; Randomized Controlled Trials as Topic

MeSH check words

Aged; Female; Humans; Male