SPECIALTY UPDATE: HIP

Hip arthroplasty for the treatment of displaced fractures of the femoral neck in elderly patients

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This review summarises the evidence for the treatment of displaced fractures of the femoral neck in elderly patients. Results from randomised clinical trials and national register studies are presented when available.

The advantages of arthroplasty compared with internal fixation are supported by several studies. A number of studies contribute to the discussions of total hip arthroplasty (THA) versus hemiarthroplasty and unipolar versus bipolar hemiarthroplasty, but no clear-cut evidence-based recommendation can be made. THA may be particularly advantageous for active, lucid patients with a relatively long life expectancy. For patients who are physiologically older, hemiarthroplasty is probably satisfactory, and for the oldest patients with more comorbidities, unipolar implants are considered to be sufficient. If the hospital can support emergency THA surgery in sufficient numbers and quality, there may be few patients who warrant bipolar hemiarthroplasty.

The direct lateral approach reduces the risk of dislocation compared with the posterior approach. Cemented implants lower the risk of periprosthetic fracture and its subsequent morbidity and mortality. As the risk of peri-operative death related to bone cement can be reduced by adequate measures, cemented implants are recommended in fracture cases.

Take home message: There remains a great variation in the surgical management of patients with a hip fracture, and an evidence-based approach should improve the outcomes for this vulnerable patient group.

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Elderly patients with a hip fracture justify urgent medical care and surgical intervention. Post-operatively, patients frequently demonstrate a decline in function and a high rate of complications including an increased risk of mortality, and place a considerable demand on hospital resources.1

The treatment of displaced fractures of the femoral neck has been debated in the literature since the1930s, when it was termed “the unsolved fracture”.2 In the 21st century, surgical outcomes are still variable, and as the population continues to age the need for research and quality improvement continues.

In the elderly patient, the goal of treatment is to regain function as soon as possible, with minimal pain or complications. In the event of treatment failure, many patients do not have the capacity to withstand a secondary procedure. As urgent surgery is indicated, the surgical techniques should be robust and easily accessible in every organisation.

Fractures of the femoral neck are usually divided into undisplaced and displaced fractures. There are no studies of internal fixation versus arthroplasty in patients under approximately 60 years of age; clinical studies focus on internal fixation and the rates of complications and re-operation. The functional outcome is seldom reported. For undisplaced fractures, internal fixation is considered to be the reference standard. Re-operation is required in about one in ten cases,3 although a randomised study comparing arthroplasty with internal fixation is underway in Norway.

This review therefore considers the evidence for the treatment of displaced neck of femur fractures in elderly patients. We consider the evidence for arthroplasty instead of internal fixation. The options for arthroplasty are varied; both total hip and hemiarthroplasty prostheses have cemented and uncemented designs. Hemiarthroplasty prostheses may have a bipolar or unipolar head. Insertion may be through a number of approaches, of which the direct lateral4,5 and the posterior6 are most common and discussed in this review.
Patients and Methods

We searched PubMed for randomised trials for key words. We included all relevant articles written in English, German and Scandinavian, and we included all available randomised controlled trial studies (RCTs). We used international register networks (ISAR, NARA) to identify registers in English or Scandinavian languages which include patients with hip fractures. Large observational studies based on national registers have increased statistical power, but seldom provide patient-reported outcomes.

We included studies from 14 different countries with awareness of the traditional differences in treatment, and of the author bias to omit culturally ‘normal’ details. For example, the Anglo-Saxon world has continued to use the Austin-Moore hemiarthroplasty, albeit with decreasing frequency. Meanwhile, the Scandinavian countries focused on internal fixation techniques until the early part of the 21st century, when a sudden shift to modern modular arthroplasty occurred. The use of total hip arthroplasty (THA) as a primary treatment varies both nationally and internationally. Other factors that influence outcomes internationally include age limits for different procedures, the accepted surgical delay, the variation in surgical training and competence, the management of complications, rehabilitation protocols, elderly care and patients’ expectations.

Internal fixation or replacement. A number of RCTs, with both long and short follow-up, demonstrate that arthroplasty is the treatment of choice for elderly patients with displaced fractures of the femoral neck.

Of the four RCTs spanning more than nine years, all described significantly lower rates of re-operation for arthroplasty compared with internal fixation, at least in lucid patients. One study found that, after 17 years, the functional outcome was still better following THA than internal fixation. The pain and function of patients who underwent internal fixation, without a major complication, was never better than those who had a successful arthroplasty procedure.

THA or hemiarthroplasty. Primary replacement of the femoral head may be with a THA or hemiarthroplasty.

In recent studies of modular hemiarthroplasty with four to five years follow-up, the rate of major hip complications ranged from 2% to 10%. The definition of ‘major’ hip complications varied between papers, however, the two most common complications after fracture-related hip arthroplasty are dislocation and infection, the next is periprosthetic fracture. Several studies support the benefits of THA, which has a comparable long-term failure rate of 5% to 10%.

This failure rate may increase though with an unfavourable combination of patients and technique. For example, in demented patients treated with THA through a posterior surgical approach, there was a failure rate of 16%. Most studies define only recurrent dislocations as a ‘failure’ after THA; hence complication rates would be higher if single dislocations were also included. Hemiarthroplasty carries the additional risk of acetabular erosion (Fig. 1). This is an elusive condition, as it can sometimes be radiological only (i.e. subclinical). Even if the patient has symptomatic acetabular erosion, the surgeon or patient may not choose to undergo revision surgery. The prevalence is heavily influenced by the selection of the patient and implant. Treating lucid patients who can walk independently prior to their injury who are aged over 60 years with a bipolar hemiarthroplasty will lead to radiological erosion in up to two thirds of the patients. However, only one fifth will undergo revision surgery.

In order that a fair comparison is made between hemiarthroplasty and THA, studies including the outdated monoblock hemiarthroplasty should be omitted. This leaves seven randomised trials comparing THA and modular hemiarthroplasty in healthy, cognitively lucid and relatively

Fig. 1a
Fig. 1b
Fig. 1c

Radiographs showing the development of acetabular erosion after hemiarthroplasty of the hip; a) first post-operative radiograph, b) three years post-operatively and c) seven years post-operatively.
active patients. Of these, four indicate better health-related quality of life (HRQoL) and/or function after THA\textsuperscript{11,21-23} whilst three did not show any functional difference.\textsuperscript{24-26} A study with seven to ten years follow-up showed a rate of revision for THA of 2.5\% in contrast with 20\% for hemiarthroplasty.\textsuperscript{27} As only healthy, active patients with a good walking ability were included, this may have contributed to the poor outcome following hemiarthroplasty.

A large cohort study found patients treated with THA had a lower level of pain and a higher level of satisfaction compared with patients treated with hemiarthroplasty or internal fixation.\textsuperscript{28}

THA is assumed to have a higher risk of dislocation than hemiarthroplasty, but the literature is contradictory, perhaps due to the influence of variable factors such as surgical approach.\textsuperscript{29-31} A recent meta-analysis did not find any difference in dislocation rate and concluded there is “some evidence” to suggest that THA may lead to a better outcome than hemiarthroplasty.\textsuperscript{32} However, THA is a demanding operation, as malposition increases the risk of dislocation and pain.\textsuperscript{33}

The choice of THA or hemiarthroplasty should be guided by the patient’s biological age, activity level, health and likely remaining life span. For the majority, (those who have functional and/or cognitive limitations) hemiarthroplasty is the most suitable choice. The benefits are surgery which can be performed by a less experienced surgeon in the emergent setting, a shorter operative time, less bleeding and possibly a lower risk of dislocation. The long-term advantages of THA may not be enjoyed by many as they may be deceased within a few years. However, in active individuals, hemiarthroplasty carries an unacceptably high risk of acetabular erosion.\textsuperscript{21} For those patients, THA is a better option.

**Cemented or uncemented fixation.** The role for bone cement in arthroplasty surgery for fracture patients is vigorously debated. Uncemented implants, which rely on metaphyseal fixation, have a higher risk of periprosthetic fractures, whereas the insertion of bone cement is associated with embolisation of fat and bone marrow contents and intra-operative death, which has been referred to as bone cement implantation syndrome.\textsuperscript{34-36}

Although catastrophic, intra-operative death is quite rare; the rate has been reported at 0.18\%.\textsuperscript{37} Even preparation of the femur, insertion of a uncemented stem and relocation of the joint may induce similar, yet milder reactions.\textsuperscript{34,38} Earlier studies comparing cemented and uncemented stems are either of poor methodological quality or assess historical implants.\textsuperscript{39-42}

Of the more recent randomised studies, five compare modern uncemented and cemented hemiarthroplasties. This generated six papers for review - two were consecutive papers of the same patient cohort. As the earlier paper reported on early complications both were included.\textsuperscript{19,43-47} The studies detected few differences regarding function or HRQoL. The three studies with positive findings contradict each other: in support of cemented implants, Taylor et al\textsuperscript{46} found improved functional outcomes at six weeks, and Inngul et al\textsuperscript{47} found better function and HRQoL during the first year. On the other hand, in support of uncemented implants, Langslet et al\textsuperscript{19} reported improved functional outcomes at five years, although no difference was found regarding activities of daily living or HRQoL. Regarding general complications, two studies reported no difference\textsuperscript{43,46} but three found more complications in uncemented cases; mostly due to periprosthetic fractures.\textsuperscript{19,45,47} There was a shorter surgical time and decreased blood loss in the uncemented group according to two studies.\textsuperscript{44,45}

Neither of the RCTs showed any difference in mortality between patients treated with cemented or uncemented stems.\textsuperscript{19,43-47} This may be due to the study groups being underpowered to test for mortality. An Australian register study showed a higher risk of death for patients with cemented implants on
the first post-operative day. However, the mortality risk was higher in the uncemented group between one week and one year post fracture.48 The Norwegian Hip Fracture Register also found patients who had a cemented hemiarthroplasty had a higher risk of death on the day of surgery and the first post-operative day. After day two, the mortality rate was equal.49 A similar pattern was found in Finland, where there was no difference in mortality after one week.50

In the United Kingdom, in 2009, the National Patient Safety Agency51 emphasised the risk of using bone cement in hip fracture patients. However, a subsequent study from the National Hip Fracture Database concluded there was no increase in peri-operative mortality related to using cemented fixation.52 There are recently published concise guidelines in the United Kingdom, after a national collaboration, to advise the anaesthetist and surgeon on measures to reduce the risk.53 The risk of bone cement implantation syndrome can be reduced by thorough lavage of the femoral canal and avoidance of excessive pressure cementation.54,55

The risk of peri-operative mortality must be weighed against the risk of periprosthetic fracture. The reports and studies of the national registers conclude that re-operations occur more frequently after uncemented hemiarthroplasty.3,50,56,57 Cementless stems increase the risk of re-operation due to periprosthetic fracture by 20 times.57

A second fracture and subsequent surgical procedure is a serious setback for an elderly patient.58,59 This might explain the equivalent or even increased long-term mortality following an uncemented arthroplasty for patients in the registry studies.48-52

**Surgical approach.** The choice of surgical approach will influence the frequency and nature of complications following arthroplasty surgery for hip fractures. In observational studies, a direct lateral approach has been found to reduce the risk of dislocation.57,60-64 There is only one modern RCT comparing the direct lateral and posterior approach in hemiarthroplasty. This was a single surgeon’s series of 216 cases, which showed no difference in the rate of complications, pain or function.66 Based on analyses of patients with osteoarthritis, the posterior approach is assumed to be beneficial regarding muscular function and gait.65 This is, however, not supported by Parker’s RCT regarding fracture cases. Pronounced pre-fracture functional limitations in frail hip fracture patients may outweigh more the subtle differences between approaches.

The posterior approach may decrease the risk of long-term aseptic loosening after THA in both osteoarthritis and hip fracture patients.64,67 Analyses on the effect of approach and loosening in patients following hemiarthroplasty are lacking. This may be due to the high mortality after hip fracture, reducing the time available for symptomatic aseptic loosening to develop.

Dislocation is an early and common complication following hemiarthroplasty, occurring in 9% to 13% of patients with the posterior approach compared with 2% to 3% with the direct lateral approach.60,63 A cohort study of 713 THA, in which the approaches were determined by the surgeons’ preferences, found the rate of dislocation was 2% with the direct lateral approach but 12% with the posterior approach with a posterior repair, 14% without a posterior repair. The posterior approach was the only factor associated with an increased risk of dislocation.61 Recurrent dislocation is a particularly devastating complication which results in a loss of HRQoL.68

Given the seriousness of recurrent dislocations and its early occurrence, the direct lateral approach is preferable.

Some centres are continuing with the posterior approach, but use a dual mobility acetabular component to reduce the risk of dislocation. The implant is sparsely studied in hip fracture cases, but three trials found the dislocation rate after posterior approach to be reduced to 0%, 4% and 6%, respectively.69-71 This looks promising, but the evidence level is poor in these studies and the long-term results of dual mobility acetabular components in fracture patients are not known.

**Unipolar or bipolar hemiarthroplasty.** The large metal head of a hemiarthroplasty prosthesis risks erosion of the acetabular cartilage, as it articulates with the native acetabulum. In order to reduce this risk, a bipolar head was developed in the 1970s which consists of an inner and an outer articulation.

Several RCTs have tried to determine whether bipolar or unipolar hemiarthroplasties should be used. A meta-analysis found similar surgical and patient reported outcomes for both.72

Register studies contradict on this issue; in Sweden there is a higher risk of early re-operation following bipolar hemiarthroplasty compared with unipolar.57 The Australian National Joint Replacement Registry found that bipolar prostheses had a decreased risk of revision than unipolar, at least in younger patients.7 These results may be influenced by patient selection; the typical hemiarthroplasty patient in Australia is younger than in Sweden. When active patients are treated with unipolar hemiarthroplasty, erosion may be frequent.21 This complication might also remain undetected in the elderly patient due to their more sedentary life. There is weak evidence that bipolar heads decrease the risk of acetabular erosion.18,57

As there are no clear clinical advantages for the more expensive bipolar implant, unipolar implants may preferred, at least for those with a shorter life expectancy. If the use of THA continues to increase, the role for bipolar hemiarthroplasty will decrease.

**Unipolar hemiarthroplasty – modular or monoblock.** The inferior clinical results of the uncemented, monoblock Austin-Moore implant are well known.73-77 However, in 2011, the British National Hip Fracture Database reported the use of “uncemented, uncoated unipolar hemiarthroplasties” in 19% of patients78 (more recent reports have less implant specific detail). It can be assumed that several of
these were Austin-Moore implants as the use of monoblock prostheses in the United Kingdom was widespread.79

The assessment of the Thompson prosthesis, also a monoblock design, is more complex. In the United Kingdom, the National Institute for Health and Care Excellence (NICE) guidelines1 have advised against the use of the Thompson and similar monoblock prostheses. However, the Annual Reports from the Australian National Joint Replacement Register show that Thompson prostheses give better clinical results than the Austin-Moore. This may be attributable to the use of cement7 and recent studies have defended its use in selected patient groups.80,81 In very elderly patients with limited mobility, it seems reasonable that subtle design differences between cemented modular and monoblock hemiarthroplasty prostheses may not be clinically detectable, providing the implants are inserted via a direct lateral approach.63 The short remaining life-span of these patients precludes the development of long-term complications such as acetabular erosion.

**Patients with severe cognitive impairment.** Historically, senile dementia was regarded as a contraindication for arthroplasty, due to concerns of an increased risk of dislocation. In addition, the patient’s inability to express pain and discomfort may have been interpreted as an absence of pain, however, there is no reason to believe that an healed fracture should be less painful in an individual with dementia. Leaving a cognitively impaired patient immobile after a hip fracture increases their demand for care and assistance. A RCT comprising individuals with severe cognitive impairment showed a modular unipolar hemiarthroplasty to be beneficial over internal fixation.82 In an earlier study on a similar patient group, uncemented Austin-Moore hemiarthroplasty did not generate better results than internal fixation.83

**Discussion**

In conclusion, the various combinations of implants, approaches and patient heterogeneity lead to considerable variations in outcome. It also presents problems for direct comparison between studies. The evidence supports the concept that healthy active patients with a fractured neck of femur and a good life expectancy should be treated with a cemented THA. In younger patients, around 60 to 65 years of age, internal fixation may be an acceptable alternative, if performed with thorough follow-up and the understanding that a secondary THA may be required (Fig. 3). At the opposite end of the spectrum, a patient with functional and/or cognitive impairment and more severe comorbidities will do well with a cemented, modular, unipolar hemiarthroplasty. The direct lateral approach is preferable to the posterior approach (Fig. 2). This algorithm may not suit every unit. Trauma surgeons may not have experience in performing THA, which is technically more demanding following hip fracture; in their hands, a bipolar hemiarthroplasty may be more appropriate.84 As some centres only perform uncemented THAs, they may not have enough experience in efficient cementing techniques; continuing professional development is essential. The use of different approaches also varies between countries. Changes to accepted practice may be met with scepticism, but can be made with the appropriate training and produce good results.85

For accountable high-quality outcomes, a clear-cut algorithm and structured training is mandatory.86 Other keystones for a successful result after the treatment of hip fracture; the prevention of general complications and optimisation of long-term rehabilitation, are topics worthy of their own reviews.

**References**

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