

Management of femoral neck fractures

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Abstract

Femoral neck fractures are the second most common non-vertebral fragility fracture, and their management is complicated by multiple controversies. This article aims to review the recent literature in an attempt to elucidate current concepts critical to the management of intra-capsular femoral neck fractures. The optimal timing of surgery remains controversial. A recent meta-analysis was able to show that a delay of longer than 24–72 hours resulted in a statistically significant increase in mortality. Internal fixation of undisplaced fractures remains undisputed. In terms of displaced fractures, two well-designed studies have shown significantly higher re-operation rates in patients treated with closed reduction and internal fixation. While there appears to be renewed interest in the use of bi-polar hemiarthroplasty, conflicting evidence has been published with regard to total hip replacement for hip fractures in the elderly, and it may only be indicated in selected subgroups of relatively healthy patients. The peri-operative use of tranexamic acid has recently been shown to result in a reduction in transfusion requirements. Arguably the most important recent development in the management of hip fractures is the decrease in mortality provided by intravenous bisphosphonate therapy. Apart from a reduction in subsequent fractures the therapy also appears to reduce mortality due to cardiovascular and pulmonary causes. Recent investigations into thromboprophylaxis have highlighted the fact there is very little data to show that potent anti-coagulation decreases the risk of fatal pulmonary emboli.

Key words: management, hip fractures, femoral neck fractures, review

Introduction

Due to the increase in the world's ageing population the incidence of femoral neck fractures is expected to triple in the next 50 years.¹ Despite the advances that have been made in terms of the surgical and medical management, the one-year mortality rate remains in the region of 30%.² Avascular necrosis can be expected in 15–33% of displaced fractures and non-union may occur in 23–37% of cases. Overall, the risk for failure of fixation of displaced fractures is estimated at 39–43%.³ A 2008 review noted that there is a limited role for non-surgical management, that cemented unipolar hemiarthroplasty remains a good option and that in appropriately selected patients the outcome following total hip replacement appears to be favourable.⁴ This article aims to review the recent literature in an attempt to elucidate current concepts critical to the management of intra-capsular femoral neck fractures.

Timing of surgery

The optimal timing of surgical intervention remains controversial. The deleterious effect of an undue delay in surgery has previously been established.⁵ The optimal timing and the effect of very early surgery have, to date, not been clearly defined. Previous studies have shown an increased mortality when surgery was performed within the first 24 hours following admission.^{5,6} Recent studies have however indicated the contrary, suggesting that early surgery may be beneficial. A meta-analysis of 52 studies, involving more than 290 000 patients, found that surgery within 48 hours of admission resulted in a decrease in the duration of hospital stay, as well as a possible reduction in complications and mortality.⁷ Another meta-analysis involving a large number of patients ($n = 257\ 367$) was able to illustrate that operative delay beyond 48 hours resulted in a 44% increase in the odds of 30-day mortality, particularly in younger and low-risk patients.⁸

These meta-analyses were however criticised due to the heterogeneous and retrospective nature of the studies that were included. A meta-analysis of improved design, incorporating 16 prospective studies, was able to show that a delay of longer than 24–72 hours resulted in a statistically significant increase in mortality, even after adjustment for confounding risk factors.⁹ The British Orthopaedic Association Standards for Trauma (BOAST) guidelines subsequently recommended that surgical fixation should not be delayed more than 48 hours from admission, unless there are clearly identifiable reversible medical conditions present.¹⁰ Ideally the question of optimal timing should be addressed through a well-designed, randomised study. Due to ethical considerations it is, however, unlikely that a study of this nature will ever be undertaken.

Undisplaced fractures

Non-operative management of undisplaced fractures has a high rate of failure due to late displacement in more than 20% of cases.¹¹ Despite the fact that internal fixation has become standard practice, some interesting questions have recently been raised with regard to the treatment of undisplaced femoral neck fractures. Lee *et al* compared the outcome of fixation utilising cannulated screws with standard dynamic hip screw and minimal invasive dynamic hip screw fixation. Although not statistically significant (97% vs 84%, $p=0.11$) they found a trend towards an increased overall success rate with minimally invasive dynamic hip screw fixation.¹² This may possibly be attributed to the improved biomechanical characteristics, in terms of guided collapse, offered by the guided sliding of the hip screws. A more aggressive approach was investigated by Parker *et al*, who compared internal fixation and hemiarthroplasty in the management of undisplaced fractures. Internal fixation was associated with fewer peri-operative complications (6% vs 23%); lower one-year mortality rates (19% vs 26%); lower reduction in mobility; lower dependency on walking aids; and lower pain scores at one-year follow-up. Despite a higher re-operation rate (17% vs 6%) the authors recommended internal fixation for the management of undisplaced fractures.¹³

Displaced fractures

Displaced fractures of the femoral neck have been referred to as the unsolved fracture. The first question that needed to be answered was whether the femoral head should be retained or replaced. The second question, requiring further investigation, pertained to implant selection once a head-sacrificing procedure was selected.

Two long-term randomised trials, comparing closed reduction and internal fixation with replacement of the femoral head, have recently been published. The first, involving 455 patients over the age of 70 years found that implant failure requiring revision occurred in 39% of patients in the internal fixation group and in only 7% of patients who were treated with uncemented monocomponent hemiarthroplasty (Austin-Moore prosthesis). If revision surgery was required for failure, it occurred within two years of the index procedure in 91% of cases. At final follow-up there was, however, no difference in the outcome in terms of pain and mobility in both the successful groups.

It is interesting to note that the mortality rate in this study, with a nine to 15 year follow-up, was 93% (and no difference was found between the two groups).¹⁴ A second randomised trial, involving a similar number of patients over the age of 70, found an overall failure rate of 46% in the fixation group versus 8% in the arthroplasty group (both hemiarthroplasty and total hip replacement were included in this study). Patients in whom union was successfully achieved with internal fixation had more hip pain and reduction of mobility at four months' follow-up compared to patients who were treated with arthroplasty (and never attained a better outcome than the latter). The conclusion from this was that primary replacement gave reliable results in patients over the age of 70 years. The mortality rate in this study, at ten-year follow-up, was 75%.¹⁵ The increased re-operation rate following internal fixation appears to be well established. Revision typically involves conversion to total hip replacement. A recent report noted that total hip replacement following failure of internal fixation resulted in relatively few complications, despite being technically challenging.¹⁶

Several studies have investigated the outcome of arthroplasty in the management of displaced femoral neck fractures. The popularity of bipolar arthroplasty rose following initial reports showing up to 94% survival rates (99% with acetabular wear as end-point) at ten-year follow-up.¹⁷ Questions arose regarding the validity of the statement that the bipolar configuration decreases acetabular wear when compared with unipolar hemiarthroplasty. Two randomised control trials have compared bipolar and unipolar hemiarthroplasty. Jeffcote *et al* found decreased combined three-dimensional wear (0.6 vs 1.5 mm) and slightly improved clinical outcomes, in the short term, with bipolar replacement.¹⁸ The second study investigated the clinical and radiological outcome in patients over the age of 80 years at one-year follow-up. Despite decreased acetabular wear in the bipolar group (5% acetabular erosion vs 20% in the unipolar group) there was no difference in the Harris Hip Score or complication rate.¹⁹ Bipolar hemiarthroplasty offer several additional advantages related to the contemporary nature of the stem design. Compared to the more traditional hemiarthroplasty implants, bipolar femoral stems offer increased modularity in terms of mode of fixation, size and offset. These theoretical advantages, combined with the popularity of the implant at certain major international orthopaedic centres, have resulted in renewed interest in the use of bipolar prostheses.

Two well-designed, randomised controlled studies comparing hemiarthroplasty and total hip replacement, in patients over the age of 70 years, have recently been published. The first, involving 120 patients with an average age of 81 years, compared the outcome of cemented total hip replacement and cemented bipolar hemiarthroplasty. The Harris Hip Score, at two-year follow-up, was found to be significantly better in the total hip replacement group.

The first question was whether the femoral head should be retained or replaced. The second question pertained to implant selection once a head-sacrificing procedure was selected

The conclusion from this series was that total hip replacement offers better hip function and quality of life in elderly, lucid patients.²⁰ The second study, however, came to a completely different conclusion and total hip replacement was not recommended as the treatment of choice in patients over the age of 70 (in the absence of advanced radiological OA or RA of the hip).²¹ This study, involving 252 patients with an average age of 81 years found no differences in the Harris Hip Scores, revision rates, general complications, or mortality at five-year follow-up. This study highlighted the fact that total hip replacement is associated with increased peri-operative blood loss, with 26% of total hip replacement patients losing more than 500 ml of blood compared to only 7% of patients in the hemiarthroplasty group. No dislocations occurred in the hemiarthroplasty group while eight dislocations occurred in the total hip arthroplasty group. The risk of dislocation following total hip replacement for fractures of the femur neck has previously been investigated. A meta-analysis found an average dislocation rate of 7%.²²

A recent meta-analysis of randomised controlled trials involving total hip replacement following femoral neck fractures found insufficient evidence to draw firm conclusions. Patients who receive total hip replacement appear to have better long-term outcomes in terms of pain, mobility and the need for a second operation. The final recommendation from this report was that total hip replacement may be indicated in a selected subgroup of relatively healthy patients.²³ A mortality rate of 80% was found at an average of 13 years following the fracture, again indicating that only a minority of patients require an implant that will last for ten years or more.

Intra-operative considerations

The risk of dislocation following total hip replacement has been shown to be directly related to the surgical approach utilised. A comparative study found a 2% dislocation rate with an anterolateral approach while a posterior approach with capsular repair resulted in a 12% dislocation rate, which increased to 14% with a posterior approach without capsular repair.²⁴

The risk of dislocation following total hip replacement has been shown to be directly related to the surgical approach utilised

The preferential use of bone cement for fixation of hemiarthroplasty appears to be well established. A randomised control trial comparing cemented Thompson's prosthesis with uncemented Moore's prosthesis showed less pain and improved mobility in the cemented group without any increase in mortality, complications or reoperations.²⁵ There are however still proponents of uncemented implants in patients with cardiovascular co-morbidities. This stems from the well-known study by Parvizi *et al*, who found an increased mortality rate with the use of cemented implants (3.5% mortality at 30 days compared to 1.5% in the uncemented group).²⁶ The use of uncemented implants has also been advocated in younger patients with good bone quality. It has been recommended that an uncemented femoral stem may be considered in patients with a medullary canal measurement of less than 16.5 mm.²⁷

Following an initial randomised controlled trial discouraging the use of calcium phosphate cement to augment cannulated screw fixation of displaced femoral neck fractures, the role of bone graft substitutes has been investigated further. A meta-analysis of randomised control trials found that calcium phosphate cement is associated with poor long-term results and stated that there is poor evidence for its use in the treatment of hip fractures.²⁸

The use of tranexamic acid to reduce blood loss following total knee arthroplasty is gaining popularity. A recent randomised, placebo control trial involving the prolonged use of tranexamic acid following total knee replacement found a statistically significant reduction in the need for transfusion without resulting in thrombotic events.²⁹ A randomised, placebo-controlled trial investigating the use of tranexamic acid in hip fracture surgery found a significant reduction in the need for blood transfusion (42% vs 60% in the control group) while the probability of a vascular event increased by 10% at six weeks.³⁰ The reduction in the need for transfusion may impart benefits in terms of survival. In a cohort of 229 patients, 53% of patients in the mortality group required transfusion, compared to only 35% in the survival group.³¹ It should be noted that the increase in mortality in the transfusion group occurred only after 90 days following the surgery.

Post-operative considerations

Arguably the most important recent development in the management of hip fractures is the decrease in mortality provided by the intravenous bisphosphonate therapy following the fracture. In an initial randomised, double-blind placebo control study the administration of one dose of zoledronic acid, within 90 days of the fracture, resulted in a 28% reduction in all-cause mortality.³² Although subsequent fractures are associated with an increase in mortality, the prevention of subsequent fractures only explained 8% of the effect on mortality. A second trial found a 30% reduction in mortality, when zoledronic acid was given between two and 12 weeks following the fracture. This study showed that the effect was independent of prevention of subsequent fractures alone, and the treatment group was less likely to die from pneumonia or cardiovascular events than placebo-treated subjects.³³

The findings of studies investigating the effect of tranexamic acid have again raised questions regarding the use of thromboprophylaxis. Although asymptomatic deep venous thrombosis (DVT) occurs fairly commonly (in up to 50% of cases) following hip fractures, the incidence of symptomatic DVT appears to be much lower at around 2.5%. The incidence of fatal pulmonary embolism following hip fracture has been shown to be in the region of 0.6% in placebo groups of randomised control trials.³⁴ Previous multi-national, randomised trials found a significant reduction in the incidence of venographic DVT with the use of fondaparinux and enoxaparin. The incidence of fatal pulmonary embolism (0.8%) was however similar to the incidence in placebo groups of previous studies.³⁵ A recent meta-analysis involving 70 studies of over 99 000 patients who had received total joint arthroplasty, echoed these findings, noting that the use of potent anti-coagulation does not reduce the overall mortality or the proportion of deaths as a result of pulmonary embolism.³⁶

A recent critical appraisal of the use of thromboprophylaxis cautioned that, unlike the previous issues, the 9th edition of the ACCP guidelines was prepared by methodologists rather than specialists in the field of orthopaedics and/or thrombosis.³⁷ The American Academy of Orthopaedic Surgeons (AAOS) 2011 guidelines support the use pharmacological and mechanical prophylactic measures following total hip and knee replacement, but admitted that the data were based mainly on the prevention of DVT rather than the clinically more important prevention of pulmonary embolism.

Iron supplementation is frequently prescribed following hip fracture and the benefit thereof has recently been investigated. In a randomised, control trial Parker found no significant clinical benefit in patients who were not anaemic prior to admission. At six weeks' follow-up patients in the treatment group had an average increase in haemoglobin of 2.1 g/dL, compared to 1.8 g/dL in the control group.³⁸

Prevention of hip fractures

A multicentre randomised control trial investigation into the use of hip protectors was discontinued prematurely after finding an increased incidence of fractures in the treatment group.³⁹ On the other hand, bisphosphonate therapy has been shown to be beneficial in the prevention of osteoporotic fractures. A network meta-analysis found the greatest reduction in the relative risk of developing a hip fracture with the use of zoledronic acid, which was closely followed by alendronate.⁴⁰ Millions of women abruptly discontinued postmenopausal hormone replacement therapy (HRT) following the initial Women's Health Initiative trial, which warned of an increased risk of cancer. Six-and-a-half years later it was noted that women who discontinued HRT had a significant reduction in bone mineral density, as well as a 55% greater risk of hip fracture.⁴¹

Conclusion

A review of recent literature suggests that younger patients with hip fractures should be operated within 48 hours, while older patients with significant co-morbidities should be optimised in a high care environment with the aim of performing surgery within 72 hours. When treating displaced fractures in patients below the age of 70 years the choice of operation remains between fixation and replacement. The choice should be based on the fracture pattern, bone stock, presence of arthritis, quality of reduction and stability of fixation. In patients older than 70, arthroplasty is recommended and the choice of implant is based on the predicted life expectancy. In patients with less than five years of life expectancy mono-component hemiarthroplasty appears to be appropriate, while in patients with five to ten years' life expectancy, bipolar hemiarthroplasty is preferred. Approximately 20% of patients should be expected to live for ten years or longer and in these cases total hip replacement should be considered. Factors to consider when deciding on the type of implant include the patient's age, co-morbid disease, ambulatory status, functional demand, cognitive function, risk of dislocation and the presence of osteo- or rheumatoid arthritis. Intra-operative consideration should be given to the use of an antero-lateral approach in order to reduce the risk of dislocation while tranexamic acid may reduce peri-operative blood loss.

Finally, cognisance should be taken of the fact that the administration of intravenous bisphosphonates, two weeks to three months following the fracture, is associated with a significant reduction in mortality.

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