Research Article
Total Hip Arthroplasty
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Periprosthetic femoral fracture around the stem of Total Hip Arthroplasty

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Introduction: Fractures occurring over a hip femoral implant can be divided into intra-operative and post-operative PFFs, and their treatment depends on factors that may severely affect the outcome: level of fracture, implant stability, quality of bone stock, patient's functional demand, age and comorbidities, and surgeon expertise. Here, we are discussing the results of management of periprosthetic femoral fractures.

Material and method: Eleven patients of periprosthetic femoral fractures were operated in our hospital in last 3 years. Patients were followed up regularly. Their results were assessed by modified harris hip score. Two fractures were Type A, seven cases were type B and one case was type C fractures. Type A fractures were managed by cables and stainless-steel wires. Type B fractures were managed by long plates, and type C fracture was managed by distal femoral locking plate.

Results: Results were assessed by modified harris hip score. It was found excellent in 3 cases, good in 7 cases and fair in one patient.

Conclusion: In the presence of a well-fixed stem there are various options for retaining the implant and reduction and fixation of the fracture, but loose implants require revision arthroplasty and internal fixation. Future large-scale randomised trials are needed to determine the optimum fixation option with an aim to reduce these complications.

Keywords: Total hip arthroplasty, periprosthetic femoral fractures, Vancouver classification

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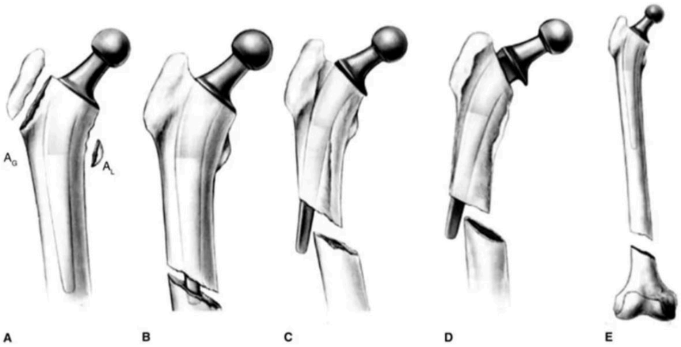
Introduction

Periprosthetic femoral fracture is a difficult surgical problem for orthopedic surgeons. It can happen during or after the operation. The ever-expanding indications for total hip arthroplasty are leading to more implants being placed in younger as well as in older patients with high functional demand. Also, prolonged life expectancy is contributing to an overall increment of periprosthetic femoral fractures. The incidence of periprosthetic femoral fractures (PFFs) has been reported to be between 1% and 11% over a primary and up to 18% over a revised hip femoral stem (1). Management of these injuries is often resource intensive and can present significant socioeconomic challenges. Understanding the principles of surgical management these cases and recognising when fixation or replacement is required is critical (2). Risk Factors for periprosthetic femoral fractures are osteoporosis, poor bone stock, uncemented femoral stem, revision of a femoral stem, previous fracture neck of femur treated by THR, osteolysis and aseptic loosening. These fractures can occur during previous implant removal, bone preparation and placement of the revision implant. History and physical examination reveal acute onset of pain, deformity and history of a fall. PFFs occurring over a THA can be divided into intra-operative and post-operative PFFs. Intra-operative fractures are estimated to occur in less than 1% of cemented and in 5.4% of uncemented primary THA, while in revision surgery the incidence of PFFs is higher, up to 3.6% during cemented and 20.9% during uncemented procedures. (7)

In general, in the context of a well-fixed femoral stem (Vancouver B1 or C) it is possible to retain the prosthesis and treat with internal fixation methods (8). When there is concern of loosening or instability around the stem (Vancouver B2, B3) then the literature supports revision arthroplasty surgery with or without internal fixation (9).

Radiographic Evaluation is done by full-length views of the femur (AP, lateral view), AP pelvic radiograph. Judet views are done to evaluate the floor, roof, and columns of the acetabulum. CT and MRI are done to rule out unusual complexity, especially around the acetabulum. Evaluation is done to exclude the possibility of infection by Inflammatory markers and intraoperative testing is done by frozen section analysis of periprosthetic tissue. Classification of periprosthetic femoral fracture is Vancouver classification. This system is based on site of the fracture, stability of the stem and quality of bone.



Type A fractures involve the greater or lesser trochanter, type B are diaphyseal starting around the stem and may extend distally whereas type C fractures are distal to the stem in the femoral shaft. The Vancouver system remains the most commonly used due to its simplicity and its application to surgical management.

Modified Vancouver Classification of Post-operative PFFs

A Proximal metaphysis

AG Around the greater trochanter

AL Around the lesser trochanter

B Bed of implant

B1 Stable stem

B2 Loose stem, good bone stock

Burst Highly comminuted fracture, more frequent in cemented stem

Clamshell* Displaced fracture of the medial cortex including residual neck, calcar and the lesser trochanter, more frequent in uncemented stem

Reverse clamshell Displaced fracture of lateral cortex with a "reverse obliquity" pattern

Spiral More frequent in cemented stem, loose bone-cement and/or cement-stem interface

B3 Loose stem, poor bone stock

C Clear of the implant, well below the prosthesis

D Clear of the implant, dividing 2 implants, a hip and a knee arthroplasty

There always remains some controversies surrounding the optimal management of peri-prosthetic fractures such as which internal fixation method is optimal in Vancouver B1 fracture and identification of stable or unstable stems when considering retention of the prosthesis (7).

Fixation option in the context of a vancouver B1 or C fracture are limited by restricted bony fixation proximally given the presence of a femoral stem and often in compromised bone stock. The use of single plate fixation for treatment of vancouver B and C type fracture with an overall failure of 33.9 %, high failure rates and need for reoperation have previously been described by Lindahl et al. The only plate is not a good choice for fixation because of high failure rate.

Cerclage wire or cable fixation is commonly employed in the management of intra-operative periprosthetic fracture at time of primary surgery however this technique may also be applied to management of post operative fracture. Cable-only fixation showed high failure rate and need revision surgery so only cable is not a good choice for fixation. A recent study demonstrated better outcome using the hybrid technique of cables and plate fixation around the stem.

Material and method

We have operated 11 cases of PPF in our hospital in last 3 years. Two fractures were Type A, seven cases were Type B and one case was Type C fractures. Type A fractures were managed by cables and stainless-steel wires. Type B fractures were managed by long plates, and Type C fracture was managed by distal femoral locking plate. Results were assessed by modified harris hip score. It was found excellent in 3 cases, good in 7 cases and fair in one patient.

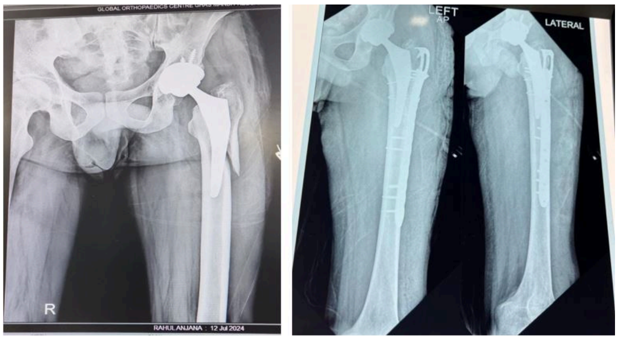


Figure 1: A- Preop xray of B1 fracture, B- Post operative xray of B2 fracture

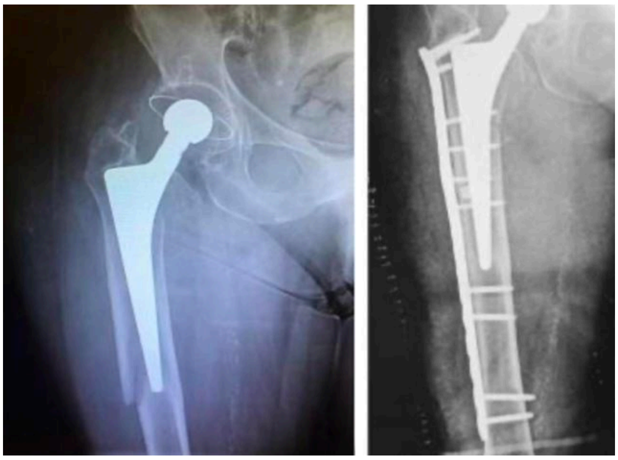


Figure 2: A- Preoperative x-ray of B2 fracture, B- Post operative x-ray

Figure 3: A- Preoperative x-ray of B1 fracture, B- Post operative X-ray

Cortical strut allograft is rarely used in isolation as they are more often applied and used in combination with plate fixation. It has been proved to be a very stable fixation. Various previous studies show that strut-graft had no added benefit over combined cable and plate fixation. It just adds as an additional procedure and economic burden to the patient.

The presence of a loose stem associated with a periprosthetic fracture requires revision arthroplasty and fixation with the aim of achieving both a stable implant and a healed fracture. Revision arthroplasty for peri-prosthetic fracture has been described using both uncemented and cemented implants. when uncemented prostheses are used, fluted titanium stem can be used to achieve diaphyseal fixation while enabling the surgeon to bypass the fracture site and achieve fixation distal to the fracture. Complications are non-union 5%, metal work failure 4%, infection 5% and reoperation in 9% cases.

Discussion

The goals of surgical treatment are restoration of anatomical alignment and length with a stable prosthesis, maintenance or enhancement of bone stock, early mobilisation and early union. Intramedullary (revision stems or nails in Type C PFFs) or extramedullary (plates, cerclages, structural graft) techniques, or a combination of both, are used to achieve these goals (1). The correct management of the fracture is demonstrated by the stability of the femoral implant: if the stem remains well-fixed the fracture can be treated with osteosynthesis, otherwise revision of the implant must be considered. Recent systematic review of internal fixation method for Vancouver Type B fractures, ORIF with cables and compression plate or locking plates have given union rate of 95%. Structural graft can add both mechanical and biological support. In the presence of loose stem revision arthroplasty with long stem prosthesis is indicated. Some author suggested that presence of fracture around a cemented stem is an absolute indication for revision arthroplasty.

Alongside recent developments in periprosthetic technology and surgical technique, demographic ageing has greatly increased the incidence of certain patient-specific complications. As we see more patients living into their sixties and beyond, we must contend with greater incidences of age-linked comorbidities, particularly osteoporosis and cognitive decline.

So, while the former of these makes fractures both more likely and more difficult to stabilize, the latter impairs patient's abilities either to avoid fractures or to comply with complex post-surgical therapeutic regimens. Consideration of such issues is essential to decide on the most appropriate approach for each patient. (4)

Essentially all periprosthetic fractures require some treatment. Stable nondisplaced fractures may only require protected weightbearing or cast/brace immobilization (and pain medication), but most unstable peri-implant fractures require surgical stabilization, implant replacement, or both to restore function. Surgical intervention follows the same guidelines for peri-implant fractures as for other fractures.

The goals of treatment include the following: Early ambulation, which helps avoid pulmonary complications, pressure injuries, disuse osteoporosis, and other complications of prolonged bedrest, restoration of axial alignment, which helps prevent eccentric stress on the prosthesis that leads to early loosening and stabilization of the limb, which allows joint motion and helps prevent stiffness and muscle atrophy. (5)

The aging population and the increasing number of patients with primary total hip arthroplasties (THA) has equated to an increased incidence of periprosthetic fractures (PPF) of the hip. These injuries are a significant source of patient morbidity and mortality, placing a financial burden on healthcare systems worldwide. As the volume of PPF is expected to along with the growing volume of primary and revision THA, it is important to understand the outcomes and factors associated with treatment success. (6)

Non-operative treatment of PPFs has been associated with poor outcomes (Nonunions and malunions), medical complications (10) except probably in cases of a critically ill patient unable to undergo any major surgical intervention. With the evolution of implants and further experience in revision surgery, operative intervention is nowadays the choice of treatment. More recently, new evidence related to anabolic drug therapies in combination with non-operative protocols, even for PPFs with an unstable prosthesis, has introduced an interesting alternative method for very frail patients, or those with minimally displaced fractures. (11)

The evolution of orthopaedic implants has provided us with more intraoperative surgical options and solutions to deal with these complex injuries, and that applies to both revision implants and fixation devices. The need though remains for even more specially designed implants to address if not all at least the vast majority of PPFs. New concepts of fracture fixation are here, such as plates with far cortical locking (FCL) and active plating. (12,13)

When managing Vancouver B3 fractures with deficient bone stock, surgeons are challenged with achieving both implant and fracture stability. It is important to recognize that bone loss encountered during the time of surgery is likely greater than initially thought on pre-operative radiographs (14). In the case of PPF with inadequate bone stock, treatment should be with a long-stemmed femoral component with bone augmentation with extra and intramedullary fixation in the form of impaction grafting or biological strut grafts (15). Another option includes a proximal femoral replacement in cases where the proximal femur cannot be reconstructed (16).

Conclusion

In the of a well-fixed stem there are various option for retaining the implant and reduction and fixation of the fracture. But loose implants require revision arthroplasty and internal fixation. Future large-scale randomised trials are needed to determine the optimum fixation with an aim to reduce these complications.

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