Intraoperative periprosthetic fracture of femur in a case of revision total hip replacement: A case report

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ABSTRACT

Introduction: The numbers of patients undergoing total hip arthroplasties are continuously increasing and with that so are cases of periprosthetic fractures. They can be either intraoperative or post-operative. Most intraoperative femoral fractures occur during insertion of the femoral stem. Multiple methods are available for fixation but principles of stable fracture fixation should be used while fixing these fractures. Case: A 72 year old male who had undergone left sided bipolar hemiarthroplasty for neck of femur fracture 2 years back presented with pain in the left hip since 1 year. X rays show loosening of bipolar stem in medullary canal with lateralisation of tip of stem. Severe osteoporosis was noted. The patient was taken up for revision total hip arthroplasty. There occurred a Vancouver type B1 fracture during insertion of the femoral stem. Immediate fixation of the fracture was done using a LC-DCP contoured to the desired shape. On 7th post-operative day patient started complaining of pain in left thigh. Repeat X rays showed plate failure with displacement of fracture. Due to corona virus pandemic patient was given skeletal traction and leg put on BB splint. After 6 weeks the patient was managed with open reduction and internal fixation using Trochanteric bridge plate with screws and titanium cables. While passing encirclage wire there was damage to the superficial femoral artery. Patient was started on anticoagulants and started guarded walking on the 7th post-operative day. Conclusion: Vancouver type B periprosthetic femur fractures are unstable and require internal fixation and stabilisation. A long Limited contact plate extending from the greater trochanter to an adequate distance beyond the fracture site gives good structural stability.

Keywords: Total hip replacement, femur fracture, intraoperative periprosthetic femur fracture.

1. INTRODUCTION

Periprosthetic fractures were first described by Horwitz and Lenobel in their case report in 1954. They published a report on a female sustaining intertrochanteric fracture of the femur near the stem of the cemented hemiarthroplasty (Lindahl, 2007). The number of patients undergoing total hip and knee arthroplasties are continuously increasing and with that so are cases of periprosthetic fractures (Berry, 1999). Periprosthetic femur fractures can be caused either intraoperatively or post-operatively. Most intraoperative femoral fractures occur during insertion of the femoral stem. An incidence rate of 0.1-1% is reported in cases where cemented stems were used. The incidence in intraoperative femur fractures increases with the use of uncemented stems (Kavanagh, 1992). Vancouver classification, given by Duncan and Masri, provides practical assessment of postoperative femur fracture according to level of fracture and presence of well-fixed or loose component (Duncan and Masri, 1995). We are reporting a case of a periprosthetic fracture at the tip of the stem of total hip replacement which occurred intraoperatively in a severely osteopenic bone.

2. CASE REPORT

A 72 year Indian male came to our OPD with complaints of pain in the left hip since 1 year. The pain was dull aching in nature and gradually progressive in intensity. The pain was aggravated on walking and relieved on taking rest and medications. The patient had been regularly coming to out OPD and was being managed with analgesics which gave him symptomatic relief for some period of time. The patient had undergone a Cemented Bipolar Hemiarthroplasty for fracture of the left neck of femur 2 years ago. Along with fracture neck of femur the patient sustained shaft of left humerus fracture in a road traffic accident. The Humerus fracture was managed with closed reduction and intramedullary nailing. However on 5 months follow up the patient presented non-union of the humerus. The patient underwent a second operation in which the nail was removed and open reduction and fixation of the fracture was done with LC DCP. Autologolous iliac crest bone grafting was done and there was excellent union in the follow up period. The patient was a known hypertensive since the past 5 years and was on regular medications for the same (Tablet Amlodipene 5 mg OD).

Xray of the pelvis and both hips (Fig 1) taken on OPD presentation showed loosening of the bipolar stem with surrounding osteolysis. The stem was lateralised and there was thinning of the lateral femoral shaft cortex near the tip of the stem. Bone cement was seen lining the medullary canal. There was significant thinning of the bone cortices suggesting osteoporosis. The loosening of the bipolar prosthesis was thought to be the reason for the continuous pain in the left hip.

The patient was planned to be taken up for total hip replacement of the left hip. Complete preoperative workup was done and the patient was taken up for surgery on being deemed fit. Cemented Acetabular Cup with Solution stem (Depusynthes) was going to be used in the surgery with cost considerations taken into account. The patient was taken up for surgery and the bipolar implant was exposed by a posterior-lateral approach. The Bipolar prosthesis was easily extracted on table as the implant was already loose. Bone cement was removed from the medullary canal with the help of a chisel and hammer. The cement was removed en bloc (Fig 2).
Acetabulum was prepared and Acetabular cup trialing was done. Once appropriate size was found the acetabular polyethylene cup was inserted with bone cement. Then Solution stem was inserted into the femoral canal with the help of insertor. The femoral head of the appropriate size was found by trial and then placed on the trunion of the solution stem. The surgery was uneventful till this point.

**Figure 1** Plain Radiograph of pelvis with both hips showing loosening of the left side bipolar stem with surrounding areas of osteolysis.

**Figure 2** Bone cement removed enbloc

While relocating the femoral into the acetabular cup a snap was heard and there was loss of transmitted movement from the leg to the femoral stem and head. On C arm imaging an oblique bicortical periprosthetic fracture was seen near the stem of the solution
stem (Vancouver type B1). The Hip was relocated and closure was done. The patient was immediately taken up for internal fixation of the periprosthetic fracture. Lateral approach to fracture was taken. Some pieces of bone cement were removed from the fracture site. Fracture was reduced with bone clamps and fixed with a LCDCP plate contoured to fit lateral part of the femoral shaft and condyle. Closure was done and the patient was put in a long knee brace and was kept nonmobile. Post-operative x-ray showed that the fracture was stabilised (Fig 3a and b).

![Figure 3a](image1.png) Post-operative x-ray of pelvis with both hips showing the left sided total hip replacement.

![Figure 3b](image2.png) Post-operative Xray of the left thigh showing the periprosthetic fracture fixed using LC-DCP compression plate

Dressing was opened on post-operative day 2 and surgical site was found to be healthy. Injectable antibiotic were stopped on the 3\(^{rd}\) post-operative day. Soakage was seen over the surgical site of the THR and the dressing was opened. Wound was found to be wet and surgical site swab was sent. Daily soakage was present for 3 days and daily dressing was done. Injectable antibiotic were started again. The surgical site swab came contaminated for skin organisms. The soakage stopped after 3 days and the injectable antibiotic for 5 more days. On the 7\(^{th}\) post-operative day the patient started complaining of pain in the left thigh. The patient was said he heard a snapping sound immediately after which the pain started. Immediate x-ray was done and there was a failure of the LC-DCP at the fracture site (Fig 4). The patient was immediately put a proximal tibial skeletal traction was put on a Bohler Braun splint with 6 kgs weights for pain relief and maintaining the position of the fracture.
The patient was planned for open reduction and internal fixation with trochanteric bridge plate with titanium banding. However due to the Corona virus Pandemic lockdown we were unable to acquire the implants for 6 weeks. The patient was admitted in the ward with the skeletal traction in the interim. Once the implants were available an x-ray of the left thigh (Fig 5) was done and callus was seen at the fracture site with the LC-DCP in situ. The fracture union was satisfactory on Anteroposterior view but on lateral view the fracture was uniting in recurvatum. The decision was made to continue with the planned surgery to correct the alignment.

The Patient was taken for surgery and the fracture site was opened by the lateral approach. The callus was broken and the LC-DCP plates with screws were removed. There was significant communication at the fracture site. Once the reduction was achieved it was maintained with a Trochanteric bridge plate (fig 6) (nebula). 4 titanium binding cables were passed through the plate. 2 were
passed above the fracture and 2 below it. While passing a k wire for encirclage at the fracture site there was significant bleeding. There was sudden fall in the BP of the patient intraoperatively. Vasocompression with esmarch bandage was done for 20 mins and the bleeding was controlled. The vascular surgeon was called and no obvious vascular damage was seen as per his expert opinion. Closure was done and the patient leg was kept in a long knee brace. The post operativexray showed a stable fixation (fig 6).

![Fracture stabilised using trochanteric locking plate with titanium cables and screws](image.png)

**Figure 6** Fracture stabilised using trochanteric locking plate with titanium cables and screws

Post operatively the patient had severe stretch pain in the left leg. A colour Doppler of the left leg was done and there was found to be a haematoma in the superficial femoral artery. There was a monophasic flow in the anterior and posterior tibial arteries. An angiogram was performed and there were presence of collaterals at the site of haematoma. The patient was started on 1.2 mg LOMOH twice daily for 3 days along with clopidogrel and aspirin. The patient had reduction in the stretch pain on the 3rd post-operative day. The patient was started non weight bearing mobilisation on 7th post operative day and discharged after suture removal (fig 7a and 7b).

![Patient commencing knee mobilisation on day 4](image.png)

**Figure 7a** Patient commencing knee mobilisation on day 4
3. DISCUSSION

Daniel Berry in his report on management of periprosthetic fractures around the hip published in 2002 concluded that intraoperative femoral fractures with meticulous preoperative planning and with the use of templates for optimising implant design and size. Most of the intraoperative fractures occur at the time of insertion of uncemented implant. This can be avoided by judicious use of force during insertion of implant and preparation of femur. Special care must be taken while working with osteopenic bone. Femoral fractures are managed according to the severity of the fracture. Minor cracks if identified intraoperatively can be managed with SS wire encirclage. If identified post operatively they can be managed by guarded weight bearing and meticulous follow up. Major intraoperative fractures associated with unstable implants require more complex reconstructions (Berry, 2002).

Takahiro Niikura et al. published a case report in 2015 regarding atypical femoral fracture in a 69 year female who had underwent right sided total hip replacement for steroid induced avascular necrosis of right femoral head. The patient had been on long term alendronate use. The patient sustained a non-traumatic transverse fracture of the femoral shaft just at the level of tip of the stem. Radiographs showed a complete transverse fracture with medial spike in proximal fragment. Alendronate use was stopped 7 months before the fracture took place and was replaced with Vitamin D and Vitamin K for treatment of osteoporosis. The patient was managed with open reduction and internal fixation using a locking compression plate of distal femur and LCP cable system. Some gap was there after reduction and fixation that’s why the gap was filled with Beta tricalcium phosphate bone substitute. Bony union progressed normally and got completed by 6 months. This case shows that alendronate use is a risk factor for periprosthetic fractures (Niikura et al., 2015).

Gill et al. published a paper in 1999 on lateral insufficiency fractures in femurs after total hip arthroplasty. He reported 5 cases in 4 patients who had undergone previous total hip arthroplasties. 4 cases had history of non-traumatic hip and thigh pain while 1 case had history of trauma. The average time between index THR and the periprosthetic fractures was 9.4 years. On radiographs severe osteopenia was seen in 4 of the 5 cases. There was loosening of the femoral components in 2 cases while there was varus angulation of femoral component in 3 cases. Lateral insufficiency fractures were seen at the tips of the stems in 4 cases while in 1 case it was proximal to the stem. All patients were treated by revision to an uncemented long-stem Wagner femoral component via transfemoral approach. All healed their osteotomy sites and insufficiency fractures and were able to walk without difficulty. The paper recommended that if there is insufficiency fracture revision to a long-stem component is needed. The use of a plate does not allow correction of varus femoral alignment, which is central feature of insufficiency fractures (Gill et al., 1999). E. Garcia-Cimbrelo et al. published a study on femoral shaft fractures after a total cemented hip arthroplasty in 1992. In the study period between 1971 to 1989, 37 cases of femoral shaft fractures were taken. 31 patients had undergone a Charnley low friction arthroplasty while 6 underwent an Mllercurved stem prosthesis implation. 11 of the fractures were present in men and 26 were in women with a mean age of 59.3 years. The mean time between surgery and fracture was 3.7 years. 7 fractures were proximal to the tip of the stem, 19 were at the tip of the stem and 11 were distal to the tip. The fractures were managed with circlage alone, plate and screws, long stem prosthesis and functional treatment. Circlage alone had the worst results of all techniques of management. Satisfactory results were seen in 26 patients. The study proved that treatment must accomplish a good union and prevent further loosening of the prosthesis. Type 1 fractures have inherent stability and can be managed conservatively or by replacing longer stem prosthesis if
there is implant loosening. Type 2 fractures are unstable and need to be treating either with long stem prosthesis. This was seen to be case for failure of the initial LC-DCP construct failure in our case. Type 3 fractures also need to be surgically fixed (Garcia-Cimbrelo et al., 1992).

Michael G. Dennis et al. published a study in 2000 comparing 5 techniques of fixation of Vancouver type B femoral fractures. The study compared fixation of periprosthetic femoral shaft fractures with compression using only titanium bands, titanium bands in the proximal segment with bicortical screws in the distal segment, unicortical screws in the proximal segment and bicortical screws in the distal fragment, unicortical screws with titanium bands in the proximal segment and bicortical screws in the distal fragment and allograft cortical graft along with titanium cables. These fixation techniques were used to fix artificially created 45 degree oblique fracture in synthetic femurs with fitted with Charnleys hip prosthesis. These fixation constructs were then subjected to axial, bending, shearing and translational loads. The construct in which the plate was fitted on the lateral surface of the femur and held in place with all screws with proximal cables was most stable and provided the great stability. These results suggest the use of screws rather than cables alone for the fixation of periprosthetic fractures. Similarly in our case we have used a construct with titanium cables along with unicortical screws in the proximal fragment and bicortical screws in the distal fragment to hold the bridging plate in place. This construct provides maximum stability to our fracture (Dennis et al., 2000).

Siu-Bon Woo et al. published a case report in 2016 of an 82 year old woman with a bisphonate induced atypical femoral fracture. The patient had a twisting injury at home and presented with left thigh pain. Before 3 years, she underwent Left sided Austin Moore hemiarthroplasty for fracture neck of femur. She was given bisphosphate therapy for the same. She had undergone a left sided total knee replacement 1 year prior to the fracture. On radiographs a Vancouver type B1 periprosthetic fracture of left femur was seen with thickened lateral femoral cortex and beak sign. She had open reduction and internal fixation with the help of long-spanning distal femoral locking cable-plate. After 12 months, radiographs showed non-union and bone resorption around fracture site without any displacement. 16 months after the fracture fixation, the patient started complaining of left thigh pain and on radiographs implant failure with breaking of the femoral locking plate and fracture displacement was seen. Revision surgery was done and the bipolar prosthesis was replaced by a Deupy long solution stem which crossed the fracture site. The fracture was stabilised by the use of 5 mm metaphyseal LCP (DePuySynthes) fixing the fracture with 2 cables and 2 screws at distal fragment and 3 cables over the proximal fragment. Iliac bone grafting was done. She was started with partial weight bearing at around 6 weeks and complete bone union was observed at 10 months (Woo et al., 2016).

The plate should span over the stem of the implant otherwise it will create a stress enhancer at the tip of the stem. This is the reason for implant failure in our initial surgical fixation of the fracture. Adequate cortical purchase of the screws was not present in the proximal fragment and the construct eventually failed as it was unable to neutralise the forces acting on the fracture. When fixing a long bone ideally 8 cortical purchases should be present on either side of the fracture. Because of canal filling cementless stem, aboveprocedure is challenging in periprosthetic fractures and moreover there is fear of destabilising cement mantle in cemented stem. By using unicortical screws or putting screws more posteriorly to dense bony ridge at linear aspera we might correct it. Cables and circlage wires could be used to further augment the fixation (Yasen and Haddad, 2015). For periprosthetic fractures of osteoporotic bone, an anatomically shaped locked screw plate is used. As it serves as an ‘internal fixator’, it has peculiar benefit when only unicortical screws are used. It has improved pull-out strength as it acts as a fixed-angle device, it minimises disturbance to the local blood supply (Tadross et al., 2000). Compression locking plate along with unicortical screws in the proximal fragment and bicortical screws in the distal fragment provides greater stability to the fracture. The plate must be extending from the trochanter and the construct augmented with cables. Allograft from iliac crest could be used to fill bone gap. While performing the procedure extreme care should be taken regarding local anatomy. Arterial injury is while passing circlage wire is a rare but devastating complication that can occur if not taken care of.

4. CONCLUSION

Vancouver type B periprosthetic femur fractures are unstable and require internal fixation and stabilisation. A long Limited contact plate extending from the greater trochanter to an adequate distance beyond the fracture site gives good structural stability. unicortical screws are used in proximal fragment and bicortical screws beyond the tip of the prosthesis. This construct is augmented with titanium cables. This fixation construct is extremely stable and provides good union in cases of such fractures. All fractures must be fixed keeping in mind biological and mechanical principles of fracture fixation otherwise the fixation is destined to fail. Along with patient related factors surgery is guided by social factors. As in our case the treatment was delayed because of the corona virus pandemic. Local vascular anatomy should be known as arterial injuries can occur while passing encirclage wires.
Conflict of interest
The authors declare that they have no conflict of interest.

Informed consent
Written and oral informed consent was obtained from participants included in the study.

Abbreviations
LC-DCP- Limited Contact Dynamic Compression Plate
OPD- Out Patient Department
BB Splint- Bohler Braun Splint
LCP- Locking Compression plate
SS Wire- Stainless Steel Wire
OD- Once a Day
BP- Blood Pressure
LOMOH- Low Molecular Weight Heparin

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REFERENCE