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Original Research Article

A prospective study of total hip arthroplasty for failed proximal femur fracture fixation

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ABSTRACT

Background: Proximal femur fractures have been widely studied and there are several well-accepted management modalities for the same such as PFN A2, IMIL nails, and DHS. Despite several management options we do encounter significant failure rates which could be due to several factors such as post-operative time rehabilitate patients related comorbidity and differences in surgical techniques. Aim of the study was to assess the outcomes of total hip arthroplasty (THA) after failed surgical management in proximal femur fractures
Methods: The 50 patients who underwent surgical management for proximal femur fractures at any given point in time and presented with non-union or malunion and inability to bear weight affecting their activities of daily living assessed with Harris hip score were enrolled in a prospective cohort study during 2015 and 2022 after obtaining IRB approval. All these patients underwent surgical management for proximal femur fractures within 3 weeks of sustaining a fracture.
Results: A strong statistically significant difference is seen with pain, functional gait, functional activity, range of movement and total score in post-operative group of patients in comparison to patients of pre-operative group. THA had excellent outcomes in 42 patients (85.71%) of the study group. About 6 (14.29%) patients of the study group had good outcome. 2 patients that lost to follow up were removed from the study.
Conclusions: THA is an effective procedure for failed proximal femur fracture fixation patients despite the challenges such as distorted anatomy of femoral head, poor bone quality, longer operative times, larger amounts of blood loss, high rates of intra-operativities and post operative complications.

Keywords: Arthroplasty, Hip, Trauma, Revision surgery

INTRODUCTION

Over 90% of proximal femur fractures above the age of 50 years will require hospitalization.[1] In the aging population femoral neck fractures and intertrochanteric fractures are more prevalent amongst the proximal femur fractures.[2] Significant trauma (motor vehicle accidents, falls) usually precedes fractures of the intertrochanteric region and the common risk fractures for these fragility fractures are osteoporosis, female gender, advancing age, gait abnormalities and history of falls.[3] Non-operative management for such cases has been associated with significant morbidity and mortality and surgery is the usually preferred modality of treatment for such cases. The outcome of surgery for these fractures depends largely on the preexisting comorbidities.

Significant failure rates (3-12%) have been reported with internal fixation for intertrochanteric fractures and the most common cause is malunion causing varus deformity (5-11%) device failure (2-12%) and non-union. The 20-36% of the patients with displaced intracapsular hip fractures required revision surgeries within 2 years due to avascular necrosis and nonunion.[5] Subtrochanteric fractures are defined as ones occurring between the isthmus and lesser trochanter of the femur and these

require stable reduction as they are more prone to malunion and nonunion. Along with stable fixation, it is important to correct the angulations caused by deforming muscular forces around the hip and also maintain the length of the femur.[6] Intramedullary implants have achieved higher success rates compared to plate fixation systems.[7]

Nonunion, malunion, femoral head osteonecrosis, post traumatic arthritis, infection, suboptimal fixation, loss of function, hardware malfunction are among the common challenges posed for management of proximal femur fractures. Although revision osteosynthesis is being performed, it is technically challenging and failures rate are higher due to poor bone quality, damaged head/head collapse, poor bone stock, or limb shortening. In such cases THA is indicated.[8-11]

Recent studies have shown a great success rate with the use of THA resulting in good functional outcomes for patients after failed osteosynthesis of proximal femoral fractures. However, there are complications associated with this procedure.

METHODS

The 50 patients who underwent surgical management for proximal femur fractures at any given point in time and presenting with non-union or malunion and inability to bear weight affecting their activities of daily living, were assessed with Harris hip score and were enrolled in an original research article study between the period of 2015 and 2022 at Vydehi institute of medical sciences and research.

Inclusion criteria

Patients with age group-20-75 years, between 2015 and 2022, failed internal fixation for proximal femoral fractures and minimal follow-up 6 months were included.

Exclusion criteria

Patients with age above 75 years, failed osteosynthesis with infection and bedridden/ non-ambulatory were excluded

A total of 50 patients underwent THA in our study. The 40 were neck of femur fractures, 8 were intertrochanteric fractures and 2 were subtrochanteric fractures. We enrolled patients and primary fixation was done within 3 weeks of sustaining a fracture. A revision osteosynthesis was performed in 7 cases before undergoing THA. In 60% of the cases primary fixation was done with cc screws, 10% with PFN and 30% of the cases with DHS.

Patients were admitted and clinical evaluation was performed using standing examination protocols. Harris Hip Score was used to assess the functional outcomes post-operatively and x-rays were done at immediate postop, at 6 weeks, 12 weeks and 6 months after surgery.

Preoperative evaluation

Pain, function, deformities and range of motion are the parameters that were considered in HHS. Limb length discrepancy and flexion contractures were assessed. The intactness of the abductor mechanism was assessed with Trendelenburg test vascular and neurologic status of the affected extremity were assessed too. Patients were also evaluated for occult infections preoperatively such as dental caries, skin lesions, urinary tract infections treated accordingly before performing THA.

Radiological assessment

Pre operatively X-rays were taken for templating. Pelvis with bilateral hips including proximal aspects of femurs was taken in anteroposterior and lateral views. An evaluation was done for the following: Bone stock of the acetabulum, size of the acetabulum, per acetabular osteophytes/ protrusion, structural integrity of acetabulum, need for bone grafting and size of the femoral canal

Templating was done for acetabular and femoral components to-achieve anatomical placement of acetabular socket, location of center of rotation of femoral head in an anatomical position, restoration of limb length and restoration of abductor arm

Osteoporosis, poor bone stock, distorted anatomy, contracted soft tissues, severe deformities were among the commonly encountered issues in our study. With preoperative planning implants were selected based on the requirement, cemented/uncemented cup, and proximal loading/distal loading stems were kept ready. The implant from the primary fixation was removed. A posterior approach using a curvilinear incision was made over the greater trochanter and extended proximally for removal of implants such as DHS and PFN and for easy access while reaming femur. After implant removal, the hip joint was approached by splitting gluteus maximus and incising the short external rotators. Sciatic nerve was protected and retracted with short external rotators. In one case, we encountered excessive bleeding and hemostasis was achieved using ligatures and cautery. After excising the capsule, hip joint was dislocated posteriorly by passive flexion, adduction and internal rotation.

After dislocating, osteotomy of the femoral neck was done as per the pre-operative template. Soft tissue attachments and articular cartilage were reamed off the acetabulum until the subchondral bleed was noted. Osteophytes were cleared and a thorough wound wash was given. In cases of protrusion acetabuli morselized femoral head was used as a graft. The size of the acetabulum was assessed and an appropriate cup was placed.

Proximal femur was exposed and hip was internally rotated. Femoral canal was reamed with a hand reamer to pre-templated size. After placement of the stem, stability was assessed. A prosthetic femoral head of appropriate

size was placed. The femoral head was reduced into the joint and stability was confirmed with range of movements. Femoral and acetabular anteversion was assessed. Postoperatively abduction was maintained. Antibiotics were given and a check x-ray was taken and assessed.

Physiotherapy

Upper limb/ chest physiotherapy was started on day 1, static quadriceps exercises were done from day 2, on the third day, patient was mobilized to the side of the bed, patient was made to walk from day 3 with assistance and with clear instructions, patients were discharged.

Statistical tests

The collected data will be evaluated using appropriate statistical methods The categorical variables will be described by means of frequency and percentages and presented graphically whenever necessary.

For quantitative data it will be described using descriptive statistics means and 95 percent confidence interval and will be presented graphically whenever necessary. The student's t test will used for normally distributed data and the Mann-Whitney U test for ordinal data. P≤0.05 will be considered statistically significant.

Data analysis

The collected data was coded and entered onto Microsoft Excel compiling the master chart. Descriptive statistics were done for all data and reported in terms of mean values and percentages. Suitable statistical tests of comparison were done. Continuous variables was analyzed with the paired t test and ANOVA single factor test. The results were expressed as proportion using appropriate tables and graphs.

Ethical clearance

Obtained from the institutional ethics committee**.**

Follow up

Follow up at 6 weeks, 3 months, 6 months, 1 year and at yearly intervals thereafter.

Clinical assessment

At each follow-up visit, clinical and radiological assessments were done and documented. HHS was used for functional outcomes.

RESULTS

The majority of patients lie within the age group of 51-60 years as represented in Figure 1.

Having around 77% of neck of femur fractures as seen in Figure 2, while subtrochanteric and inter trochanteric fracture represented only 3% and 22% of the fracture pattern respectively.

The type of total hip replacement done was uncemented in 80% of the patients while cemented was done only for around 10% of the cases.

It was noted that post-operatively, that 36% patients suffered from periprosthetic fracture as a complication while, 18% of the cases suffered from post-operative dislocation and infection and about 27% of the cases were lost to follow up as seen in Figure 4.

Age, gender and fracture pattern and the type of hip replacement done showed no significance in the outcome, however pain, functional gait and the range of movement score and showed significant difference pre-operatively and post-operatively as seen in Table 1.

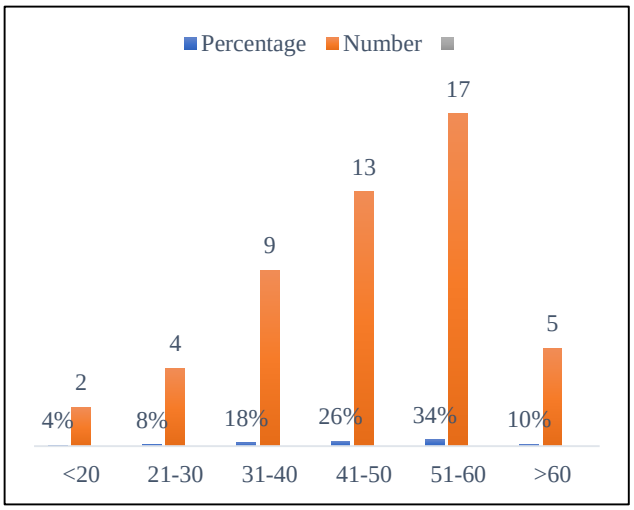

Figure 1: Age distribution of patients.

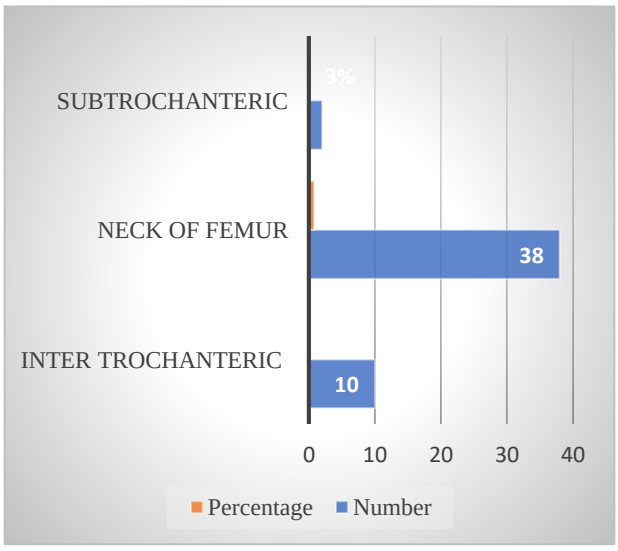

Figure 2: Types of fracture.

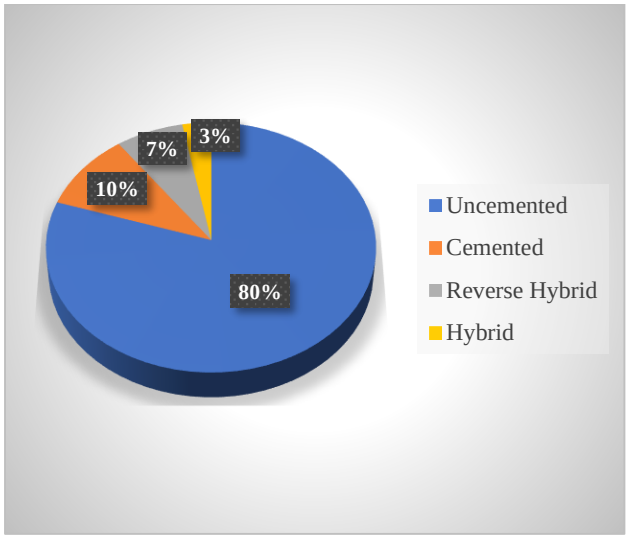

Figure 3: Types of THA done.

Table 1: An evaluation of pain, functional gait, functional activity, absence of deformity, rom score and total score at pre-op and post-op.

Variables	Pre op	Post op	Difference	P value
Pain	10.57	42.29	31.72	<0.0001
Functional gait	10.00	30.46	20.46	<0.0001
Functional activity	5.11	11.43	6.32	<0.0001
Absence of deformity	4.00	4.00	-	-
ROM score	2.43	4.64	2.21	<0.0001
Total score	32.14	92.93	60.79	<0.0001

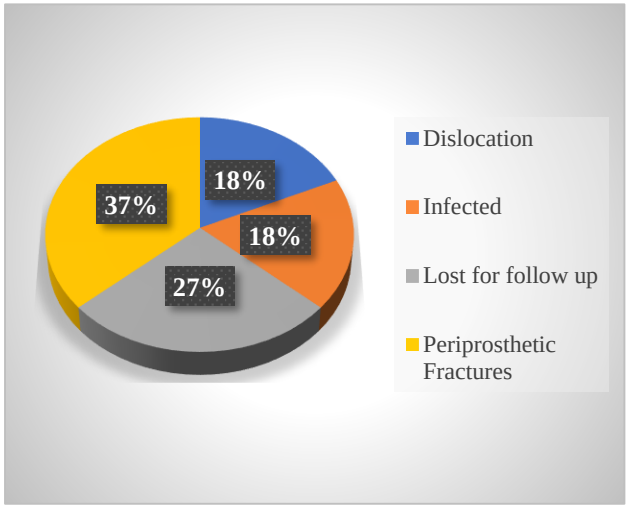

Figure 4: Complications.

The individual cases scenarios and intra-operative and post-operative radiographs are represented from Figure 5 to 9.

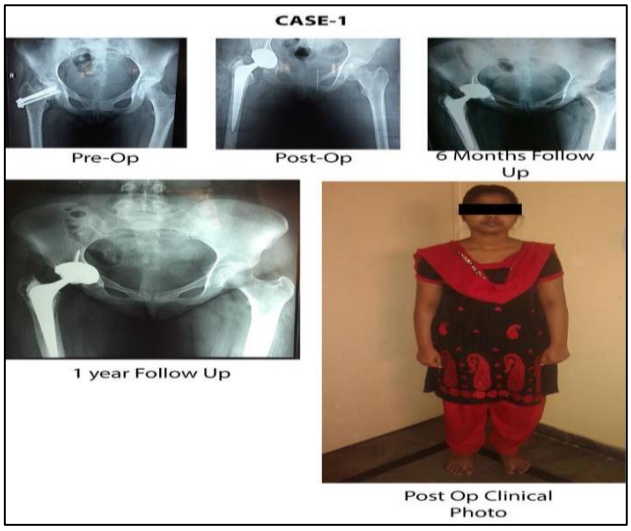

Figure 5: Case number 1.

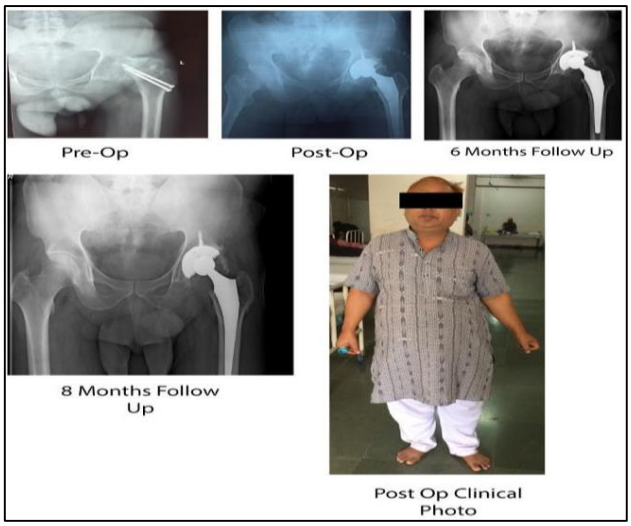

Figure 6: Case number 2.

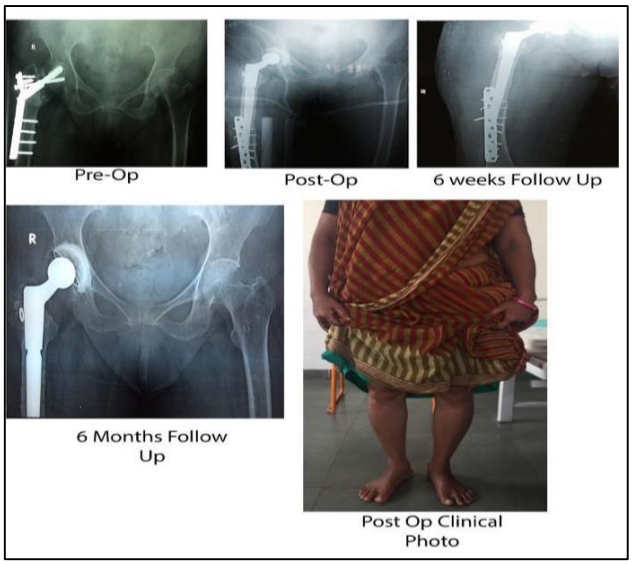

Figure 7: Case number 3.

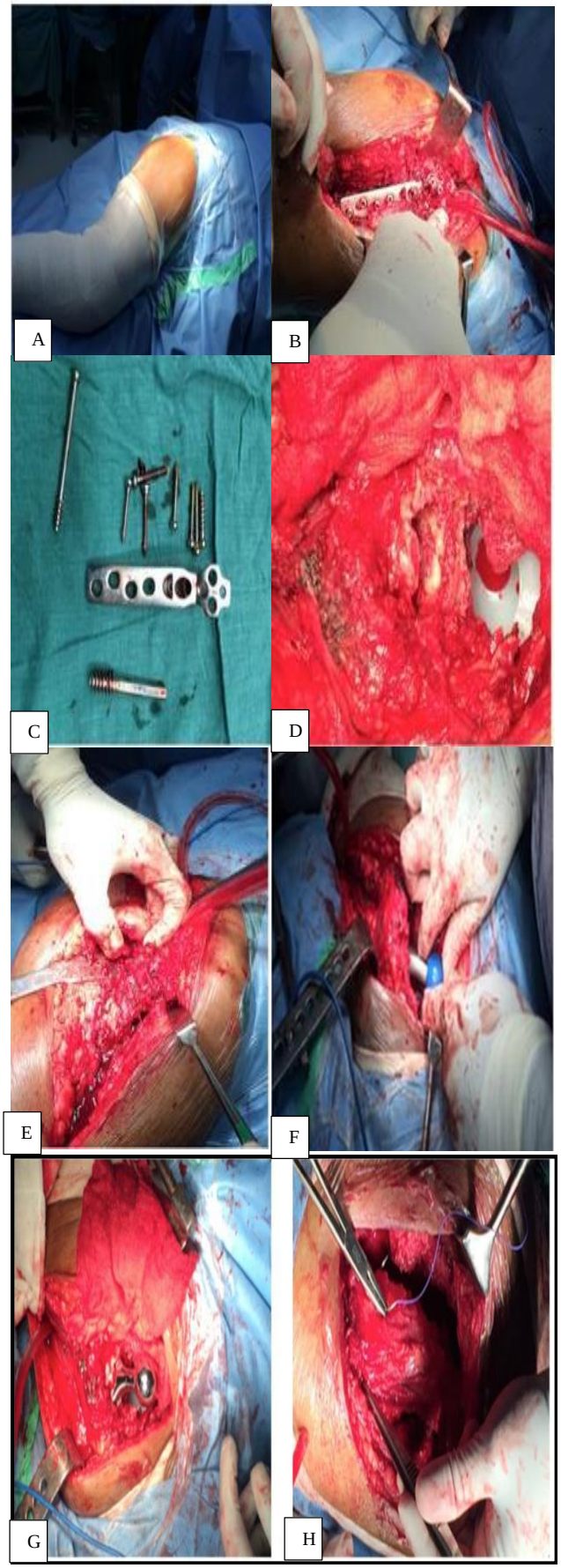

Figure 8 (A-H): Intra-operative pictures.

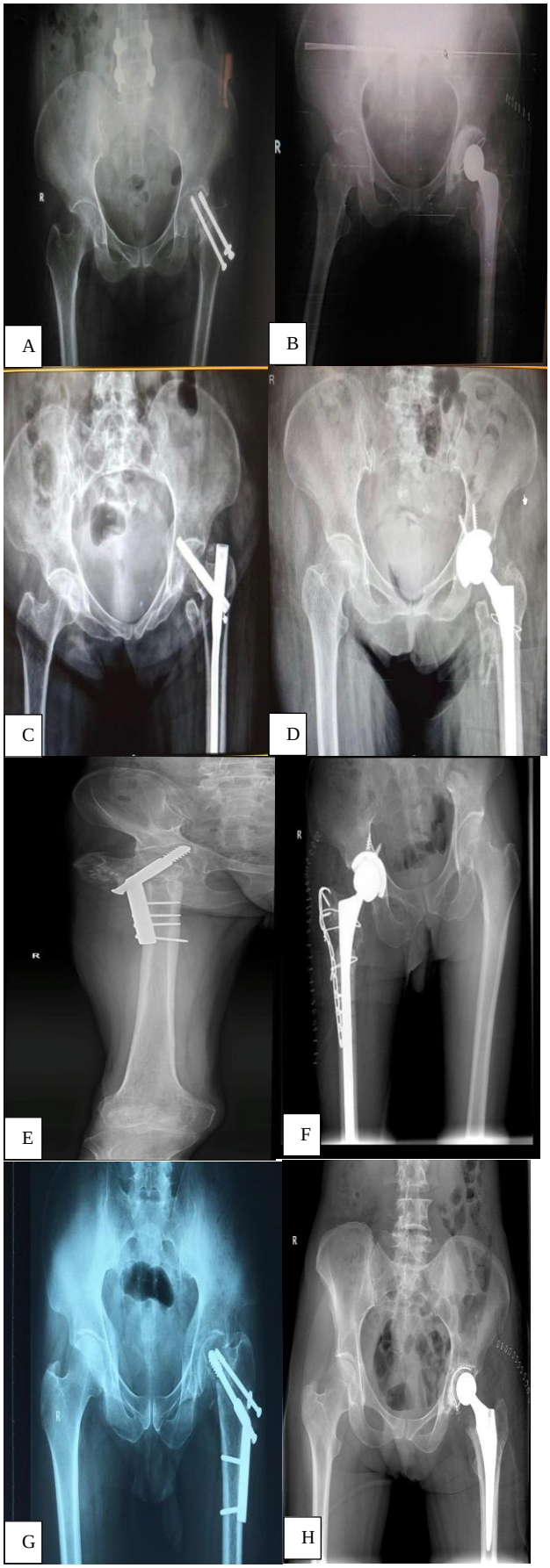

Figure 9 (A-H): Pre and post-operative X-rays.

DISCUSSION

Over 90% of post traumatic proximal femur fractures will end up with hospitalizations, particularly in those aged above 60 years.[1] Management of these fractures' ranges from conservative management to primary arthroplasty. Osteosynthesis is very commonly done, particularly intramedullary fixation than extramedullary for better rehabilitation, preservation of normal anatomy and early return to function. Osteosynthesis of proximal femur can fail secondary to non-union, traumatic arthritis, femoral head osteonecrosis, malunion, implant failure due to poor technique. Management of failed internal fixation of proximal femur fractures includes revision osteosynthesis, bone grafting, hemiarthroplasty or conversion THA. THA is an accepted salvage procedure after the failure of primary osteosynthesis.[2,12]

The purpose of choosing THA after failed fixation of proximal femur fractures was to restore hip center and joint kinematics, secure implant fixation and support host bone. The extent of bone loss determines the type of implant to be used and the method of reconstruction. Good pre-operative planning and templating are essential and it determines the success rates of THA. The average time period between the primary fixation and salvage THA was 9 months (6 months-9 years). The average surgery time was 2 hours which included the time taken to remove the existing implant.

The chosen implants were based on preoperative planning, considering the patient's age, bone loss, physiological age, physical demands and the level of activity. Relatively younger individuals were advised uncemented THA. Uncemented THA was performed in 40 cases, 6 cases underwent cemented THA, 2 were hybrid THA and the other 2 were reverse hybrid THA. A single-stage procedure was performed in all cases and 42 of these had a proximal loading stem and 8 had distal loading.

The majority of our group patients underwent uncemented THA as it carries advantages of biologic bone in growth with potential for the bone-implant interface to remodel and has resulted in excellent outcomes. Cementless THA differ in terms of geometry and the means of obtaining internal fixation and are associated with excellent long-term survivorship. Six cases underwent cemented THA. Age, patient's level of activity and bone defects especially acetabular defects were criteria for cemented THA. In terms of implant survival, Abdulkarim et al reported no significant differences in implant survival between cemented and uncemented implants.[13]

Proximal loading cementless porous-coated stems were chosen in cases with good calcar strength and no bone defects to obtain greater bone loading proximally and neck preserving. These stems are defined as implants that achieve fixation in the proximal metaphysis.[14,15] In cases with severe bone deficits and poor bone quality in proximal femur we used porous coated distal loading fixation long femoral stems to bypass cortical defects left at the site of failed fixation devices. Various studies of revisions using long stem femoral components reported good results in long-term follow-up.[16-18] Sinha et al reported calcar replacement prosthesis is a reasonable option in THA with proximal femoral bone loss to restore hip stability and function in their study.[19]

Wagner stems or cone prosthesis are used to achieve good contact between the distal stem and diaphysis.[20] Cementless implants have longer durability as the conical shape and longitudinal spline said in primary axial and rotational stability which led to osteointegration of the implant. Great care has to be taken with greater trochanter as there are higher chances of fractures in greater trochanter while performing salvage THA due to distorted proximal femur anatomy.[2] Fragmentation of the greater trochanter can impede the stability of the joint leading to post-operative dislocations and affecting ambulation.[2]

In this study, we fixed unhealed fragmented greater trochanter with a plate in 2 cases amongst which one also had a dislocation on day 3 of surgery, immediately identified and reduced under anesthesia. In a retrospective study by Shekar et al dislocation rate was 11.4%. Infection was seen in one patient, which was superficial. It was treated with antiseptic dressings and antibiotics. Mitchell et al in their 36 patients who were treated with THA after a complication of ORIF for hip fracture, one patient developed acute deep infection. Other studies reported 1-3.8% infections.[2,12]

Vascular complications were seen in a patient who underwent cemented THA after failed osteosynthesis of femoral neck fracture. On the day of surgery, the patient had a pale and pulseless limb 3 hours after the surgery. Immediately evaluated with angiography, which showed complete occlusion of the left common femoral artery. Emergency thrombectomy was carried out and the patient recovered well. Such complications are expected after THA but is there an increased incidence after salvage THA is not determined. Predisposing factors for vascular complications include smoking, peripheral vascular disease, bone anomalies, anatomic abnormalities etc. Direct trauma to vasculature while manipulation intraoperatively, constant pressure from prolonged retraction, preexisting atherosclerotic vessels with plaque tear following overextension. Cement leakage can lead to vascular injury. [21-23] In our study, 2 patients had periprosthetic fractures, intraoperatively treated with long femoral stems, plates and wires. Sekhar et al reported 6.2% periprosthetic fractures.[2]

Limitations

The following are the limitations with regards to this study. The sample size was small and therefore did not allow for multivariate regression analysis, in order to identify for predictors of our key clinical outcome. The follow ups were also limited. Moreover, THA related complications and revisions may occur in the future, particularly ascptic loosening which haven't been considered in the outcome.

CONCLUSION

Internal fixation is a successful treatment modality for proximal femur fractures. But a failed surgery is distressing for both the patients, due to pain and disability and the surgeons, due to challenges in performing salvage procedures. However, there are complications associated with this procedure. THA is an effective procedure for failed proximal femur fracture fixation patients despite the challenges such as distorted anatomy of femoral head, poor bone quality, longer operative times, larger amounts of blood loss, high rate of intraoperative and post operative complications.

Our study is in support of THA in failed osteosynthesis of proximal femur fractures. 87.5% of patients in our study had pain relief and marked improvement in functional outcomes with excellent outcomes in 85%of patients and good outcomes in 15% of patients. Despite the technical difficulties, and implications THA is an effective salvage modality for failed fixation of proximal femur fractures.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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