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Fuctional outcome of intertrochanteric femur fracture after internal fixation with proximal femur nailing with medial entry portal

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Intertrochanteric femur fracture; Proximal femoral nail (PFN); Proximal femur fracture; Internal fixation; Intramedullary nailing; Functional outcome; Harris Hip Score; Elderly patients; Osteoporotic Fractures; Evan's classification; Stable and unstable fractures; Closed reduction; Early mobilization; Radiological union; Postoperative complications; Varus collapse; Screw back-out; Load-sharing implant; Minimally invasive fixation.

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ABSTRACT

Intertrochanteric fractures of the femur are common in the elderly population and are associated with significant morbidity and mortality if not treated appropriately. Early surgical fixation and mobilization are essential to restore function and reduce complications related to prolonged immobilization. This prospective study was conducted to evaluate the functional and radiological outcomes of intertrochanteric femur fractures treated with proximal femoral nailing (PFN). A total of 100 patients above 18 years of age with intertrochanteric femur fractures were included and managed surgically using PFN. Patients were followed up clinically and radiologically at regular intervals for a minimum period of six months. Functional outcome was assessed using the Harris Hip Score. The majority of patients belonged to the 60–79 year age group, with female predominance. Radiological union was achieved in most cases at a mean duration of 12 weeks. According to Harris Hip Score, excellent to good outcomes were observed in 85% of patients. Complications included superficial and deep infection, screw back-out, and varus collapse, with no cases of non-union or periprosthetic fracture. Proximal femoral nailing provided stable fixation, allowed early mobilization, and resulted in satisfactory functional and radiological outcomes. PFN is an effective and reliable method for the management of intertrochanteric femur fractures, particularly in elderly patients with osteoporotic bone.

INTRODUCTION

Intertrochanteric fractures occur in the region between the greater and lesser trochanters of the proximal femur, occasionally extending into the subtrochanteric region. These extracapsular fractures occur in cancellous bone with an

abundant blood supply. Deforming muscle forces will usually produce shortening, external rotation, and varus positioning at the fracture.

Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly with osteoporotic bones, usually due to low-energy trauma like trivial falls. The incidence of intertrochanteric fracture is rising because of increasing number of road traffic accidents; constructions works and senior citizens with osteoporosis.

gait and balance, physical disability, not taking regular exercise, greater dependence on others, postural imbalance, visual abnormalities, alcohol.

Intertrochanteric femur fractures most commonly occur in elderly individuals as a result of low energy trauma. Most of these fractures require operative intervention to restore patient mobility and to optimize the post injury level of function[5]. The most commonly associated fractures are an ipsilateral distal radius fracture (2%) or an ipsilateral proximal humerus fracture (1%).

Literature says that about 15 to 20 % of elderly patients with inter-trochanteric fractures dies within one year of injury if no appropriate treatment is given[4]. Previously these fractures are treated conservatively with traction and prolonged bed rest for 10 to 12 weeks followed by ambulation training. Prolonged bed rest leads to increase in morbidities like bed sores, urinary tract stiffness and mortility. Appropriate treatment of this fracture is must to prevent these complications. The first one in the history is Jewett and Holt nail which is a fixed angle nail plate. This nail plate failed because of lack of controlled impaction. Then sliding hip screw has been used but had high failures in those fractures with loss of posteromedial congruity. To overcome this, intramedullary devices were developed.

we have studied the results of intertrochanteric fractures and their management with Proximal Femoral Nailing in a series of 100 patients.

SURGICAL STEPS

Most of the patient are given spinal anaesthesia Preoperatively antibiotic inj. Cefosulba (1g) IV was given to every patient, average 30 minutes before the incision. After spinal anesthesia effects patient is shifted to a radiolucent fracture table in a supine position with perineal post. Operative leg was slightly adducted and put on traction. Opposite limb was put in a full abduction as to give space for the image intensifier in between the legs. Reduction was achieved by traction and internal rotation primarily and adduction or abduction as required. Reduction was checked under image intensifier with anterior-posterior and lateral views. Positive or neutral reduction are acceptable while negative reduction tends to future collapse. Limb was scrubbed, painted and draped with standard sterile aseptic precautions.

Figure Intraoperative position on patient on traction table

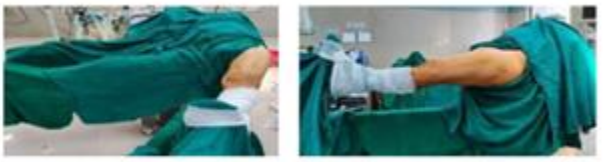
If indirect reduction was not satisfactory the following methods were used: **Percutaneous reduction manoeuvre**

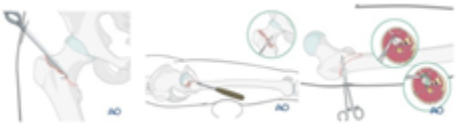
- Insertion of Steinmann pin in the proximal fragment and manipulation so as to correct the deformity
- By using bone lever (spike) or bone hook
- Maintaining relative adduction of the limb by keeping the jig close to the body and inserting the nail in this position.

Figure Percutaneous reduction manoeuvre

Intertrochanteric fractures account for nearly 50% of all fractures of the proximal femur. There exists a bimodal distribution with 10% of cases in young individual with history of fall from height and road traffic accidents. Remaining 90% of cases are elderly people with history of slip and accidental fall in the floor. Most fractures result from a direct impact to the greater trochanteric area. The ratio of women to men ranges from 2:1 to 8:1, likely because of postmenopausal metabolic changes in bone.

Factors associated with an increased risk of falling are increased age, Concurrent medical illness, mental impairment, disorders of





After accepting the fracture reduction internal fixation of proximal femur fracture is done with proximal femur nail in following manner.

A 4-6cm longitudinal incision was placed above the tip of the greater trochanter in line with femoral shaft axis and deepened to the gluteus medius muscle. Tip of the greater trochanter palpated and minimal muscle attachment was cleared off. After this PFN was fixed in a following manner:

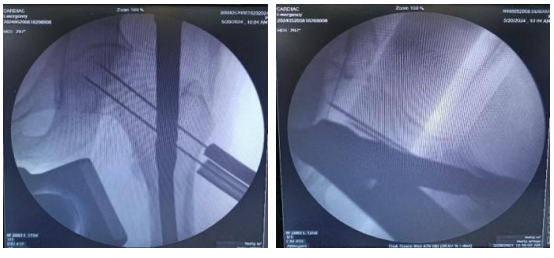
Entry point was identified with bone awl at the piriformis fossa in AP view and in line of femur shaft in lateral position (Ideal in most of case).

Entry point have to modified slightly medial or lateral on basis of the comminution at GT. Avoid to take entry from fracture site which would eventually lead to opening of the fracture.

2.8mm guide is inserted at entry point into the femoral shaft and across the fracture site in 6° of valgus. Its position is checked in the image intensifier and the entry is widened with bone awl or fossa finder instrument. Through it guide wire passed in distal femur through fracture site.

Reaming of the proximal femur is done with help of proximal reamer. Proximal reamer is passed over guide wire and remain is done up to lesser trochanter till which broader proximal part of the nail can accommodate. Proximal reamer is needed in all patients irrespective of age group.
Further reaming of femoral shaft canal in increasing size is preferred in younger age, good bone quality and fracture. Take care to avoid lateral entry or lateral reamer migration which can lead to force varus malalignment when nail is inserted.
Appropriate length of nail measured while checking in IITV from tip of Greater trochanter to superior pole of patella and size selected by one size smaller than reaming of femoral canal done or in case of unreamed femur approximate size of nail diameter mounted and checked in IITV.
Nail is fixed on the jig and the alignment is checked. Alignment of nail should be anterior bowing along length and proximal locking of nail from lateral side. Then the nail is inserted into the femur. The position of the holes for the hip screws is checked in the image intensifier for the depth of the nail. Nail is advance till inferior guide of proximal locking passes near to femoral calcar.
In case of significant anterior bowing of femoral shaft, short PFN should be used.

Guide wires for the screws are inserted through the jig and sleeve guide. The ideal position of the guide wires is parallel and in the lower half of the neck in AP views, in a single line in the centre of the neck in the lateral views. The guide pins are inserted 5 mm from the articular surface of the femoral head and not piercing the articular surface. The size of the lag screw determined using same size another guide pin, drilling for lag screw done.



First 8mm drill bit is used to ream over distal guide pin till 5mm away from subchondral bone.
Similarly proximal guide pin is reamed using 6.4 mm drill bit.
First the 8mm hip screw is inserted till fracture site after reaming over the distal wire and then the 6.4mm screw is inserted and tighten. Later remaining 8mm screw is tighten while releasing the traction and cycling of hip to achieve desired collapse. The proximal hip screw should be 5mm away from the sub-chondral bone.

one or two 4.9mm interlocking bolts are inserted in to the distal part of the nail. Out of which one is a static and another is a dynamic hole. It is done free hand with the help of image intensifier in long PFN and the jig is removed. While in short PFN distal lock can be done with help of zig and sleeve.
Dynamic locking is done in all type of fractures especially stable variant.
Additionally Static locking is done in all unstable fracture.

The final position of the nail is checked in the image intensifier in both views and after giving through wash, the wound was closed in layers

POST OPERATIVE PROTOCOL

- Antibiotics: Inj. Cefosalba 1 gm i.v. 12hrly was continued for first 3 days and then it was shifted to oral antibiotics, tablet Amoxiclav (625mg) for next 5days.
- Analgesics and other supportive medications were given.
- Post Operative day Bed side knee bending, Quadriceps strengthening exercises, ankle mobilization and calf pumping are started.
- Patients were advised to walk non-weight bearing walking (NWBW) as soon as tolerable from 2nd or 3rd post-operative day.
- Patient were discharged on average 4th postoperative day.
- Partial weight bearing walking was allowed at 4 to 6 weeks follow up and Fully weight bearing walking was allowed after radiological and clinical union was achieved. Assessment for radiological and clinical union was done at 10 to 12 weeks of follow up.
- Follow up: patient is asked to come for follow up 1, 2, 4 and 6 months from the date of surgery. At each follow up patient is assessed clinically and x-ray AP/LAT view of hip with femur, PBH is taken.
- At final follow up, minimum 6-month, Harris Hip Score measure.

OBSERVATION AND RESULTS

All 100 cases of proximal femoral fracture treated with proximal femur nail (PFN)'s data, intra-operative data, post-operative outcome and complication are analyzed and explained below.

Table 1 – Age distribution in our study
AGE DISTRIBUTION

Age	No. of patients	Percentage
18-39	4	4%
40-59	20	20%
60-79	70	70%
>80	6	6%

In our study, we involved all patients above age of 18 years. In the graph below, we distributed our patients in age group from 18 years in 20 years of interval. Highest number of patients in 60-79 years group which was 70%. 38 patients were male (38%) and 62 patients were female (62%). Common cause was domestic fall at home (71. 6 %) followed by road traffic accidents (28%) due to (57 %) was more involved as compared to right side (43%). Patients are classified based on Evan's classification system for proximal femur fracture. According to which fracture divided on posteromedial cortex either stable or unstable. In which 68 patients had unstable fracture (68%) while 32 patients had stable fracture (32%). Also, on basis of fracture line obliquity passing either type 1 or type 2 fracture. Out of 100 patients, 96 patients had type 1 fracture while 4 patients had type 2 fracture. Mean interval between time of injury and time of surgery in this study was 4.2 days with maximum of 10 days due to medical comorbidity of uncontrolled hypertension or high blood sugar level (medically unfit patient). Mean operative time required was 85 minutes, with minimum of 50 minutes and maximum of 120 minutes. Most of patients were given Spinal anesthesia while two patients were operated under general anesthesia. In our study, closed reduction was achieved around 82% cases and open reduction was needed in 18% cases which further aided by cerclage wire or trochanteric stabilizing plate. In 58 patients long PFN and in 2 patients short PFN was used due to short femur length. We used long PFNs with average 360mm length and 10mm diameter. One short PFN was used with 240mm length and 10mm diameter. All PFNs were distal locked with dynamic screw and 8 patient were additionally locked with static screw. In 6 patients stainless steel wire as cerclage was used for augmentation.

Implant	No. of patients	Percentage
Short PFN	04	4%
Long PFN (only)	86	86%
Long PFN with TBW	10	10%
TOTAL	**00**	**100%**

The average time of hospitalization in this study was 6.5 days with one patient having maximum duration of 19 days due to medical issues like constant uncontrolled sugar level (one of the causes of wound infection) which was controlled under guidance of general medicine department. The average time of radiological union in our study was 12 weeks with minimum of 8 weeks and maximum of 18 weeks. The mean time of full weight bearing walking was 10 weeks with minimum of 7 weeks and maximum of 15 weeks. Full weight bearing is started only after seeing radiological union in 3 cortices. In majority of cases 71 patients there was no difference in femoral neck shaft angle between normal side and post-operative side x-ray. 125 patients had more than 1^0 of increase in neck shaft angle fixation i.e. coxa valgus and 4 patients had more than 1^0 of decrease in neck shaft angle due to varus collapse i.e. coxa varus. In our study, 5 patients got infected, superficial infection occurred in four patient which was resolved by local debridement and antibiotics while deeper infection occurred in one patient which required debridement and removal of implant after union. One patient had Varus collapse associated with limb length discrepancy (2cm). Lag screw back-out was seen in 5 patients after 2 months post operative while 2 patients after 4 months. One patient Z effect occurred with proximal screw penetrating in while other distal screw back-out.

Complications	No. of patients	Percentages
Infection	05	5%
Screw back-out	07	7%
Varus collapse	04	4%
Non-union	00	0%
Total	**15**	**15%**

Functional outcome was measured at around one year follow up with the help of Harris Hip Score in which 66 patients had excellent and 19 patients had good outcome. Out of 100 patients only 15 patients had fair to poor outcome which was due to complication and lack of patient's compliance to physiotherapy. The average Harris Hip Score in our study was 88.82 with minimum of 61 and maximum of 96.

Results	No. of patients	Percentage
Excellent (90-100)	66	66%
Good (80-89)	19	19%
Fair (70-79)	10	10%
Poor (<70)	05	05%
TOTAL	**100**	**100%**

Proximal femur fracture which are commonly seen in elderly patients due to fall down at home while doing routine day to day activities. One of the major for this fracture due to trivial injury is osteoporosis. The outcome of these fractures depends upon many factors such as general health of patient, comorbidity, age, time from injury to treatment, reduction and stability of fixation, postoperative physiotherapy and post operative care. Earlier proximal femur fractures were treated conservative management with long bed rest which leads to complication like pressure sores, venous thrombosis, pulmonary and urinary tract infection, muscle wasting, eventually death may occur due to comorbidities. Now a days there is no role of conservative management when operative management reduces previous complication. There are only few indications to this fracture to be treated conservatively such as excessively high risk of mortality from anesthesia and surgery or non-ambulatory patient who has minimal discomfort following fracture. The goal of fracture management is restoration of physiological function at the earliest. Operative management of fracture reduction and internal fixation permits early mobilization and minimizes complications which becomes the treatment of choice for intertrochanteric fractures. Intertrochanteric fracture fixation can be done by various implants present till date but the search is still going on to decide the best method. Intramedullary nail has axial telescoping and rotation stability with minimally invasive procedure which is better tolerated in elderly patients. In 1996, AO/ASIF developed a new load sharing device Proximal Femoral Nail have been shown to be biomechanically stronger than extramedullary implants. This is prospective study done to evaluate 100 patients results in management of proximal femur fracture treated with proximal femoral nail. Mean age of patients was 64.8 years with minimum age was 28 years and

maximum age was 95 years. Majority of patients belong to 60-79 years age group. This age group has inferior bone quality as compared to young age patients. Complication with PFN postoperatively in follow up period were found such as infection, screw back out, varus collapse, shortening and non union. In our study 5 patients of infection reported in which 4 got superficial and 1 deeper infection. 4 patients develop varus collapse may be due to early weight bearing by patient against medical advice or failure of reduction, which led one of the patient to limb length discrepancy of more than 2 cm. Not a single case of periprosthetic fracture and non- union was noted.

The two lag screws device was better in load failure testing but this construct is shown to have a particular failure pattern in vivo named the "Z" effect. This failure typically occurs with the use of short nails in unstable fracture patterns. The "Z" effect occurs when proximal screw penetrates the joint and the other screw backs out of the nail. This phenomenon is felt to be secondary to differing tension and compression forces on two lag screws9,10,29. In our study, this effect was not found. Early mobilization with partial or full weight bearing depends on type of fracture, reduction and stability obtained by fixation, bone quality and postoperative radiographs. After signs of union seen patient were advise for partial weight bearing, walk with walker at around 6 weeks postoperatively. Later on 3-6 weeks, full weight bearing was advised. Average time for full weight bearing in our study is 10 weeks.

DISCUSSION & SUMMARY

This is study of 100 patient of proximal femur fracture in more than 18 years of age treated primary with skin traction and immobilization of affected limb preoperatively then definitive fixation was done with reduction of fracture and internal fixation with proximal femoral nail (PFN) in our institute from March 2022 to July 2024 with limited follow up. The maximum patients were between 60–79 year age group. The mean age is 64.3 year. The majority of injured patients were female 62 out of 100(62%). The majority of patients were left side injured 57 out of 100 (57%). The majority of patients were due to domestic fall 72 out of 100 (72%). The majority of patients had Evan's Unstable fracture 68 out of 100 (68%). The average hospital stay in our study was 6.5 days. One patient stayed for 19 days due to medical condition which was managed by medicine department. The majority of patients were reduced by simple traction, adduction and internal rotation in closed manoeuvre 82 out of 100 (82%). The average radiological union time is 12 weeks postoperatively. One patient came with leg length discrepancy of 2cm shortening due to severe osteoporotic bone and varus collapse. One developed deeper infection for which debridement was done but on persistent of infection implant removal was done after union. Lag screw back out in PFN was found in 7 patients out of 100 (7%).

Varus collapse femoral neck shaft angle
difference normal side and postoperative side of more than 10 was found in 4 patients. According to Harris Hip score, in our study 66 patient had excellent result, 19 had good and 10 had fair result while 5 patient poor outcome. In our study, we can conclude that all proximal femur fracture treated with proximal femoral nailing gives optimal outcome both functionally and radiologically provided proper all preoperative measures taken with good planning, proper reduction and surgical techniques are followed.

Proximal femoral nailing (PFN) as it is intramedullary device has excellent biological and mechanical advantage as it is close procedure which preserves the fracture hematoma and helps in early bone union and early mobilization with lesser soft tissue damage. Because of invasive technique requiring spinal minimally anesthesia, with fewer complication, and early weight bearing of PFN it is safe and effective in elderly patient with multiple comorbidities. Proximal femoral nail being load sharing implant with fewer complication and minimally invasive technique which favors early full weight bearing and start routine day to day activity in elderly patients without any serious complication.

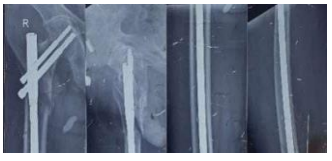
CLINICAL CASES

CASE 1: 75-year-old male patient had history of domestic fall while doing routine work and got right side Evan's unstable type of intertrochanteric femur fracture treated with closed reduction and internal fixation with long PFN and dynamic distal screw.

Pre Operative Radiographs

Post Operative Radiographs

4 weeks follow up Radiographs



Radiographs 18 weeks follow up Radiographs

1 year follow up Radiographs

Clinical images at 1 year follow up

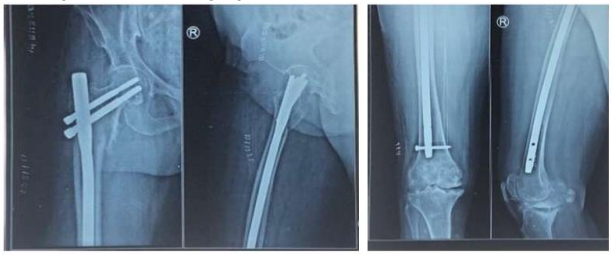
CASE 2: 65 years old female patient with history of domestic fall while doing routine work got right side Evan's stable type of intertrochanteric femur fracture which was treated with closed reduction and internal fixation with long PFN nail with dynamic distal locking screw.

Pre Operative Radiograph

24 weeks follow up radiograph

1 year follow up radiograph

Post Operative Radiographs



4weeks follow up radiograph

Clinical images at 1 year follow up



CONCLUSION

Medial entry facilitates better alignment with the femoral canal, reduces varus malreduction, and allows more accurate placement of the nail and cephalocervical screws. This approach is particularly advantageous in unstable fracture patterns, obese patients, and cases with altered proximal femoral anatomy where lateral entry may be difficult. Reduced stress on the greater trochanter and abductor musculature contributes to lower rates of iatrogenic fracture and postoperative pain. Functional outcomes, as assessed by standardized hip scores, show early mobilization, improved fracture union, and a low incidence of implant-related complications. However, meticulous surgical technique and proper fluoroscopic guidance are essential to avoid medial cortical breach and intraoperative complications. Overall, medial entry Proximal Femoral Nailing is a safe, reproducible, and effective method that enhances fracture stability and functional recovery, and it should be considered a valuable option in the surgical management of intertrochanteric femur fractures.

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