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Dr. Yathisha SR
Postgraduate in Department of Orthopaedics, VIMS, Ballari, Karnataka, India

Dr. Mohd Zeeshan Vasif
Postgraduate in Department of Orthopaedics, VIMS, Ballari, Karnataka, India

Corresponding Author:
Dr. Yathisha SR
Postgraduate in Department of Orthopaedics, VIMS, Ballari, Karnataka, India

A prospective study of surgical management of fractures of proximal femur using proximal femoral nail

Dr. Yathisha SR and Dr. Mohd Zeeshan Vasif

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Abstract
Background and Objectives: Proximal third fractures of femur like intertrochanteric and subtrochanteric fractures, are a leading cause of hospital admissions in elderly people. The number of such admissions is on a raise because of increasing life span and sedentary habits. Conservative methods of treatment results in malunion with shortening and limitation of hip movement as well as complications of prolonged immobilization like bed sores, deep vein thrombosis and respiratory infections. This study is done to analyze the surgical management of proximal third fractures of femur using Proximal Femoral Nail.
Methods: This is a prospective study of 30 cases of fresh trochanteric and subtrochanteric fractures admitted to Vijayanagar institute of medical sciences Ballari From september 2015 to august 2017. Cases were taken according to inclusion and exclusion criteria i.e., patients with Proximal third fracture femur above the age of 18yrs. Medically unsuitable and patients not willing for surgery were excluded from the study.
Results: In our series of 30 cases there were 19 males and 11 females, maximum age of 81 and minimum age of 21 years most of the patients were between 61-80 years. Mean age of 57.4 years. 80% cases were admitted due to slip and fall and with slight predominance of right side. Out of 30 cases, 19 were trochanteric and 11 were subtrochanteric. In trochanteric fractures 36.84% were Boyd and Griffin type 2, in subtrochanteric fractures 27.27% were Seinsheimer type 3a. Mean duration of hospital stay is 15 days and mean time of full weight bearing is 15 weeks. 30 case were followed up. Out 30 cases 19 trochanteric and were 11 subtrochanteric. Good to excellent results are seen in 89.47% of trochanteric fractures and 81.81% subtrochanteric fractures. Overall, we had good to excellent results in 86.66%, fair in 13.33%, we had no case with poor results.
Conclusion: From this sample study, we consider that PFN is an excellent implant for the treatment of Peritrochanteric fractures. The terms of successful outcome include a good understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate instrumentation, good image intensifier and exactly performed osteosynthesis.

Keywords: PFN, subtrochanteric, trochanteric, peritrochanteric

Introduction
Proximal femoral fractures are commonly seen in patients over 70yrs of age. Incidence of these fractures has increased primarily due to increasing life span and more sedentary life style brought by urbanization. In younger population, proximal femoral fracture occurs due to high velocity trauma, whereas in elderly population, it is most often due to trivial trauma. Proximal femoral fractures comprise of intertrochanteric and subtrochanteric fractures.
Incidence of trochanteric fractures is more in females compared to males due to osteoporosis. Mortality ranges between 15%-20%. Other risk factors include white race, neurological impairment, malnutrition, impaired vision, malignancy, and decreased physical activity [1].
The incidence of intertrochanteric fractures is gender- and race-dependent and varies from country to country. In western countries, the annual rate of proximal femur fractures in elderly females is about 63 per 100,000, in males 34 per 100,000. Incidence of proximal femur fractures in Indian population found to be higher due to poor nutrition, low socioeconomic status. Incidence of all hip fractures in Asian population as estimated in 1990 was around 26%,

this figure may rise to 37% in 2025 and 45% in 2050.

Objectives

1. To evaluate the union rates with proximal femoral nail
2. To evaluate the clinical outcome associated with this treatment modality.
   - Hip Range of movements
   - pain relief
   - Return to normal activities and work.
3. To identify appropriate entry point.

Materials and Methods

The material for the present study was obtained from the patients admitted in Vijayanagar institute of medical sciences, Department of Orthopaedics with diagnosis of intertrochanteric fractures and subtrochanteric fractures from September 2015 to August 2017. A minimum of 30 cases were taken and the patients were informed about the study in all respects and informed consent was obtained from each patient.

After the patient with intertrochanteric fracture was admitted to hospital all the necessary clinical details were recorded in proforma prepared for this study. After the completion of the hospital treatment patients were discharged and called for follow up at outpatient level, at regular intervals for serial clinical and radiological evaluation.

Inclusion Criteria

1. All patients with proximal femur fractures treated with PFN
2. All skeletal mature patients(>18years)
3. Patients with osteoporosis

Exclusion Criteria

- Age: less than 18 years.
- Compound fractures.
- With other fractures in upper and lower limbs which will hamper mobilization of the patient after surgery.
- Peri-prosthetic fractures.
- Patients unfit for surgery.
- Patients unwilling to consent for surgery

Implant details

Proximal femoral nail consists of self tapping 6.5mm hip pin, self tapping 8mm femoral neck screw, 4.9 distal locking screw and an end cap. Proximal femoral nail is made up of either 316L stainless steel or titanium alloy which comes in following sizes.

1. Length: Standard PFN- 250 mm, Long PFN- 340, 380, 420 mm
2. Diameter: 9, 10,11,12 mm
3. Neck shaft angle range: 125, 130,135 degree.

The nail is having 14mm proximal diameter. This increases the stability of the implant. There is 6 degree mediolateral valgus angle, which prevents varus collapse of the fracture even when there is medial comminution.

The distal diameter is tapered to 9 to 12mm which also has grooves to prevent stress concentration at the end of the nail. Proximally it has 2 holes the distal one is for the insertion of the 8mm neck screw which acts as a sliding screw, the proximal one is for 6.5mm hip pin which helps to prevent rotation. Distally nail has two holes for insertion of 4.9mm locking screws, of which one is static and the other one is dynamic which allows dynamization of 5mm.

In our study we used a standard length PFN of 250mm with distal diameter of 10, 11, 12 mm, the proximal diameter of the nail is 14mm. The proximal derotation screw of 6.5 mm and distal lag screw of 8mm. Distal locking done with self tapping 4.9 mm cortical screws one in static mode and other in dynamic mode allowing 5mm dynamisation. The nail is universal with 6 degrees mediolateral angulation and with a neck shaft angle of 135 degrees.

Operative technique

Patient positioning and fracture reduction

The patient is placed in supine position on fracture table with adduction of the affected limb by 10-15 degrees and closed reduction of the fracture was done by the traction and internal rotation. The unaffected leg is flexed and abducted as far as possible or kept in wide abduction. The image intensifier was positioned so that anterior-posterior and lateral views of hip and femur could be taken. Open reduction is performed if closed reduction failed.

The patient is then prepared and draped as for any standard hip fracture fixation Prophylactic antibiotic is given in all patients 30mins before surgery**.**

Approach

The tip of greater trochanter was located by palpation in thin patients and in obese patients, we used image intensifier. 5cms longitudinal incision was taken proximal from the tip of the greater trochanter. A parallel incision was made in fascia lata and gluteus medius was split in line with the fibres. Tip of greater trochanter is exposed**.**

Determination of entry point and insertion of guide wire

In AP view on c-arm, the entry point is on tip or slightly lateral to the tip of greater trochanter. However in intertrochanteric fractures fracture involves tip of trochanter with communition. If it is a simple fracture extending to tip of trochanter without communition, it is easy to put guide pin as fracture site itself provides the entry point. But in practice, there is always some communition at tip of trochanter or fracture line is not exactly through tip. Due to this even if an entry is made in tip of trochanter, due to narrow bone bridge lateral to tip of trochanter and medial to fracture line, guide wire and subsequent reamers fall into fracture line thus making the entry lateral to tip of trochanter. Some times there will be communition with an additional coronal split so that there is no lateral support at the entry region while reaming or putting nail. All these things lead to lateral entry of nail. However we believe these things will not affect the final outcome as communited fragments sit around the nail and mould and unite thus there will not be significant abductor weakness. Important technical aspect here is to start the entry from tip of trochanter and slightly anterior in the lateral plane

and then aim to pass the guide wire into shaft of femur in the centre, once guide wire is passed into shaft we ignore the lateralization of guide wire at tip of trochanter.

Insertion of PFN

After confirming satisfactory fracture reduction, an appropriate size nail as determined preoperatively is assembled to insertion handle and inserted manually. This step is done carefully without hammering by slight twisting movements of the hand until the hole for 8mm screw is at the level of inferior margin of the neck. Open reduction is performed in case satisfactory reduction is not possible by closed means.

Insertion of the guide wire for neck screw and hip pin

These are inserted with the help of aiming device lightly screwed to the insertion handle. A 2.8 mm guide wire is inserted through the drill sleeve after a stab incision. This guide wire is inserted 5mm deeper than the planned screw size. The guide wire is advanced in to the femoral head at least 4mm superior to the calcar to a level 5mm below the subchondral bone. The final position of the guide wire should be in the lower half of the neck in AP view and in the centre of the neck in lateral view.

A second 2.8 mm guide wire is inserted through the drill sleeve above the first one for hip pin. The tip of this guide wire should be approximately 25-20mm less deep than planned neck screw.

Insertion of the Neck Screw and Hip Pin

Drilling is done over 2.8mm guide wire until the drill is 8mm short of tip of the guide wire. Tapping is not done as neck screw is self-tapping. Neck screw is inserted using cannulated screw driver. Similarly appropriate length hip pin is inserted. Length and position of the screw is confirmed with c-arm image.

Distal locking

Distal locking is usually performed with two cortical screws. A drill sleeve system is inserted through a stab incision. A drill hole is made with 4mm drill bit through both cortices. Locking screw is inserted and position confirmed with image intensifier**.**

Closure

After fixation is over, lavage is given using normal saline and incision is closed in layers. Suction drain is used in case open reduction is performed. Sterile dressing applied over wound and compression bandage given.

Results

In our study average duration of hospital stay was 15 days.

The mean time for full weight bearing was 14.97 weeks.

All patients enjoyed good range of hip and knee range of motion except two who improved with physiotherapy.

Post operative mobility was aided in immediate postoperative period but later all patients were ambulatory independently.

Table 1: Assessment of results

Mean duration of hospital stay	15days
Mean time to full weight bearing (in weeks)	14.97 weeks
Mobility after surgery	20
Independent aided	10
Non ambulatory	0
Mean range of movements (10 weeks postoperatively)	
Hip joint 0 to 110	30/30
Knee joint 0 to 120	28/30

Follow up

All patients were followed at 6 weeks, 12 weeks, 6 months and same patients up to one year if necessary. At each follow up radiograph of the operated hip with upper half of femur was taken and assessed for fracture union and implant failure and screw cut out.

Anatomical results

Anatomical results were assessed by presence or absence of deformities, shortening, and hip and knee range of motions.

In our study one patient had shortening >1cm, two patients had varus malunion <10 degrees

Functional Results

In our series of 30 operated cases

Functional and anatomical results were assessed taking using Harris Hip scoring system (Modified)

Intertrochanteric - 19

Subtrochanteric - 11

Discussion

W.M. Gadegone & Y.S. Sulphale[10] in 2007 reported a study on proximal femoral nail- an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. Postoperative radiographs showed a near anatomical fracture reduction in 88% of patients. The fracture consolidated in 4.5 months. No perceptible shortening was noted. Of the patients 7% had superficial infections which were controlled by antibiotics, 82% had a full range of hip motion. One case of Non union because of distraction in high subtrochanteric fracture. In their study they had 95% of near normal anatomical reduction # consolidation in 16.5 weeks. Two cases had shortening of more than 1 cm.

Migration of screws due to severe osteoporosis was detected during the follow up in seven patients. In three patients there was Z effect with the migration of hip pins into joint. No implant failures were observed.

Metin Uzun *et al.*, [9] in 2009, In a study of 35 patients reported long term radiographic complications following treatment of unstable intertrochanteric fractures with the proximal femoral nail and effects on functional results.

Reduction was assesses as good or acceptable in all the patients. Complete union was achieved in all but two patients. The mean Harris hip score was 82.1. The results were excellent in 11 patients (31.4%), good in 15 patients (42.9%), fair in seven patients (20%) and poor in two patients (5.7%). Radiographic complications mainly included secondary varus displacement in nine patients (25.7%). Secondary varus displacement was due to to cut out of the proximal screws (n=2), screw loosening due to collapse of the fracture site (n=2), and reverse Z effect (n=5). In our study mean Harris hip score was 83.5. Radiological complications chiefly

include 3 cases of varus malunion in 3 patients. We had no implant failure or reverse Z effect.

The aim of the study was to study the epidemiology of intertrochanteric and subtrochanteric fractures in adults and anatomical and functional outcome with this newer method of intramedullary fixation with PFN.

Conclusion

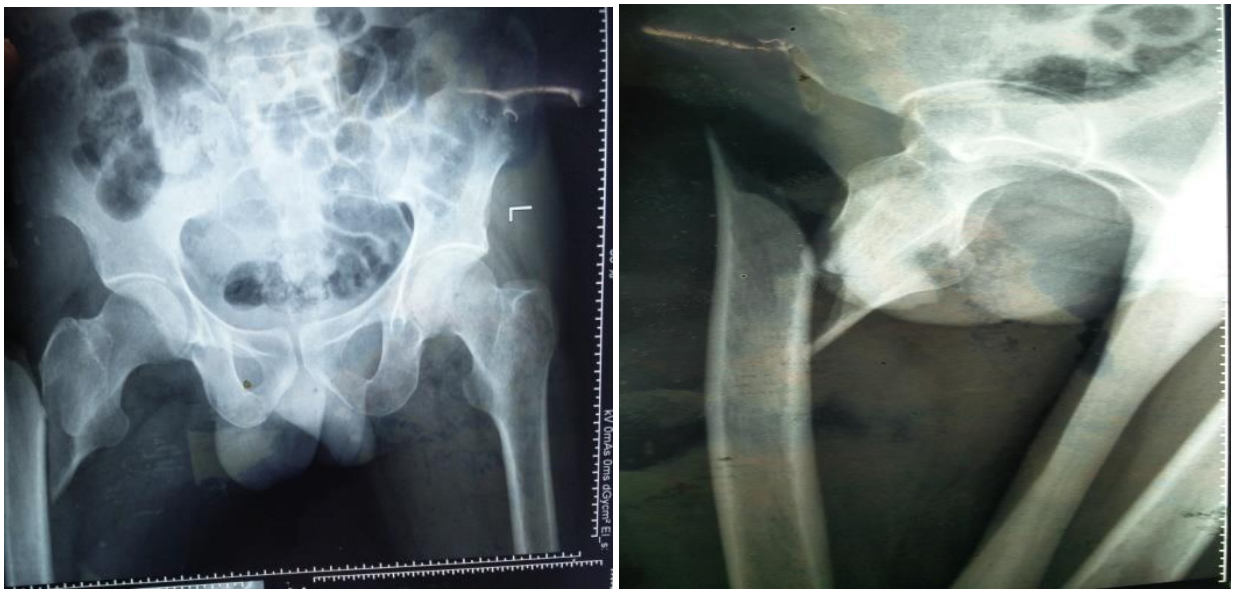
In the present study 30 patients with extracapsular proximal femoral fractures were surgically managed with proximal femoral nail.

The data was assessed, analysed, evaluated and the following conclusions were made

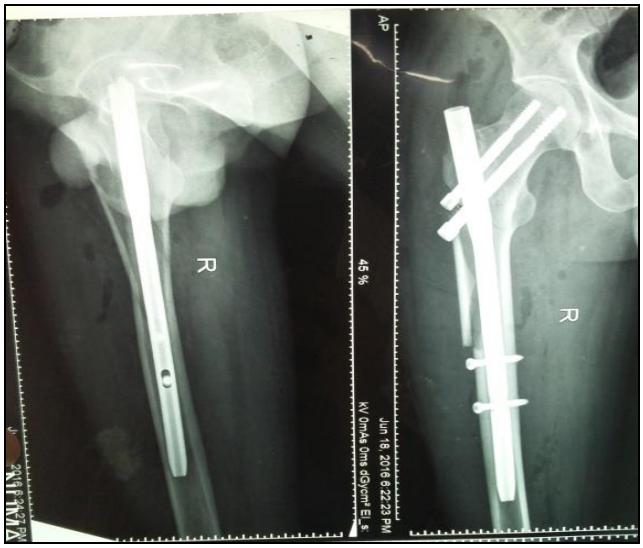
- Peritrochanteric fracture of the femur is common in the elderly, due to osteoporosis and in young due to high velocity trauma
- The mode of injury for peritrochanteric fracture in the elderly is a trivial trauma, however in the young individuals it occurs following a high velocity trauma.
- Since in the elderly the mode of injury is a low velocity trauma, the incidence of associated injuries is less.
- Since the fracture is common in the elderly the incidence of associated diseases requiring medical attention is high.
- As the fracture is more common in the elderly, early reduction and internal fixation increases patient comfort, facilitates nursing care, helps in early mobilisation of the patient and decreases the duration of hospitalisation.
- Anatomical reduction can be achieved by closed manipulative or open methods. As the incidence of comminution is high, these fractures may require a stable reduction and internal fixation. Bone grafting is required if there is a deficiency.
- PFN has the advantage of collapse at the fracture site and is biochemically sound as it is done by closed technique, fracture opened only when closed reduction could not be achieved and it is an intramedullary device.
- Another advantage of this device is it prevents excess collapse at fracture site thus maintaining neck length.
- The entry point determination is the most crucial step in this procedure which is the tip of the trochanter. The device is fixed distally in both dynamic and static mode so in case of delayed union it can be dynamised.
- The two neck screws should be placed in the centre of neck and head, the proximal one acts as derotation screw and the distal one as collapsing screw.
- The fixation of peritrochanteric fractures with a PFN markedly reduces the morbidity and mortality in the elderly individuals in whom the fracture is more common.
- If the above technical details are achieved the function of the hip joint is regained to near normal and the rehabilitation of the patient is smooth.
- Most of the complications are surgeon and instruments related which can be cut down by proper patient selection and good preoperative planning.
- With the experience gained from each case the operative time, radiation exposure, blood loss and intraoperative complications can be reduced drastically.

Hence I conclude, though the learning curve of this procedure is steep with proper patient selection, good instruments, image intensifier and surgical technique, PFN remains the implant of choice in the management of intertrochanteric and subtrochanteric fractures.

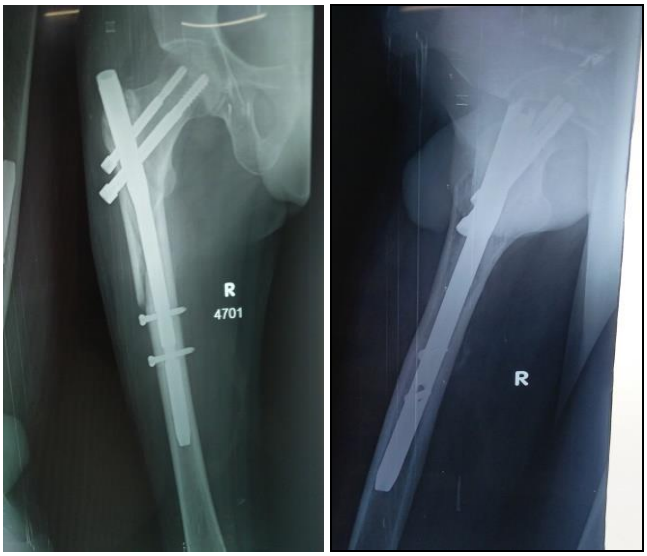
X Rays



Preoperative X-Ray



6 Weeks



3 Months

6 Months

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