

Original Research Article

Functional outcome of peritrochanteric fractures femur treated with proximal femoral nail

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ABSTRACT

Background: Peritrochanteric fractures are common injuries, especially in the elderly, with significant impact on health care. The aim of treatment should be prevention of malunion and early mobilization. Taking all the factors into consideration, surgery by internal fixation of the fracture is an ideal choice.

Methods: This study included 40 adult patients with peritrochanteric fractures of the femur who met the inclusion criteria and were treated with a Proximal Femoral Nail at BGS Global Institute of Medical Sciences, Bangalore, from November 2022 to November 2024.

Results: The study included 40 cases, 31 males and 9 females, aged 22–94. The majority of patients (45%) were admitted for slip-and-fall injuries, mostly right-sided fractures. 25 of 40 cases were trochanteric, 15 subtrochanteric. The trochanteric fracture group had 40% Boyd and Griffin type 2, while the subtrochanteric group had 33.3% Seinsheimer type IIIa and 20% type IIb. The average hospital stay was 20.67 days and weight-bearing took 16.5 weeks. Two patients died before the 6-week follow-up and three were lost to follow-up. The remaining 35 fractures were 22 trochanteric and 13 subtrochanteric. 90.9% of trochanteric fractures and 88.57% of subtrochanteric fractures had good to excellent results.

Conclusions: The study concludes that the PFN is an excellent implant for the treatment of peritrochanteric fractures. The terms of a successful outcome include a thorough understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate reduction of the fracture, instrumentation and a good image intensifier.

Keywords: PFN, Peritrochanteric, Subtrochanteric, Trochanteric

INTRODUCTION

Peritrochanteric fractures represent significant injuries primarily impacting the elderly, though they can also occur in younger individuals. These fractures pose a considerable burden on the healthcare system and society at large. Peritrochanteric fractures primarily involve the trochanter and subtrochanteric areas of the femur.

Even with significant advancements in implant design, surgical methods and patient management, peritrochanteric fractures still represent a considerable burden on our healthcare resources.^{1,2} Trochanteric

fractures frequently occur among the elderly population. The rise in the incidence of these fractures can largely be attributed to longer life expectancies and the more sedentary habits that have emerged as a result of urbanization. Trochanteric fractures are typically seen in younger individuals as a result of high-velocity trauma, while in older adults, these fractures commonly arise from seemingly minor injuries.³

Trochanteric fractures are observed more frequently in women than in men, largely attributed to the prevalence of osteoporosis in the female demographic. A Swedish study involving over 20,000 patients found that the rate of hip

fractures among women increased twofold every 5.6 years starting from the age of 30.⁴ Trochanteric fractures can often be effectively managed through conservative approaches, typically resulting in successful union of the fracture. Without appropriate precautions, a fracture may heal improperly, resulting in malunion. This can cause deformities such as varus and external rotation at the fracture site, along with a reduction in hip movement and potential shortening. Prolonged immobilization can lead to a range of complications, including bedsores, deep vein thrombosis and respiratory infections.⁵

Given that this type of fracture is prevalent among older adults, the focus of treatment should be on preventing malunion and promoting early mobilization. Considering all relevant factors, internal fixation surgery for the fracture emerges as the optimal option.

METHODS

This prospective study included 40 patients with fresh trochanteric and subtrochanteric fractures who were admitted to BGS Global Institute of Medical Sciences, Bangalore, from November 2022 to November 2024. Ethical approval was taken from the institutional ethical committee and written informed consent was taken from all the participants.

The study employed a consecutive sampling method, where all eligible patients with peritrochanteric femur fractures treated with proximal femoral nails during the study period were included consecutively. Patients were selected according to the following inclusion and exclusion criteria:

Inclusion criteria

Subtrochanteric fractures. Stable and unstable intertrochanteric fractures (reverse oblique fractures and intertrochanteric fractures with loss of the posteromedial cortex).

Exclusion criteria

Intertrochanteric fractures involving the piriformis fossa, open hip fractures, pathological fractures, periprosthetic fractures, pediatric fractures (before physeal closure).

Data collection

Upon admission, comprehensive clinical details were recorded for each patient using a proforma specifically designed for this study.

Following hospital treatment, patients were discharged and scheduled for regular follow-up visits at the outpatient clinic for serial clinical and radiological evaluation. Follow-up continued until fracture union and functional recovery were achieved. Additional follow-up was conducted as needed.

Patient management

Patients with suspected subtrochanteric or trochanteric fractures underwent clinical and radiological evaluation, followed by admission to the ward. Initial management included resuscitation and splintage using skin traction. The following investigations were performed routinely on all patients preoperatively.

Blood

Hb%, total leukocyte count, differential count.

Urine

Routine and microscopic examination.

Blood sugar (fasting and postprandial), serum electrolytes, blood urea and serum creatinine, electrocardiogram, Chest X-ray, X-ray of the pelvis with both hips (anteroposterior view). X-ray of the femur with hip and knee joints (anteroposterior and lateral views). After obtaining fitness for surgery, patients were operated on.

Surgical procedure

The patient was placed in a supine position on a fracture table under spinal or general anesthesia. A closed reduction was attempted under image intensifier guidance. An open reduction was performed in cases where closed reduction was not possible. A lateral incision was made over the greater trochanter and the fascia over the gluteus maximus was incised in line with its fibers. The gluteus medius muscle fibers were split and the vastus lateralis was exposed.

A longitudinal incision was made in the vastus lateralis fascia and the muscle was split in line with its fibers to the vastus ridge. Stay sutures were applied. The entry point for the proximal femoral nail (PFN) was identified at the tip of the greater trochanter using an awl and confirmed with an image intensifier. A guide wire was inserted and the entry point was enlarged with a 16 mm cannulated bore. Sequential reaming was performed over the guide wire. The appropriate size PFN was selected and inserted over the guide wire, ensuring proper rotation and alignment.

The proximal interlocking screw was inserted using a jig and its position was confirmed with the image intensifier. Distal locking was performed either freehand or with a jig. The wound was closed in layers over a suction drain and a sterile dressing was applied.

Postoperative management

Postoperatively, patients were monitored and intravenous antibiotics were administered for 48 hours. Analgesics were given as needed. Suction drains were removed after 48 hours and sutures were removed on the 10th postoperative day. Physiotherapy was started on the first

postoperative day, including static quadriceps and hamstring exercises, followed by assisted mobilization. Partial weight-bearing was allowed as tolerated, with progression to full weight-bearing depending on radiological evidence of fracture healing. Patients were followed up at regular intervals in the outpatient department for clinical and radiological assessment until union occurred.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

RESULTS

The following observations were made from the data collected during this study of proximal femoral nail in the treatment of 40 cases of Peritrochanteric fractures of the proximal femur in the Department of Orthopaedic Surgery, BGS Global Institute of Medical Sciences, Bangalore, from November 2022 to November 2024.

Age distribution

The majority of cases, 16 (40%), were in the age group of 41-60 years, followed by 12 (30%) cases in the age group 61-80 years. The youngest patient was 22 years old and the oldest patient was 94 years old. The mean age was 55.18 years.

Sex distribution

The study included 31 male (77.5%) and 9 female (22.5%) patients.

Nature of violence

45% of cases were admitted due to slip and fall and 55% were due to road traffic accidents.

Side affected

Right side was involved in 52.5% of cases and left side in 47.5%.

Type of fracture

Out of 40 cases, 25 (62.5%) were trochanteric and 15 (37.5%) were subtrochanteric.

Classification of fractures

In the trochanteric group, 40% were Boyd and Griffin type 2. In the subtrochanteric group, 33.3% were Seinsheimer type 3a and 20% were type 2b.

Associated injuries

12.5% of patients had associated injuries.

Intra-operative details

Mean duration of hospital stay: 20.67 days. Mean time to full weight-bearing: 16.5 weeks

Follow-up

Out of 40 cases, 2 patients expired before the first follow-up at 6 weeks and 3 cases were lost to follow-up. The remaining 35 cases (22 trochanteric and 13 subtrochanteric) were included in the final analysis of results.

Functional results

In trochanteric fractures, good to excellent results were seen in 90.9% of cases. In subtrochanteric fractures, good to excellent results were seen in 88.57% of cases.

Table 1: Age distribution.

Age group (in years)	No. of cases	%
21-40	8	20
41-60	16	40
61-80	12	30
81-100	4	10
Total	40	100

Table 2: Type of fracture.

Type of fracture	No. of cases	%
Trochanteric	25	62.5
Subtrochanteric	15	37.5
Total	40	100

Table 3: Boyd and Griffin classification.

Classification	No. of cases	%
Type 1	6	24
Type 2	10	40
Type 3	5	20
Type 4	4	16
Total	25	100

Table 4: Seinsheimer classification.

Classification	No. of cases	%
Type I	0	0
Type IIA	2	13.3
Type IIB	3	20
Type IIC	2	13.3
Type IIIA	5	33.3
Type IIIB	3	20
Type IV	0	0
Type V	0	0
Total	15	100

Table 5: Intra-operative details.

Intraoperative details	
Mean duration of surgery	65 mins
Mean duration of hospital stay	20.67 days
Mean time to full weight-bearing	16.5 weeks

Table 6: Intraoperative complications.

Complications	No. of cases	%
Nil	36	90
Difficult reduction	2	5
Varus mal-reduction	2	5
Total	40	100

Table 7: Delayed complications.

Complications	No. of cases	%
Non-union	0	0
Infection	0	0
Implant failure	1	2.5
Limb length discrepancy	2	5
Cut out of screw	0	0
Mortality	2	5

Table 8: Assessment of results.

Result	Trochanteric	Subtrochanteric	Total
Excellent	12	6	18
Good	8	5	13
Fair	2	2	4
Poor	0	0	0
Total	22	13	35

Table 9: Functional results of intertrochanteric fracture.

Functional result	No. of cases	%
Excellent	12	54.54
Good	8	36.36
Fair	2	9.09
Poor	0	0
Total	22	100

Table 10: Functional results of subtrochanteric fracture.

Functional result	No. of cases	%
Excellent	6	46.15
Good	5	38.46
Fair	2	15.38
Poor	0	0
Total	13	100

DISCUSSION

The management of peritrochanteric fractures of the proximal femur continues to encounter certain challenges, leading to instances of treatment failure. The factors contributing to this issue include a lack of attention to biomechanics, an inflated belief in the capabilities of emerging surgical techniques or implants and insufficient adherence to established protocols. The presence of high stress concentration, coupled with multiple deforming forces, presents a challenge in healing due to the predominance of cortical bone. This condition is further complicated by decreased vascularity and a notable incidence of complications following surgical interventions. These factors necessitate careful consideration by surgeons when selecting the appropriate implant for treatment.⁶

Currently, the most prevalent methods of fixation include blade plate systems, sliding screw systems and intramedullary devices. From a mechanical perspective, utilizing a combined intramedullary device through a minimally invasive procedure appears to offer advantages for elderly patients. Closed reduction plays a crucial role in maintaining the fracture hematoma, which is vital for the healing process. Intramedullary fixation enables surgeons to limit soft tissue dissection, which in turn helps to decrease surgical trauma, blood loss, the risk of infection and complications related to wounds.^{7,8}

The PFN represents a contemporary advancement in intramedullary implants, drawing on insights gained from the use of the gamma nail. The gamma nail, utilized as an intramedullary device, presents a significant learning curve, accompanied by technical and mechanical failure rates estimated at around 10%. The gamma nail is prone to failure at its most vulnerable location, which is the lag screw-implant interface. In 1996, the Arbeitsgemeinschaft für Osteosynthesefragen (AO ASIF) introduced the proximal femoral nail featuring an anti-rotational hip pin

and a reduced distal shaft diameter. This design aims to minimize stress concentration, thereby helping to prevent potential failures. The proximal 115 femoral nail offers several benefits characteristic of intramedullary devices. It effectively reduces the moment arm and can be inserted using a closed technique, which preserves the fracture hematoma—an essential factor in the healing process. Additionally, it minimizes blood loss, lowers the risk of infection and reduces soft tissue damage. The 115 femoral nail offers numerous benefits associated with intramedullary devices. It effectively reduces the moment arm and can be inserted using a closed technique, which helps preserve the fracture haematoma—an essential factor in the healing process. Additionally, it minimizes blood loss, lowers the risk of infection and reduces soft tissue dissection and potential wound complications.⁹

Our research revealed that 45% of incidents were attributed to slip and fall accidents, while 55% resulted from road traffic collisions. In older adults, a simple fall is the most prevalent cause of peritrochanteric fractures. In young patients, road traffic accidents emerge as the leading cause of injury.

The patient cohort in our study spanned an age range of 22 to 94 years, with a mean age calculated at 55.18 years. The highest proportion of patients fell within the age range of 41 to 60 years, accounting for 40% of the total. The average age reported across the various studies was 68 years, with a range spanning from 17 to 94 years. The study comprised 31 males, accounting for 77.5% of the participants and 9 females, representing 22.5%. Research indicates that peritrochanteric fractures typically occur more frequently in females; however, our findings reveal a higher prevalence among males.^{8,9} The research revealed that 52.5% of the cases presented with fractures on the right side, while 47.5% exhibited fractures on the left side. In our analysis, of the 40 cases examined, 25 (62.5%) were identified as trochanteric, while 15 (37.5%) were categorized as subtrochanteric. Within the trochanteric

cohort, 40% were classified as Boyd and Griffin type 2. Among the subtrochanteric group, 33.3% were classified as Seinsheimer type 3a, while 20% fell into the type 2b category. In their 2000 study, Halder et al and Williams et al utilized the AO classification system, revealing that type A2 fractures accounted for 61% of cases, while type A3 fractures represented 29%. No type B or C fractures were present. In a study conducted by Uzun et al the findings revealed that 74% of the fractures were classified as type A2, while 26% were categorized as type A3, based on the AO classification system. Their series did not report any instances of type B or C fractures.¹⁰

Our research indicates that the average length of surgery was 65 minutes. The average length of hospital stay was recorded at 20.67 days, with a range spanning from 13 to 30 days. The average duration until patients could bear full weight was 16.5 weeks. According to the findings of Gadegone et al and Salphale et al, the average duration for achieving union was noted to be 12 weeks, with a variability spanning from 8 to 20 weeks. Our research revealed several complications, including two instances of difficult reduction, two cases of varus mal-reduction, one occurrence of implant failure, two instances of limb length discrepancy and two fatalities.

In a study conducted by Uzun et al it was found that secondary varus displacement emerged as the most prevalent complication, affecting nine patients, which accounts for 25.7% of the cases examined.¹¹ The secondary varus displacement can be attributed to several factors: cut-out of the proximal screws in two cases, screw loosening resulting from the collapse of the fracture site in another two instances and the reverse Z-effect observed in five cases. The average Harris hip score observed in our study was 83.5. Radiological complications primarily consist of three instances of varus malunion observed in three patients. There were no instances of implant failure or the reverse z effect observed.

Limitation of the study is sample size is too small for generalization of the study findings. The findings of the study indicate that PFN serves as a highly effective implant for addressing peritrochanteric fractures. A successful outcome hinges on several critical factors: a thorough understanding of fracture biomechanics, appropriate patient selection, meticulous preoperative planning, precise instrumentation and effective use of an image intensifier.

CONCLUSION

Our study concludes that PFN is an excellent implant for the treatment of peritrochanteric fractures. The terms of a successful outcome include a good understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate instrumentation and a good image intensifier. The PFN system combines the advantages of an intramedullary device with those of a minimally invasive procedure. The nail is inserted through

a short incision at the tip of the greater trochanter. The proximal interlocking screws are inserted percutaneously. The PFN has a small diameter, thus minimizing the size of the entrance hole in the greater trochanter, which preserves the structural integrity of the proximal femur. Because of the minimally invasive procedure, there is less surgical trauma, shorter operative time, less blood loss and decreased infection rates.

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