



## Management of Subtrochanteric Fracture Femur- by Proximal Femoral Nailing

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### Abstract

**Background:** Numerous variations of intramedullary nailing have been evolved over the years for stable fixation and early mobilisation of subtrochanteric fracture, out of which one is proximal femoral nail. Aims and objectives -We conducted this study with an objective to evaluate the results of internal fixation of subtrochanteric fractures of the femur with proximal femoral nail - AO type Design. **Methods:** This was a prospective study carried out at our tertiary care institute on 30 patients who had suffered subtrochanteric fracture and were subsequently treated with a proximal femoral nail (PFN). Proximal femoral nail was inserted through the tip of greater trochanter. All patients were followed up for a period of one year; at an interval of 3 months and during each follow-up visit for the functional outcome by modified Harris Hip Score, was assessed in the form of walking, squatting, sitting and rising from chair. **Results:** Modified Harris hip score was used for the evaluation of results in our study which showed excellent result in 21 patients (70%), good results in 3 cases(10%), fair results in 3 patient (10%) and poor results in 3 cases(10%). The mean Harris hip score in our study was 90.6. **Conclusion:** PFN is an intramedullary load sharing implant. Reduction and management of subtrochanteric fractures is challenging in traumatology. Proximal femoral nailing spanning whole femur with proximal and distal locking appears to be a satisfactory implant in management of fractures of subtrochanteric femur.

**Keywords:-** Fracture femur, closed reduction, Proximal femoral nail.

## INTRODUCTION

Subtrochanteric fractures are femoral fractures that occur in the shaft femur below the lower trochanter and up to 5 cm distal.<sup>[1]</sup> Ten to thirty percent of all hip fractures are caused by these fractures.<sup>[2]</sup> They have a bimodal distribution,

with diverse mechanisms of damage in both age ranges. In adults, a large force, i.e. a high-energy damage, is necessary to fracture this bone, however in the elderly, because the bone is weak, it can be fractured by minor stress.

Because of the complex anatomy, powerful muscular pull, and highly stressed location in the femur, reducing a subtrochanteric femur fracture is one of the most difficult difficulties in traumatology.<sup>[1]</sup> Multiple muscle attachments such as lateral hip abductors, medial hip adductors, the iliopsoas, and short external rotators are located in the subtrochanteric area, increasing tension around the hip and proximal femur.<sup>[3]</sup>

In terms of mechanisms, treatment, and complications, these fractures differ significantly from femoral shaft fractures.<sup>[4]</sup> According to previous studies, the overall incidence of this type of fracture is 15–20 per 100,000 people, with females over 50 years old being the most commonly affected.<sup>[5]</sup>

The New York Academy of Medicine awarded Dr. Hibbs a gold medal for his paper on subtrochanteric fractures. He advised bringing the distal fragment in line with the proximal and holding it in place with traction.<sup>[6]</sup> Boyd and Griffin in their investigation suggested that these fractures are most difficult to treat of all trochanteric fractures.<sup>[7]</sup>

Non-union is uncommon with these injuries since the subtrochanteric area has a robust muscle envelope with abundant blood supply. Because this fracture has a substantial socioeconomic impact, a treatment method is chosen that reduces the risks of malunion, shortening, and stiffness while allowing for early mobilisation and rehabilitation of the Nonoperative care has no place in the treatment of subtrochanteric fractures since it increases morbidity and mortality, and early surgical surgery is the only option. Subtrochanteric fractures have primarily been treated using

plates and screws such as dynamic hip screws, condylar screws, or cephalo-medullary nails throughout the last two to three decades.<sup>[8]</sup> In the subtrochanteric area, tensile and compressive stresses are larger than body weight.<sup>[9]</sup> Closed proximal femoral nailing allows for rotation and axial translation control while retaining the hematoma and periosteal envelope, which aids healing. This was a prospective study of proximal subtrochanteric femur fractures treated with proximal femur nailing at our tertiary care centre.

### Aims and objective

The goal of this study was to see how well internal fixation of subtrochanteric femur fractures with a proximal femoral nail – AO type design worked.

## **MATERIAL AND METHODS**

From May 2018 to December 2019, we conducted a prospective study on 30 patients with subtrochanteric femur fractures who were treated with a proximal femoral nail – AO type Design in our tertiary care centre. Wide no. 7/5/18/gmc/ptl was approved by the ethical committee. There was no potential for a conflict of interest. Valid written consents from study participants were obtained. The duration of follow-up ranged from 6 to 12 months, with an average of 11 months. Patients were chosen based on their age range of 18 to 65 years, their willingness to give written informed consent for the trial, and their ability to present within 15 days of injury.

Patients who refused to give informed consent, patients aged 65 and under 18, open fractures, patients with systemic injuries such as thorax, abdomen, or head injuries, pathological

fractures, and patients who presented after more than 15 days were all excluded.

### Statistical Analysis

The sample size was determined with 95 percent confidence using the formula  $n = Z^2 (1 - \frac{1}{2})^2 \frac{SD^2}{d^2}$ . The standard deviation is SD, the error rate is d, and the minimum sample size is n. According to this formula, the minimal sample size is 30.1, with SD =14 and d =5. In our study, the Student's t test was employed for statistical analysis, with p.05 being statistically significant. IBM SPSS statistics version 22.0 for Windows was used to conduct the statistical analysis.

### Management

All of the patients were treated as if they were indoor patients. On arrival, a medical history was collected, which included the date, cause of injury, and other pertinent details. An examination of the affected limb's neurovascular state was performed and recorded. Below-knee skin or skeletal traction was used to immobilise the damaged limb. X-rays were taken on a subject who was thermodynamically stable. Anteroposterior and lateral X-rays of the femur with the knee of the affected limb, as well as anteroposterior and lateral X-rays of the pelvis with both hips and anteroposterior and lateral X-rays of the femur with the knee of the affected limb, were taken. X-rays were used to make the diagnosis. As needed, other routine investigations were carried out. Patients were taken for internal fixation as soon as they were fit for surgery under anaesthesia as elective surgery.

All fractures in this study were stabilized with an AO type proximal femoral nail. Stainless

steel femur nail with a 14 mm proximal diameter. Preoperatively, the length of the nail was determined by measuring the femur from the tip of the greater trochanter to the adductor tubercle of the normal limb. Under spinal or epidural anaesthesia, the patient was placed on a fracture table with perineal support. 5 cm proximally from the greater trochanter's tip, an incision was made. Incisions were made in the skin, subcutaneous fat, and gluteal fascia. The gluteus maximus fibers were divided in the direction of the fibers. In AP view, the entry point was taken over the tip of the greater trochanter, and in lateral view, the entry point was taken over the middle of the greater trochanter. After passing through the fracture site, the guide wire was inserted from the entrance point and advanced up to the lower end of the femur. The PFN was inserted after the proper sized nail was mounted in the introducing device. In the proximal part of the nail, an appropriate sized lag screw and an anti-rotation screw were put.

Distal interlocking was done depending on the type of fracture. The wound was layered closed and a sterile dressing was applied. The patient was moved to the recovery room. Analgesics and antibiotics were given to the patients after surgery. Weight bearing was started early in non-comminuted fractures, while it was postponed until the formation of callus in comminuted fractures.

All patients were called for a first follow-up after four weeks, a second follow-up after ten to twelve weeks, and then every three months after that. Patients were checked for wound condition, pain, swelling, and tenderness at the fracture site, limb length discrepancy, implant impingement, or any other complaint, as well as

hip and knee range of motion. The radiological evaluation was completed. Following the clinico-radiological progress of fracture healing and condition, partial weight bearing with axillary crutches or a walker or full weight bearing was allowed. The absence of pain at the fracture site is a clinical marker of fracture healing, and the appearance of bridging callus on a roentgenogram is a radiological sign of union. If the clinico-radiological evidence of fracture union were not present, dynamization was performed by removing the distal locking bolts at roughly 6 weeks.

## RESULTS

The following are the results from the data gathered during this investigation of the proximal femoral nail in the treatment of 30 cases with proximal femur Subtrochanteric fractures.

**Age and sex** - In our research, the average age was 43.33 years, with a maximum age of 65 years and a minimum age of 18 years. The majority of the patients in our study are between the ages of 51 and 65 (36.66 percent). The majority of the patients were males, with 22 (73.33 percent) of the 30 patients being males and 8 (26.66 percent) being females.

**Side affected** - In our study, 17 patients (56.66%) had a right-side subtrochanteric femur fracture and 13 patients (43.33%) had a left-side subtrochanteric femur fracture.

**Mode of injury**- The majority of the incidents in our analysis were roadside accidents (53.33 percent) and falls (46.66 percent).

**Classification of Subtrochanteric fractures**- Seinsheimer classification is used to classify subtrochanteric fractures.<sup>[11]</sup> The majority of fractures in our study were type 2B and type 5 (25 percent of cases in each group), with type 3b having the least number of instances [Table 1].

**Days between admission and surgery**- In our study, the average time between admission and surgery was 6.83 days. In our study, the majority of the patients, 21 (70 percent), were operated on within seven days of arrival [Table 2].

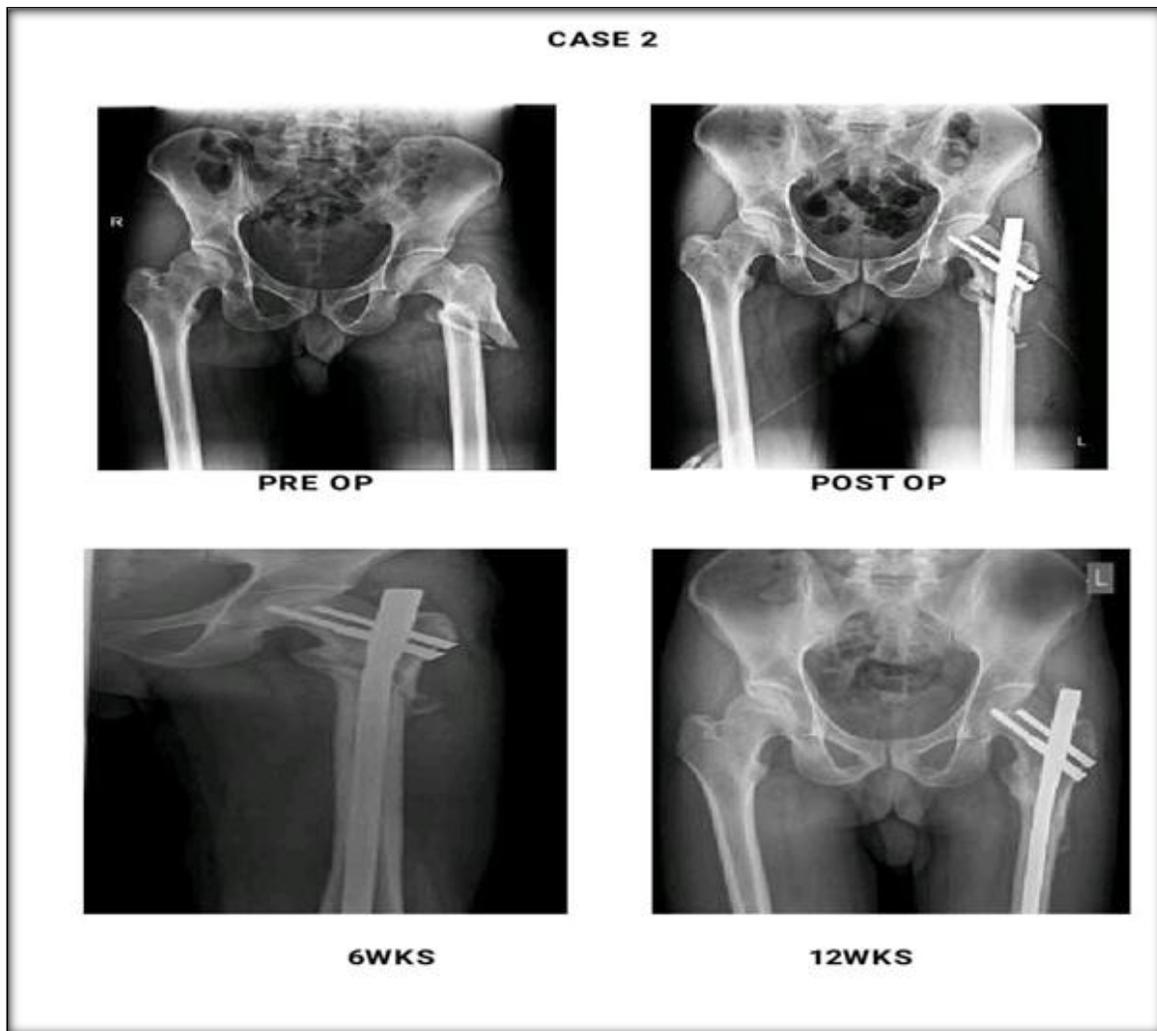
**Intraoperative complications**- Following intraoperative complications were encountered - fracture of lateral cortex in 2 cases (6.66%) and guide wire breakage in 1(3.33%) case.

### Postoperative complications

[Table 3] shows the postoperative complications that were seen until the last follow-up, which was one year following surgery.

**Union:** At their follow-up appointments, all of the patients were evaluated for radiological evidence of union [Figure 1]. By the end of six months, 26 of the 30 patients had radiological signs of union. Exchange nailing and bone grafting were used to treat two patients who had delayed union and two patients who had gone into non-union [Table 4]. The average length of time spent in union was 14.6 weeks.

**Results at final follow-up**- We evaluated 30 participants in our trial at the end of the study. During the study period, no deaths were documented. In our study, the average Harris hip score was 90.6 [Table 5].



**Figure 1:** showing management of subtrochanteric fracture femur by PFN

**Table 1:** Showing number and percentage of cases according to Seinsheimer classification.

Type	Number of cases	Percentage%
1	0	0%
2A	2	6.66%
2B	8	26.66%
2C	3	10%
3A	4	13.33%
3B	3	10%
4	2	6.66%
5	8	26.66%

**Table 2:** Showing No of days between admission and surgery and their percentage

Days between admission and surgery	Number of patients	Percentage of patients
1-4 days	11	36.66%
5-8 days	10	33.33%
9-12 days	6	20%
13-16 days	3	10%

**Table 3:** Showing Post Op complications and their percentage

Post op Complications	Number of patients	Percentage%
Hip Joint Stiffness	3	10%
Knee Joint Stiffness	2	6.66%
Non-Union	2	6.66%
Implant Breakage/Failure	1	3.33%
Varus angulation	4	13.33%
Superficial Skin Infection	1	3.33%
Z effect	3	10%

**Table 4:** Showing Union rates and their percentage

	Number of patients	Percentage
Union by end of 6 months	26	86.66%
Delayed union	2	6.66%
Non-Union	2	6.66%

**Table 5:** Showing Functional results of subtrochanteric fracture treated with PFN.

Functional results	Harris hip score (modified)	Number of Patients	Percentage%
Excellent	90-100	21	70%
Good	80-89	3	10%
Fair	70-79	3	10%
Poor	0-69	3	10%

## DISCUSSION

We used a fracture fixing approach using proximal femur nails to treat 30 patients with subtrochanteric femur fractures. From May 2018 to December 2019, a prospective randomised trial was conducted.<sup>[10]</sup> We didn't lose any of our patients due to a lack of follow-

up. The most common mode of injury in our analysis was road traffic accidents (53.33 percent). Subtrochanteric fractures account for 10-34 percent of all hip fractures, with a bimodal age distribution.<sup>[11,12]</sup>

As people live longer, the number of patients who suffer fractures as a result of low-energy



trauma is projected to rise. Self-fall fractures were found in 46.66 percent of the patients in our study. The average age of the patients was 43.33 years, with a maximum age of 65 years, a minimum age of 18 years, and a mean age of 65 years. The most common types of fractures were Seinsheimertype 2B and type 5 (25 percent of occurrences in each category), with type 3b being the least common. By 6 months, 26 patients had radiographic evidence of union. There were two examples of delayed union and two cases of non-union. In our study, the average Harris hip score was 90.6.

The patients in the current series had an average age of 43.33 years, compared to 73 years in Boldin et al.<sup>[13]</sup> and 82.2 years in I.B.Schipper Series.<sup>[14]</sup> This preference for young comes from the fact that they rely more on outdoor activities to make a living. Sandeep Sharma's study found that the average age was 53 years,<sup>[15]</sup> which is identical to ours. In our study, there were 73.33 percent men, compared to 70 percent females in Boldin et al and 82 percent females in I.B.Schipper study.<sup>[13,14]</sup> Males outnumber females in the Indian population. In our study, the right side of injury was the most common (56.66 percent), whereas the left side was afflicted in 43.33 percent of patients. In a study by I.B. Schipper,<sup>[14]</sup> 52 percent of the cases were right-sided, whereas 48 percent were left-sided. In our study, the average time from admission to surgery was 6.83 days, compared to 2 days in the I.B.Schipper study.<sup>[14]</sup> Longer surgical times could be owing to a lack of operating room availability or a delay in case fitness for surgery. We used Seinsheimer's classification system.<sup>[11]</sup> The most common types of fractures in our study are type 2B and type 5 (25 percent of cases in each group), with type 3b having the fewest

cases and type 1 having none while most common type in Sandeep Sharma Study and Seinsheimer Study was type 3A.<sup>[11,15]</sup>

The average period of union in our study was 14.6 weeks, which was similar to the 13.88 weeks in the Vivek Pradhan Study.<sup>[16]</sup> It took about 16 weeks in the I.B.SCHIPPER series.<sup>[14]</sup> One patient developed a superficial skin infection after surgery that was treated with wound care and antibiotics and showed no signs of osteomyelitis at the last follow-up. Non-union in two patients, implant fracture in one, varus angulations in four patients, and z effect in three patients were among the other surgical problems identified in our patients. Sandeep Sharma's study found a nonunion rate of 3.5 percent, D.M. Rahme's study reported a rate of 12 percent, and W.M. Gadegone's study recorded a rate of 13 percent.<sup>[15,17,18]</sup> The outcomes of our study were evaluated using the modified Harris hip score, which revealed outstanding results in 21 patients (70%) and good results in three patients (10%), acceptable results in three patients (10%), and poor results in three patients (10%). In our investigation, the mean Harris hip score was 90.6, which was greater than the I.B.Schipper series,<sup>[14]</sup> which had a mean of 77.6. To examine the outcomes as per an Indian's activities of daily living, we replaced the 6<sup>th</sup> and 7<sup>th</sup> elements of the Harris Hip Score, 'put on socks and shoes' and 'sitting' with 'squatting' and 'cross legged sitting.' Our findings are comparable to those of other studies, according to Harris Hip Score.<sup>[13,14,15,16,17,18]</sup>

The goal of treatment for a subtrochanteric fracture of the femur is to return to pre-trauma status as soon as feasible with minimal morbidity and death. In the past, many

treatment methods such as traction, plaster, femoral/tibial pinning, external fixator, and others were utilized to treat these types of fractures. The advancement of plate osteosynthesis (Dynamic Compression Screw and Plate, Dynamic Hip Screw and Plate, angle blade plate, Jewett plate, and so on) has improved the reduction, but factors such as surgical time, blood loss, infection, non-union, and implant failure remain key unsolved issues.

The current trend is to employ plate osteosynthesis less frequently. Closed nailing has progressed from simple Kuntcher nailing through Zickle nailing, 1<sup>st</sup> generation interlocking nailing, and so on, but the problem of not being able to cure the fracture with proximal extension has remained. These issues have been considerably resolved with the introduction of the gamma nail, Russell Taylor nail, proximal femoral nail, and ante grade femoral nail. Fractures distal to the implant are linked to short nails.<sup>[2]</sup> Closed reduction with PFN requires less time for surgery, and the patient can be mobilised sooner after PFN

## REFERENCES

1. Barbosa de Toledo Lourenço PR, Pires RE. Subtrochanteric fractures of the femur: update. *Rev Bras Ortop.* 2016;51(3):246-253. doi:10.1016/j.rboe.2016.03.001
2. Nieves JW, Bilezikian JP, Lane JM, Einhorn TA, Wang Y, Steinbuch M, et al. Fragility fractures of the hip and femur: incidence and patient characteristics. *Osteoporos Int.* 2010;21(3):399-408. <https://doi.org/10.1007/s00198-009-0962-6>
3. Feldman F. Atypical diaphyseal femoral fractures--new aspects. *Skeletal Radiol.* 2012;41(1):75-81. doi: 10.1007/s00256-011-1130-6.
4. Goswami A, Chaudhari U, Dalal B, Gandhi A, Rathod S. Effect of proximal femoral nailing in proximal third

fracture repair.<sup>[4]</sup> Our findings demonstrate that proximal femoral nailing can be a viable alternative to surgery.

## Limitations of study

1. The sample size is insufficient. A multicenter experiment with a bigger sample size could be conducted.
2. C arm imaging is required for proximal femoral nailing for subtrochanteric fractures of the femur.
3. For beginners in orthopaedic practices, reducing and fixing such fractures may be difficult.

## CONCLUSIONS

Proximal femoral nail an intramedullary load sharing implant in traumatology, reducing and managing subtrochanteric fractures is difficult. In the treatment of subtrochanteric femur fractures, proximal femoral nailing across the entire femur with proximal and distal locking appears to be a suitable implant.

5. femur fracture. *Int J Med Sci Public Health.* 2013; 2(4): 904-907.
5. Streubel PN, Wong AHW, Ricci WM, Gardner MJ. Is There a Standard Trochanteric Entry Site for Nailing of Subtrochanteric Femur Fractures?. *J Orthop Trauma.* 2011;25(4):202-7. <https://doi.org/10.1097/bot.0b013e3181e93ce2>
6. Hibbs RA. The management of the tendency of the upper fragment to tilt forward in fractures of the upper third of the femur. *NY Med. J.* 1902; 75:177-79
7. Boyd HB, Griffin LL. Classification and treatment of trochanteric fractures. *Arch Surg.* 1949;58(6):853-66.
8. Robertson R, Tucker M, Jones T. Provisional Plating of Subtrochanteric Femur Fractures Before Intramedullary Nailing in the Lateral Decubitus Position. *J Orthop Trauma.* 2018;32(4):e151-6



9. Bianchi R, Clerici P, Miani A. Quantitative and comparative stress analysis in human femur under two different static situations by three-dimensional photoelasticity. *Anat Rec.* 1985;211(3):323-8. doi: 10.1002/ar.1092110314.
10. Panjabi MM, Walter SD, Karuda M, White AA, Lawson JP. Correlations of radiographic analysis of healing fractures with strength: a statistical analysis of experimental osteotomies. *J Orthop Res.* 1985;3:212-218. doi: 10.1002/jor.1100030211
11. Seinsheimer F. Subtrochanteric fractures of the femur. *J Bone Joint Surg Am.* 1978;60(3):300-6.
12. Joglekar SB, Lindvall EM, Martirosian A. Contemporary management of subtrochanteric fractures. *Orthop Clin North Am.* 2015;46:21-35.
13. Christian Boldin, Franz J Seibert, Florian Fankhauser et al.: "The proximal femoral nail (PFN)—a minimal invasive treatment of unstable proximal femoral fractures. *Acta Orthop Scand* 2003; 74(1): 53 - 58.
14. Schipper I B et al. Treatment of Unstable trochanteric fractures :*JBJS* 2004; 86 B : 86 - 94
15. Sharma S, Swamy A, Salgia A, Mohapatra A, Parmar KS. Management of Subtrochanteric Fracture Femur With Proximal Femoral Nail(PFN). *J Pharm Biomed Sci.* 2014;04(03):235-40.
16. Pradhan V, Jain S, Agrawal S, Sharma SL. Comparative prospective study of proximal femoral nail and locking compression plate in subtrochanteric fractures of femur. *Natl J Clin Orthop.* 2018;2(4):188-91
17. Rahme DM, Harris IA. Intramedullary Nailing versus Fixed Angle Blade Plating for Subtrochanteric Femoral Fractures: A Prospective Randomised Controlled Trial. *Jr of Orthop Surg.* 2007;15(3):278-81. <https://doi.org/10.1177/230949900701500306>
18. Gadegone WM, Salphale YS. Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. *Int Orthop.* 2007;31(3):403-8. <https://dx.doi.org/10.1007%2Fs00264-006-0170-3>

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