



BMH Med. J. 2018;5(3):67-73 **Research Article**

## **A Study On Surgical Management Of Unstable Intertrochanteric Fractures Using Proximal Femoral Nail**

CV Mudgal<sup>1</sup>, R Madhuchandra<sup>2</sup>, Dhanoop Dhananjayan<sup>3</sup>

<sup>1</sup>Associate Professor, <sup>2</sup>Assistant Professor, <sup>3</sup>Junior Resident, Department Of Orthopaedics, Karnataka Institute Of Medical Sciences Hubli

**Address for Correspondence:** Dr. Dhanoop Dhananjayan, Junior Resident, Department Of Orthopaedics, Karnataka Institute Of Medical Sciences Hubli, India. E-mail: dhanoopkv@gmail.com

### **Abstract**

**Introduction:** Fractures around the trochanteric area of the femur are among the most frequent fractures encountered in orthopaedics and also among the most distressing injuries of the elderly. A burgeoning population and increased life expectancy have resulted in a rise in these types of fractures. Several implants have been designed for the treatment of these fractures. In this study we analyze the functional and radiological outcome of unstable inter-trochanteric fractures fixed with proximal femoral nail.

**Methods:** This is a prospective study. 30 patients with inter-trochanteric fractures treated by proximal femoral nail from December 2015 to December 2017 were included in the study. We analyzed these 30 patients for functional and radiological out come and complications. The criteria for the assessment of efficiency of surgical technique included duration of surgery, number of intra-operative complications, blood loss and radiographic screening time. Clinical assessment includes post operative walking ability, hip and knee function, fracture union time, and implant bone interaction by Hips Harris Score.

**Results:** The fracture union rate was 86.6 % and the average union time was 13.5 weeks. According to Hip Harris Score (Modified), over all 7 % of patients had outstanding results, 47 % of patients had good results, 33 % of patients had fair results and only 4 cases i.e., 13 % of patients had poor results.

**Conclusion:** The result of our study shows that proximal femoral nail is an effective device for the fixation of inter-trochanteric fractures of femur with good functional and radiological outcome. We conclude that the PFN is a highly accepted minimally invasive implant for unstable proximal femoral fractures but future modification of the implant to avoid Z-effect phenomenon, careful surgical technique and selection of the patients should further reduce its complication rate.

**Keywords:** Inter-Trochanteric Fracture, Proximal Femoral Nail, PFN

## Introduction

The incidence of inter-trochanteric fractures has been increasing significantly due to the rising age of modern human populations [1]. Elderly patients with a minor fall can sustain a fracture in this area because of debilitated bone due to osteoporosis or pathological fracture and this account for 90% of inter-trochanteric fractures.

The occurrence of proximal femoral fractures among females is 2 to 3 times higher than the incidence of such fractures amongst males [2]. Also, the possibility of sustaining a proximal femoral fracture doubles every 10 years subsequent to age 50 years [3]. In view of the fact that the femur is the longest and the strongest bone in the body and the principal load bearing bone in the lower extremity, fracture of this bone may result in drawn out morbidity and far-reaching disability unless the treatment is apt. Conservative management of inter-trochanteric femoral fracture often yields poor therapeutic outcomes, and surgical fixation is generally warranted [4]. Until 1960's non operative treatment was the option on hand for these types of fractures in the form of traction with prolonged bed rest with fracture healing occurring in ten to twelve weeks (usually) followed by a prolonged program of ambulation training. These are coupled with problems of prolonged recumbence like decubitus ulcer, urinary tract infection, pneumonia, joint contractures and thrombo-embolic complications ensuing in a high mortality rate. The primary reason for surgery is to permit the early mobilization of the patient, with partial weight-bearing limitations depending on the stability of the reduction [5]. The most widespread internal fixation device used today is the fixed angle extra-medullary device, such as a 95-degree lag screw and side plate or blade plate. The advantage of the sliding lag screw, compared with a static screw, is that it permits impaction of the fragments; this impaction enhances the bone-on-bone contact, encouraging osseous healing while decreasing implant stress. Dynamic hip screw (DHS) requires a relatively larger exposure, more tissue handling and anatomical reduction, all of which increase the morbidity, the probability of infection and significant blood loss, the possibility of varus collapse and the inability of the implant to survive until fracture union. The side plate and screws weaken the bone mechanically. The other spectrum is intra-medullary fixation with devices like the IMHS (intra medullary hip screw), Gamma nail, Russell - Taylor reconstruction nail, ATN (Ante-grade trochanteric nail), TFN (Trochanter fixation nail) and the PFN (Proximal femoral nail). The screw and side plate and blade plate have been revealed to have elevated rates of fracture union when used with fractures involving the piriformis fossa, but intra-medullary nails have been suggested if the posteromedial cortical buttress cannot be established in unstable fractures. Benefits of intra-medullary devices include preserved blood supply to the bone fragments, less operative blood loss and less disruption of the environment. After fracture fixation, the patient usually requires protected weight bearing for 6 to 12 weeks, and as callus formation is observed radiographically, weight bearing is slowly increased. This study consists of 30 cases of intertrochanteric fractures which were fixed with proximal femoral nail and their final outcome is compared.

## Materials and Methods

During the period between September 2015 to September 2017, 30 patients who were admitted in Karnataka Institute of Medical Sciences with intertrochanteric fractures that fitted into the inclusion criteria and managed surgically with proximal femoral nail were included in the study. Criteria to include the patients in this series were all unstable intertrochanteric fractures including Intertrochanteric fractures with Sub-trochanteric extension. Age > 20 years and Exclusion criteria were age less than 20 years, pathological fractures, compound fractures, previous wound or bone infections and operatively treated fractures. Unstable intertrochanteric fractures were categorized as those with the following fracture configurations: Loss of medial support with involvement of the lesser trochanter, lateral column involvement, reverse obliquity fractures and fractures with sub-trochanteric extension. These cases would be evaluated on the basis of method of injury, classification and treatment with proximal femoral nail and their surgical and functional outcome with or without residual complication. The end results were evaluated in terms of: Clinical

parameters, Wound healing, Fracture union, Mobilization status, Range of motion; hip, knee, Complications and Subsequent procedures and resumption of activities. Study was approved by the institutional review board.

## Results

The following observations were made from the data collected during the study of proximal femoral nail in the management of 30 cases of intertrochanteric fractures of proximal femur in the Department of Orthopaedic Surgery, Karnataka Institute of Medical Sciences, Hubli from December 2015 to December 2017.

In our follow up of cases the maximum age was 85 years and minimum age was 24 years. In our series 20% of the patients were in the age group of 20 to 50 years and other 80% were above 50 years and mean age group was 65 years. There were 73% males and 27% females, which indicate males are greatly exposed to the risk factor, due to highly challenging physical work and vehicular accidents. In our series majority of the cases were due to self fall and minority of the cases were due to other causes. In our study twelve patients were injured on right side and ten on left side.

Boyd and Griffins classification was used for intertrochanteric fracture classification in this study. There were 60% type II fractures, 20% type III fractures and 20% type IV.

In our study mean time interval was one week. Two patients were treated after 2 weeks as they were having associated head injury which was given initial treatment priority, followed by stabilization of systemic condition.

In our series 26 patients underwent closed fixation and 4 patients underwent open fixation due to delay in surgery and failure to achieve anatomical reduction due to deforming forces.

In our study, we measured various intra-operative parameters such as interval of radiographic screening, high exposure in case of comminuted fractures with difficult reduction. Blood loss was calculated by mop count (each fully soaked mop containing 50 ml blood). The mean operative time was about 95 minutes and mean duration of X-ray exposure was 100 Seconds.

In our study, we had seven instances of intra operative complications. In one case we experienced jamming of the drill sleeve and in one case we had guide wire breakage. In the immediate post operative period we had no complications. We had one case of implant breakage, two cases of delayed union and two cases of non union. There was shortening of 1.5 cms in one case and secondary infection in another.

In our series suture removal was done on 10th post operative day. Then patient was made to follow up with rehabilitation program such as partial weight bearing, crutch walking. So the average hospital stay was less than 3 weeks.

All patients were followed at 6 weeks, 12 weeks, 6 months and some patients up to one year and further if needed. In our study the mean duration of hospital stay was 16.83 days, the average time for full weight bearing was 13.5 weeks. All patients had a good range of hip and knee range of motion except five patients who had hip joint stiffness and three patients who had knee joint stiffness for some duration of time. Mobilization was protected in immediate post operative period but later all patients were ambulatory independently with or without walking aid after 6weeks, except two patients.

In our series different fractures took different duration of time for union. Average period of union

was as follows: Type II- was about 3 months, Type III- was about 3 months and Type IV- was about 4 months.

In our study of 30 operated cases, no deaths were reported during the study period. The results of the treatment of intertrochanteric and sub-trochanteric fractures using Proximal Femoral Nail were assessed by Harris Hip Score system (Modified).

The average period of union in our study was 13.75 weeks. Anatomical results were evaluated by presence or absence of deformities, shortening, and hip and knee range of movement. In our study the union rates were 86.67% and one patient had shortening of 1.5 cms, five patients had knee joint stiffness and eight patients had hip joint stiffness.

The results of the treatment of intertrochanteric and sub-trochanteric fractures using Proximal Femoral Nail were assessed by Harris Hip Score system (Modified). 14 cases (37%) has good score, 10 cases (33%) has fair score, 4 cases (13%) has poor score while 2 cases (7%) has excellent score.

## Discussion

Fractures of the proximal femur are challenging injuries for the orthopaedic surgeon. The sub-trochanteric and intertrochanteric fractures of the proximal femur management are related with some failures. Faulty operative procedures, unsatisfactory reductions, serious osteoporosis, and incorrect positioning of the weight bearing screw are the most important factors responsible for the failed internal fixation [7]. High stress concentration which is subject to multiple deforming forces, and long healing duration because of predominance of cortical bone, decreased vascularity, result in high incidence of complications after surgical management.

Closed management of these injuries poses difficulty in obtaining and maintaining a reduction, making operative treatment the ideal treatment. Currently common modes of fixation devices used are Blade plate systems, Sliding screw systems and Intra-medullary devices. Since its introduction in the 1980s, cephalomedullary fixation for IT fractures in the elderly has gained popularity. Aside from the theoretical advantage of being less invasive and biomechanically superior, these devices have been advocated in cases of unstable fracture patterns such as reverse obliquity, lateral wall incompetence, sub-trochanteric extension, and medial calcar disruption [8,9].

An intramedullary device inserted by means of minimally invasive procedure is suitable in elderly patients. Closed reduction maintains the fracture hematoma, which is vital for the consolidation process. Intra-medullary fixation is helpful to minimize soft tissue dissection and reducing surgical trauma, blood loss, infection, and wound complications.

A precise reduction and proper surgical method is of utmost importance in the treatment of unstable trochanteric fractures with the PFN. PFN is a novel, recent intramedullary implant based on experience with the gamma nail [10]. The gamma nail has technical and mechanical failure rates of about 10% and is vulnerable to fail at the lag screw-implant interface which is its weakest point.

The Arbeitsgemeinschaft fur osteosynthesefragen (AO ASIF) in 1996 invented the proximal femoral nail which has an anti-rotational hip pin with the smaller distal shaft diameter which decreases stress concentration to surpass these failures.

An intra-operative fracture dislodgment during manual introduction of the nail into the femoral shaft has been a problem with the PFN. The rationale may be that the entry point of the PFN at the tip of the greater trochanter is located directly in the fracture region which can lead to an intra-operative fracture dislodgment. In our study we did not face any intra-operative fracture dislodgment after nail insertion. In comparison to gamma nail, we did not face neither any fracture of the femoral shaft or any break in the implant, intra-operatively.

The aims and objectives of this series is to study unstable intertrochanteric fractures of femur in adults and its biomechanics, to study the results of surgical management of these fractures with Proximal femoral nailing, to re-establish the anatomy of these fractures flawlessly by operative management using proximal femoral nailing, to assess the union of these fractures after surgical management using Proximal femoral nailing, to assess the stable fixation and early ambulation of the patients and to assess the post operative restoration of the walking capacity of these patients.

The criteria for the evaluation of efficiency of surgical technique included interval of surgery, number of intra-operative complications, blood loss and radiographic screening time. Clinical evaluation includes post operative walking capacity, hip and knee function, fracture union time, and implant bone interaction by Hips Harris Score. In our series we have chosen the age group from 21 years up to 85 years of age, with the average age of 65 years. The maximum numbers of cases were found in the age group between 51 to 65 years, as compared to the average age of 70.2 years in a study conducted by Rowe et al [1]. The age specific incidence rate showed a gradual increase. The most common cause of injury was a simple fall.

Males were more commonly affected than females, males accounting to 22 cases contributing to 73 % of cases and females contributed to 8 cases making 27% of cases, as compared to 48% male patients and 52% of female patients, in a study conducted by Rowe T et al [11].

Right sided fractures were slightly more than left sided fractures accounting to 17 cases, which made for 57 % of cases and left sided fractures accounted for 13 cases making 43% of cases.

In our series, Boyd and Griffin type II and type III contributed eighteen and six cases in each group, making to 60 % and 20% followed by type IV contributing 6 cases making 20 %.

We performed closed procedure in 26 cases (87%) and open nailing in 4 cases (13%). The average duration of radiation exposure was 120 seconds, average duration of surgery was 95 minutes and average blood loss was 140 ml with 23% intra-operative complications. In the intra-operative period, in one case we had jamming of the drill sleeve and in two cases we had breaking of the guide wire, however, the jammed drill sleeve was removed and operation was continued using another drill sleeve and in case of guide wire breakage, it was retrieved successfully and we did not put hip screw in 1 case.

In the study carried out by Papisimos et al the average operating time was 71.2 minutes and open reduction was needed in 8.1% with mean blood loss of 220 ml. Seven cases showed local intra-operative complications (3.3%) [12].

The average duration of hospital stay was 16.83 days; average time for full weight bearing was 13.5 weeks. Post operatively all patients were mobile of which two of them required walking aids. One patient had 1.5 cms shortening after fracture union which was managed conservatively by single rise. All patients had good range of hip and knee movements except eight patients had hip restrictions and five patients had knee limitation of movements.

In the study conducted by Papisimos et al the average duration of hospital stay was 8.8 days. In that study the average weeks of fracture union was 13 weeks and complication rates were 25%. Two patients had varus deformity of less than ten degrees and no attempt was made to revise. Fracture union was uneventful. One patient had malrotation and five case of Z effect were observed [12].

In our study, no deaths were reported during the study period. In the series conducted by Papisimos S et al, 40 patients of proximal femoral fractures were treated by PFN [12]. In the series conducted by Boldin C et al, 34 patients of unstable proximal femoral fractures were managed by PFN [6]. The

comparison of these series with the present series is as follows (Table 1).

Sl. No.	Series	No. of patient	Union	Non union	Delayed union
1	Papasimos's	40	100%	0%	5%
2	Boldin's	55	88%	5.4%	5.4%
3	Present	30	86.6%	7%	7%

**Table 1**

According to Hip Harris Score (Modified), over all 7 % of patients had outstanding results, 47 % of patients had good results, 33 % of patients had fair results and only 4 cases i.e., 13 % of patients had poor results. After comparing in various studies, it was seen that our series was comparable with most of the standard published series.

### Conclusion

In the light of the results obtained from the present study, we believe that the PFN emerges as a valid option for the treatment of unstable proximal femoral fractures of the trochanteric region, because of the simplicity and lack of aggressiveness of the surgical technique and the low level of technical complications encountered, which is particularly important bearing in mind that the large majority of patients who suffer these kinds of fracture are elderly, and their general condition is frequently compromised. Use of PFN in such fractures provides various benefits including closed procedure, minimal soft tissue damage, no stress risers in bone and closer to weight bearing axis. It offers greater stabilization than other presently used methods of internal fixation. At present, we consider that the PFN is a highly accepted minimally invasive implant for unstable proximal femoral fractures but future modification of the implant to avoid Z-effect phenomenon, careful surgical technique and selection of the patients should further reduce its complication rate. Early post operative ambulation and physiotherapy improves the results of PFN.

### References

1. Knowlton LM, Staudenmayer KL. Traumatic Injury in Older Adults. Principles and Practice of Geriatric Surgery. 2017:1-21.
2. Cauley JA, Chalhoub D, Kassem AM, Fuleihan GE. Geographic and ethnic disparities in osteoporotic fractures. Nature Reviews Endocrinology. 2014 Jun 1;10(6):338-51.
3. Melton JL, Ilstrup DM, Riggs BL, Beckenbaugh RD. Fifty year trend in hip fracture incidence. Clin Orthop 1982; 162:144 -9.
4. Yin PB, Long AH, Shen J, Tang PF. Treatment of intertrochanteric femoral fracture with proximal femoral medial sustainable intramedullary nails: study protocol for a randomized controlled trial. Clinical Trials in Orthopedic Disorders. 2016 Apr 1;1(2):44.
5. Browner BD, Levine AM, Jupiter JB, Trafton PG. Skeletal trauma, Basic science, Management, and Reconstruction. 3rd ed. Philadelphia: Saunders; 2003.

6. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty: an end-result study using a new method of result evaluation. *J Bone Joint Surg [Am]* 1969;51-A: 737-55.
7. Liu JJ, Shan LC, Deng BY, Wang JG, Zhu W, Cai ZD. Reason and treatment of failure of proximal femoral nail antirotation internal fixation for femoral intertrochanteric fractures of senile patients. *Genet Mol Res*. 2014 Jan 1;13(3):5949-6.
8. Matre K, Vinje T, Havelin LI, Gjertsen JE, Furnes O, Espehaug B, Kjellevoid SH, Fevang JM. TRIGEN INTERTAN intramedullary nail versus sliding hip screw: a prospective, randomized multicenter study on pain, function, and complications in 684 patients with an intertrochanteric or sub-trochanteric fracture and one year of follow-up. *JBJS*. 2013 Feb 6;95(3):200-8.
9. Okcu G, Ozkayin N, Okta C, Topcu I, Aktuglu K. Which implant is better for treating reverse obliquity fractures of the proximal femur: a standard or long nail? *Clinical Orthopaedics and Related Research*. 2013 Sep 1;471(9):2768-75.
10. Russel TA, Taylor JC. : Subtrochanteric fractures of the femur. In : Browner BD, Jupiter JB, Levine AM. : *Skeletal trauma 2nd Edition*, Philadelphia, PA: WB Saunders; 1992 p. 1832 – 78r] 2004;86-B:86-94.
11. Rowe SM, Yoon TR, Ryang DH. An epidemiological study of hip fracture in Honam, Korea. *International orthopaedics*. 1993 Jun 1;17(3):139-43.
12. Papasimos S, Koutsojannis CM, Panagopoulos A, Megas P, Lambiris E. A randomised comparison of AMBI, TGN and PFN for treatment of unstable trochanteric fractures. *Archives of Orthopaedic and Trauma Surgery*. 2005 Sep 1;125(7):462-8.