

Original research article

## Study on Proximal Femoral Nail in the Treatment Intertrochanteric and Subtrochanteric Fractures, an Observational Study

Dr. Omprakash.T<sup>1</sup>, Dr. Srimukthi Madhusudan<sup>2\*</sup>, Dr. P.Sadanandam<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Orthopedics Medicity Institute of Medical Sciences Ghanpur, Telanagana State, India.

<sup>2</sup>Assistant Professor, Department of Orthopedics Government Medical College Siddipet, Telangana State, India

<sup>3</sup>Assistant Professor, Department of Community Medicine Government Medical College Siddipet, Telangana, India.

Corresponding Author: Dr. Srimukthi Madhusudan, drmadhusudans@gmail.com

### Abstract

**Introduction:** Intertrochanteric and subtrochanteric fractures are devastating injuries that most commonly affect the elderly, but it is not uncommon in younger age group, have a tremendous impact on both the health care system and society in general. Peri trochanteric fractures mainly comprise of fractures of trochanter and subtrochanteric region. There are various forms of internal fixation devices used for Trochanteric Fractures, of them the most used device is the Dynamic Hip Screw with Side Plate assemblies. This is a collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability.

**Objectives:** 1) To assess the stable fixation and early mobilization of patients with Intertrochanteric and subtrochanteric fractures. 2) To analyze the anatomical and functional outcome of treatment of Intertrochanteric and subtrochanteric fractures using Proximal Femoral Nail.

**Methodology:** The present study consists of 40 adult patients of intertrochanteric and subtrochanteric fractures, who are treated with Proximal Femoral nail in Mahatma Gandhi Memorial Hospital, attached to Kakatiya Medical College, Warangal, Telangana state between November 2012 and June 2014.

**Results:** Mean duration of screening was 90 seconds, mean duration of operation 90 minutes and Mean blood loss 130 milli liters. Intraoperative complications were, 15% Failure to get anatomical reduction, 15% Failure to put derotation screw, 15% Varus angulation and 10% Failure of distal locking. Fracture of lateral cortex, Breakage of guide wire and Breakage of drill bit observed 5% of operations. In our study the average duration of hospital stay was 19.33 days. The mean time for full weight bearing was 12.6 weeks. All patients enjoyed good range of hip and knee range of motion except one who had septic arthritis knee. Post-operative mobility was aided in immediate post-operative period but later all patients were ambulatory independently with or without walking aid after 6 weeks.

**Conclusion:** 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:** Intertrochanteric and subtrochanteric fractures, Proximal Femoral nail, anatomical and functional outcome

## Introduction

Intertrochanteric and subtrochanteric fractures are devastating injuries that most commonly affect the elderly, but it is not uncommon in younger age group, have a tremendous impact on both the health care system and society in general. Peri trochanteric fractures mainly comprise of fractures of trochanter and subtrochanteric region.<sup>1</sup>

Subtrochanteric fractures comprises about 10 to 34% of hip fractures.<sup>1</sup> Subtrochanteric fractures are complicated by malunion and delayed or nonunion. The factors responsible for these complications in subtrochanteric fractures are high stress concentration, predominance of cortical bone and difficulties in getting biomechanically sound reduction because of comminution and intense concentration of deforming forces.<sup>2</sup>

Many internal fixation devices have been recommended for use in subtrochanteric fractures, because of high incidence of complications reported after surgical treatment with each implant. A lack for satisfactory implant in surgical treatment of subtrochanteric fractures has led to series of evolution in design of a perfect implant.<sup>3</sup>

Subtrochanteric femoral fractures are associated with high rates of non-union and implant failure, regardless of the method of fixation. Only recently has a better understanding of biology, reduction techniques and biomechanically improved implants allowed subtrochanteric fractures to be addressed with consistent success.

Trochanteric fractures occur in the younger population due to high velocity trauma, whereas in the elderly population it is most often due to trivial Trochanteric fractures are common in the elderly people.<sup>4</sup>

Trochanteric fractures treated without surgical intervention malunion with coxa vara deformity resulting in shortening of limb and limp are commonly seen. It is also associated with complications of prolonged immobilization like bedsores, deep vein thrombosis and respiratory infections. Since this fracture is more common in the elderly patients, 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 ideal choice.<sup>5</sup>

There are various forms of internal fixation devices used for Trochanteric Fractures, of them the most used device is the Dynamic Hip Screw with Side Plate assemblies. This is a collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability.

The latest implant for management of trochanteric fractures is proximal femoral nail, which is also a collapsible device with added rotational stability. This implant is a Centro medullary device and biomechanically sounder. It also has other advantages like small incision, minimal blood loss. Intertrochanteric and subtrochanteric fractures of femur possess clinical, structural, anatomical, and biomechanical characteristics that distinguish them from intracapsular fractures.<sup>6</sup>

## Objectives:

- To assess the stable fixation and early mobilization of patients with Intertrochanteric and subtrochanteric fractures.
- To analyze the anatomical and functional outcome of treatment of Intertrochanteric and subtrochanteric fractures using Proximal Femoral Nail.

**Methodology:**

The present study consists of 40 adult patients of intertrochanteric and subtrochanteric fractures, who are treated with Proximal Femoral nail in Mahatma Gandhi Memorial Hospital, attached to Kakatiya Medical College, Warangal, Telangana state between November 2012 and June 2014. All the patients were followed up till fracture union and function recovery after surgery at regular interval. Sub trochanteric fractures and unstable intertrochanteric fractures (Reverse oblique fractures and inter trochanteric fractures with loss of posteromedial cortex) were included. Open hip fractures, Pathological fractures, Periprosthetic fractures and Pediatric fractures (before physeal closure) were excluded from the study.

All patients were followed up at an interval of 6 weeks till the fracture union is noted and then after once in 3 months till 1 year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. X-ray of the involved hip with femur was done to assess fracture union and implant bone interaction.

Functional Results assessed based following hip scoring system adopted. Harris Hip Scoring System (Modified)<sup>54</sup>. This score consists of maximum points possible – 100 (Pain relief- 44 Function- 47, Range of motion, Absence of deformity- 4).

**Results:**

The following observations were made from the data collected during this study of proximal femoral nail in the treatment of 40 cases of intertrochanteric and subtrochanteric fractures of femur. 20 were intertrochanteric and 20 were subtrochanteric fractures.

In our study maximum age is 92 years and minimum age 26 years. Most (50%) of the patients were between 60 to 75 yrs. followed by 41-60 years i.e, 30%. Mean age of the study population 61.4 years. Majority (75%) were females.

Nature of violence was slip and fall among 50% of the patients, 30% had fall from height. 20% of patients had motor vehicle accident as a nature of violence. Almost equally involved both the sides right side involvement observed among 55% of patients and 45% in left side. Associated fractures observed were, two patients had left knee (ipsilateral) effusion with septic arthritis with fracture surgical neck humerus (simple) on right, two patients had ipsilateral compound grade 2 comminuted fracture at junction of mid and lower thirds of right tibia treated with external fixator and two patients had ipsilateral fracture clavicle with fracture of 4, 5, 6 ribs. All were treated conservatively.

Majority (60%) cases were type 2 fractures, 30% were type 1 fractures 10% were type 3 fractures according to Boyd and Griffin classification of trochanteric fractures.

Subtrochanteric fractures classified according to **Seinsheimer classification. We found 40% were 3a fractures, 2b and 2c were 20% 2a and 3b were 10%.**

All the patients were operated at an average interval of 8 days from the date of trauma. Mean duration of screening was 90 seconds, mean duration of operation 90 minutes and Mean blood loss 130 milli liters.

Intraoperative complications were, 15% Failure to get anatomical reduction, 15% Failure to put derotation screw, 15% Varus angulation and 10% Failure of distal locking. Fracture of lateral cortex, Breakage of guide wire and Breakage of drill bit observed 5% of operations.

In our study the average duration of hospital stay was 19.33 days. The mean time for full weight bearing was 12.6 weeks. All patients enjoyed good range of hip and knee range of motion

except one who had septic arthritis knee. Post-operative mobility was aided in immediate post-operative period but later all patients were ambulatory independently with or without walking aid after 6 weeks.

#### *FOLLOW UP*

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

Anatomical results were assessed by presence or absence of deformities, shortening, hip and knee range of motions. In our study one patient had shortening >1cm, three patients had varus malunion <10 degrees. One patient had post septic arthritis knee stiffness.

#### **FUNCTIONAL**

#### **RESULTS:**

In our series of 40 operated cases 2 cases expired before first follow up due to associated medical problems and old age.

Functional and anatomical results are assessed taking the remaining 38 cases into consideration. Table No 1 explains results of functional outcome

**Table 1: Functional outcome**

<b>Functional results</b>	<b>Intertrochanteric fracture</b>	<b>Subtrochanteric fracture</b>
Excellent	66.66%	12.5%
Good	33.33%	75%
Fair	0%	12.5%
Poor	0%	0%

#### **Discussion:**

The treatment of fractures of the proximal femur is still associated with some failures. The reasons are disregard for biomechanics, overestimation of the potentials of new surgical techniques or new implants or poor adherence to established procedures. High stress concentration that is subject to multiple deforming forces, slow healing time because of predominance of cortical bone, decreased vascularity, high incidence of complications reported after surgical treatment compels the surgeon to give a second thought regarding selection of the proper implant.

Pajarinen et al<sup>7</sup> found sex ratio as 3:1 in their study. Our study was similar with this. AS Sidhu et al<sup>8</sup> observed sex ratio 1.724:1.

Dominigoetal<sup>9</sup> found 77min as mean duration of surgery. CBolding etal<sup>10</sup> observed 68 min as mean duration of surgery. These two studies were approximately similar with our study where our mean duration of surgery was 90min. Simmermacheretal<sup>11</sup> took very less time to complete surgery i.e, 45 min. CBolding etal<sup>10</sup>, Dominigoetal<sup>9</sup> and our study observed 100% bony union. Whereas Simmermacheretal<sup>11</sup> observed 98%. CBolding etal<sup>10</sup>, Simmermacheretal<sup>11</sup> and our study had no failures in fixation. Dominigoetal<sup>9</sup> observed 11% of failures in fixation. Simmermacheretal<sup>11</sup> had 2% of delayed union. We found 11% in our study.

CBolding etal<sup>10</sup> did open reduction in 10% of cases. Simmermacheretal<sup>11</sup> performed open reduction 34.6% of cases. Whereas in our study no open reduction performed.

In our study, mean Harris Hip score was 89.8 which is comparable to that of Karn et al.<sup>12</sup> Simmermacher et al.<sup>11</sup> (1999), in a clinical multicentric study, reported technical failures of PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. In our study poor reduction occurred in three cases, three with varus malreduction. A cut out of the neck screw occurred in 0.6% cases in the study conducted by Simmermacher et al.,<sup>11</sup> but we did not encounter such complication in our study. Anatomical fracture reduction was found in 86% of the patients and full weight bearing stability was achieved in 94%. In our study acceptable anatomical reduction was obtained in 85% cases. An intraoperative fracture displacement during manual introduction of the nail into the femoral shaft has not been reported with the gamma nail but this has been a problem with the PFN. One reason may be the entry point of the PFN at the tip of the greater trochanter is located directly in the fracture region which can cause intraoperative fracture displacement.

However, Simmermacher et al.<sup>11</sup> had no cases of intraoperative fracture displacement using the PFN mainly in 31-A2 fractures. In our study we had no case of intraoperative fracture displacement after nail insertion. In comparison to gamma nail, we found no fracture of the femoral shaft and no break in the implant.

W. M. Gadegone & Y. S. Salphale,<sup>13</sup> 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 with antibiotics, 82% had a full range of hip motion. In our study we had 85% near normal anatomical fracture reduction and fracture consolidated in 12.6 wks. One case we had shortening of more than 1 cm. near normal range of hip motion. We encountered no nonunion. No cases of implant failure were observed.

Metin Uzun et al.,<sup>14</sup> In a study of 35 patients reported Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results. Reduction was assessed 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 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). Radiological complication chiefly includes 3 cases of varus malunion. we had no implant failure or reverse z effect.

The aim of the study was to study the epidemiology of proximal third fracture femur in adults and anatomical and functional outcome with this newer method of intramedullary fixation with PFN.

The assessment criteria for the efficiency of surgical technique included duration of surgery, number of intraoperative 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.

In our study, mean Harris Hip score was 89.8 which is comparable to that of Karn et al.<sup>12</sup> The most common current modes of fixation are Blade plate systems, Sliding screw systems and

Intramedullary devices. From the mechanical point of view, a combined intramedullary device inserted by means of minimally invasive procedure seems to be better in elderly patients. Closed reduction preserves the fracture hematoma, an essential element in the consolidation process. Intramedullary fixation allows the surgeon to minimize soft tissue dissection there by reducing surgical trauma, blood loss, infection, and wound complications.

PFN is a novel, modern intramedullary implant based on experience with the gamma nail. The currently used gamma nail as an intramedullary device also has a high learning curve with technical and mechanical failure rates of about 10%. The gamma nail is susceptible to fail at its weakest point, the lag screw-implant interface. Proximal femoral nail with an anti-rotational hip pin together with a smaller distal shaft diameter which reduces stress concentration to avoid these failures. Proximal femoral nail has all advantages of an intramedullary device, such as decreasing the moment arm, can be inserted by closed technique, which retains the fracture hematoma an important consideration in fracture healing, decrease blood loss, infection, minimizes soft tissue dissection and wound complications.

In an experimental study, Gotze et al.<sup>15</sup> compared the loadability of osteosynthesis of unstable per and subtrochanteric fractures and found that the PFN could bear the highest loads of all devices.

#### **Conclusion:**

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.

**Acknowledgement :** None

**Funding :** Nil

**Conflict of Interest :** Nil

**Ethical Approval :** Approved by Institutional Ethical Committee

#### **References:**

1. JDavid G.Lavelle. Fractures and dislocations chapter-52 in Campbell's Operative Orthopaedics, eleventh edition.VOL-3 pages;3237-3308.
2. Kyle Richard F, Campbell Sara J. intertrochanteric fractures,chapter-40 in MichaelW.Chapman Operative Orthopaedics.Vol-1,pages 600-603.
3. "The association of age, race and sex with the location of proximal femoral fractures in elderly". JBJS 1993;75(5),752-9.
4. Boyd H B, GRIFFIN "Classification and treatment of trochanteric fractures" Arch surgery, 1949;58;853-866.
5. Haberne H, Wallner T, Aschauer E, Schmid L.Comparison of Ender nails, dynamic hip screws and Gamma nails in treatment of peritrochanteric femoral fractures". Orthopaedics, 2000; 23{2);121-7.
6. Pelet S: Arlcttaz Y, ChevalleyF.Osteosyntliesis of petrochanteric and subtrochanteric fractures with 90° blade plate versus Gamma nail-A randomized prospective study.SWISS-SURG 2001; 7(3);126-33.
7. Parjarinen J, Lindahi J, Michelsson O, Savolainen Vvensalo E. Per trochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail. A randomized study

- comparing post-operative rehabilitation, The journal of Joint and Bone Surgery (Br), Jan 2005 (Volume 87, Number 1).
8. AS Sidhu MS, B SBrarMS, HSMann, ArvindKumar Pb Journal of Orthopaedics Vol-XII, No.1, 2010.
  9. Herrera A, Domingo LJ, Calvo A, Martinez A, Cuenca J. A comparative study of trochanteric fractures treated with the Gamma nail or the proximal femoral nail. *Int Orthop* 2002;26(6):365-9. Epub 2002 Jun 31.
  10. Christian Boldin, Franz J Seibert, Florian Fankhauser, GeroifPeicha, Wolfgang Grechenig and Rudolf Szyszkowitz. PFN-a minimal invasive treatment of unstable proximal femoral fractures .A prospective study of 55 patients with a follow-up of 15 months *Acta OrthopScand* 2003; 74(1): 53-58.
  11. Simmermacher RKJ, Bosch A M, Van der Werken C. The AO ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. *Injury* 1999; 30: 327-32.
  12. NK Karn, Ashish Jain, P Nepal, Mahi Pal Singh, N Das *Health Renaissance*, January-April 2011; Vol 9 (No.1);7
  13. W. M. Gadegone& Y. S. Salphale. Proximal femoral nail - an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. *International Orthopaedics (SICOT)* (2007) 31:403-408.
  14. Metin Uzun, Erden Erturer, Irfan Ozturk, SenolAkman, FaikSeckin, Ismail Bulent Ozcelik. Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results. *Acta OrthopTraumatolTurc* 2009;43(6):457-463.
  15. Gotze B, Bonnaire F, Weise K, Friedl H P Belastbarkeit von Osteosynthesen bei instabilen per- und subtrochanteren Femurfrakturen: experimentelle Untersuchungen mit PFN, Gamma-Nagel, DHS Trochanter stabilisierungs plate 95°-Kondylarplatte und UFN Spiralklinge. *Aktuelle Traumatologie* 1998;2 8: 197-204.