

Study of Clinical and Functional Outcome of Unstable Trochanteric and Subtrochanteric Fractures Managed With Proximal Femoral Nail in Elderly



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Introduction

Intertrochanteric fracture of femur is defined as fractures involving upper end of femur through and in between both trochanters with or without extension into upper femoral fragment. The incidence of intertrochanteric fracture is rising because of the increase in number of elderly population superadded with osteoporosis. These fractures are three to four times more common in women and the mechanism of injury is usually due to low-energy trauma like a simple fall.

The Problems of these fractures are:

- Association with substantial morbidity and mortality,
- Malunion,
- Implant failure, cutout of head, and penetration into hip,
- Great financial burden to the family and government,
- Associated medical problem like diabetes, hypertension, and cardiovascular diseases.

More than 50% of inter trochanteric fractures are unstable [1]. Unstable intertrochanteric fractures are those in which comminution of posteromedial buttress exceeds a simple lesser trochanteric fragment or those with subtrochanteric extension. Unstable patterns occur more commonly with increased age and with low bone mineral density. The presence of osteoporosis in intertrochanteric fractures is important because fixation of the proximal fragment depends entirely on the quality of cancellous bone present. The surgical stabilization of unstable intertrochanteric fractures remains a persistent challenge. These are treated by various methods, Dynamic Hip Screw (DHS) being the gold standard for intertrochanteric fractures.

Subtrochanteric fractures, which account for 10% to 15% of proximal femoral fractures and these fractures account for 10 % to 34% of all hip fractures [2]. Fractures of the subtrochanteric

region of femur can be difficult to treat. This anatomic region experiences the highest tensile and compressive stresses in the human skeleton. The proximal fragment is often quite short, offering limited opportunity for internal fixation, which must withstand these substantial forces. In subtrochanteric fracture, the proximal fragment is flexed, abducted and externally rotated due to the iliopsoas, abductor muscles, and short external rotators muscle pull. The goal of operative treatment is restoration of normal length and angulations to restore adequate tension to the abductors.

As a result of these high forces, the bone in this region is a thick cortical bone with less vascularity and results in increased potential for healing disturbances. Hence intertrochanteric fractures with posteromedial comminution and subtrochanteric fracture is difficult to manage and associated with many complications. As with the recent advances in the surgical field, new treatment modalities are developing for treatment of intertrochanteric fractures. One such recent treatment modality is Proximal Femoral Nail (PFN) devised by AO/ASIF group has proven to be a promising implant in peritrochanteric, intertrochanteric or subtrochanteric femoral fractures. Biomechanically, compared to a lateral fixed side plate device, an intramedullary device decreases the forces of hip joint on implants by 25 to 30%. This has advantage especially in elderly patients, in whom the primary goal is early weight bearing and mobilization.

Materials and Methods

Twenty five patients suffering from unstable trochanteric and subtrochanteric fractures for 30 months from July 2012 to December 2014. All cases of unstable trochanteric and subtrochanteric fractures operated by proximal femoral nail during this time period were taken up for study, which were studied prospectively after taking due consent. All the patients were initially evaluated as to their general condition, hydration

and corrective measures were undertaken. Antero-posterior radiograph of the affected hips were taken. The patients were then put on skeletal traction or skin traction over a Bohler-Braun frame. No open fractures were encountered in this series. Patients were taken up for surgery as soon as their general condition permitted. Adequate blood transfusion, thromboprophylaxis and other supportive measures were given depending on the pre-operative condition of the patient and also post surgery based on the blood loss during surgery.

There was no defined postoperative patient protocol, but all patients were given post-operative injectable antibiotics for 3-5 days followed by oral antibiotics for next 1 week and deep venous thrombosis prophylaxis (squeezing calf muscles, in bed mobilization, static quadriceps strengthening exercises). Patients were allowed to sit up in bed on the second post-operative day. Static quadriceps exercises were started on the second and third post-operative day. Drain was removed after 2nd post op day. Sutures were removed after 10 to 14 days. Patients were mobilized non-weight bearing as soon as the pain or general condition permitted. Weight bearing was commenced depending upon the stability of the fracture and adequacy of fixation, delaying it for 6 weeks, for patients with unstable or inadequate fixation. All the patients were followed up for a period of minimum 6 months and maximum of 1 year. All the patients were followed up for a period of minimum 6 months and maximum of 1 year. The outcome was assessed based on the postoperative pain, walking ability, hip joint range of motion, and limb length shortening as follows.

This study involves patient's manipulation and is the method of choice advocated by authors in standard books and international journals. So ethical clearance was obtained prior to the study from the ethical committee of the institution and prior consent was obtained from each of the participants. Data was entered into Microsoft Excel (Windows 7; Version 2007) and analyses were done using the Statistical Package for Social Sciences (SPSS) for Windows software (version 18.0; SPSS Inc, Chicago). Descriptive statistics such as mean and standard deviation (SD) for continuous variables, frequencies and percentages were calculated for categorical Variables were determined. The association between predictor and outcome variables was analyzed using chi-square test and Fischer's test (when appropriate). The level of significance was set at 0.05. Bar charts were used for visual representation of the analysed data.

Results

Mean age of the 25 patients who underwent proximal femoral nailing was 78.1 years (Table 1). In our study majority of the patients are females i. e, out of 25 patients, 17 patients are females (68%) and 8 patients are males (32%) (Table 2). The most common mode of injury in our case series was trivial fall accounting for 20 cases (80%), followed by fall from height in 4 cases (16%) and road traffic accidents in 1 case.

Table 1: Distribution of patients according to their Age Group (N = 25).

Age in years)	No.	Percent
< 70	5	20.0
70-79	7	28.0
80-89	9	36.0
≥ 90	4	16.0
Mean ± SD	78.1 ± 10.6	
Range	55-95	

Table 2: Distribution of patients according to their Gender (N = 25).

Gender	No.	Percent
Male	8	32.0
Female	17	68.0

In our study of 25 cases we had 12 cases of unstable trochanteric and 13 of subtrochanteric fractures (Table 3). In our study degree of osteoporosis was recorded using the scale of Singh with 76% of the case being in levels III and IV (Table 4). The mean duration of hospital stay in was 12 days. Out of 25 patients in the study, 15 patients were hypertensive, 9 diabetes and 4 had ischemic heart disease. Type of implant used: Long PFN used in 6 cases (24%) and short PFN in rest 19 cases (76%). Based on the diameter 9mm nail was used in 2 patients, 10mm nail was used in 16 patients, 11 mm nail was used in 4 patients and 12mm nail in 3 patients.

Table 3: Distribution of patients according to their classification of fractures.

Classification of Fracture	No.	Percent
Sub-Trochanteric	13	52.0
Unstable Trochanteric	12	48.0

Table 4: Distribution of patients according to Singh s Index (N = 25).

Singh s Index	No.	Percent
II	1	4.0
III	7	28.0
IV	12	48.0
V	5	20.0

In our series of 25 cases, Epidural anesthesia given in 17 cases and spinal anesthesia for 5 cases and rest 3 cases were given combined spinal anesthesia with epidural analgesia. Mean duration of surgery was 75 minutes. Blood loss was measured in terms of mop count and suction collection. The average amount of blood loss was 60ml. On analysis Functional results were

excellent in 5 cases and good in 10 cases with singh's index [3] of IV and V with p value of 0.018, which was significant. On analysis of difference between the long and short PFN over the functional results, p value was 0.581 which was statistically insignificant (Table 5).

Table 5: Association of type of PFN with Functional Results.

Type of PFN	Functional Results				P Value
	Excellent	Good	Fair	Poor	
Long	1	4	1	0	0.581
Short	4	7	6	2	

Functional Result

At final follow-up by Harris Hip scoring system, Excellent to good results was seen in 64% cases with poor results in 8% which was similar to other studies (Table 6). The mean Harris Hip Score was 83.5. The mean union rate or fracture consolidation was 4.5 months (Figures 1-6).

Table 6: Distribution of patients according to their Functional Results.

Functional Results	No.	Percent
Excellent	5	20.0
Good	11	44.0
Fair	7	28.0
Poor	2	8.0



Figure 1: Pre op X rays: pelvis with both hips –ap and right hip ap view.



Figure 2: Post Op 3 Months & 6 Months.



Figure 3: Hip Flexion & Straight Leg Rising.

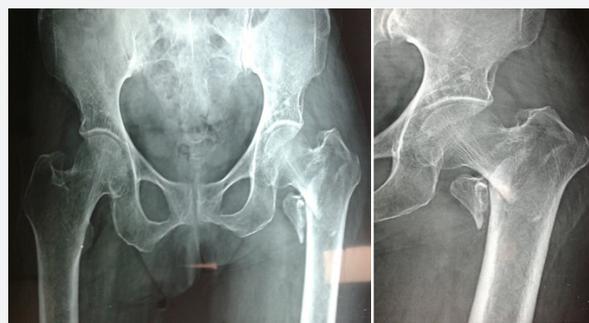


Figure 4: Pre op X rays: pelvis with both hips –ap and right hip ap view.

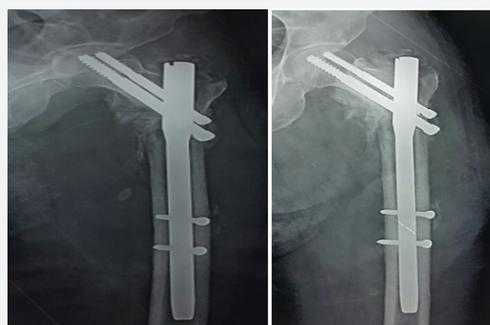


Figure 5: Post Op 3 Months & 6 Months.



Figure 6: Squatting & Straight Leg Rising.

Discussion

Unlike osteoporotic trochanteric fractures, subtrochanteric fractures are usually the result of high-energy trauma and often subjected to significant displacement and great difficulty in close reduction through traction. The high incidence of delayed union, malunion and non-union of fractures has left conservative treatment, as advocated by DeLee et al, abolished in modern trauma care. Extra medullary fixation with plating has the

potential disadvantages of extensive surgical exposure, severe soft tissue damage and blood loss, thus leading to problems of fracture union and implant failure. In addition, the eccentrically plating is prone to fatigue breakage due to their mechanical load-sharing effect.

Boyd and Griffin in 1949 were the first to describe the subtrochanteric fractures as a variant of trochanteric fractures and noted high incidence of unsatisfactory results with operative fixation [1]. In same year Mervyn Evans classified trochanteric fractures as stable and unstable. In 1949, Trochanteric buttress plates were first reported by Boyd and Griffin (they were invented by Richardson at the Campbell Clinic) for preventing medialization with the Neufeld plate in unstable fractures [1]. In 1966, Fielding and Magliato proposed a simple classification for subtrochanteric fractures based on distance of the fracture from the lesser trochanter [2].

In 1980, the concept of indirect reduction was introduced and significantly improved union rates and reduced the need for bone grafting when the medial comminution was completely bypassed by the use of indirect reduction and pre tensioning of the blade plate. In early 1997, AO/ASIF developed the proximal femoral nail (PFN) as an intramedullary device for the treatment of unstable peritrochanteric and subtrochanteric femoral fractures. The PFN has certain modifications like 6mm anti rotation screw, to increase rotational stability 6 degree valgus bend in coronal plane, a narrow distal diameter, distal flexibility which minimizes the stress concentration and tension on femoral shaft [4].

In 2003, Christian boldin et al concluded proximal femoral nail as a good minimal invasive implant for unstable proximal femoral fractures, if closed reduction is possible [5]. In 2005, Pajarinen J et al compared post-operative rehabilitation in peritrochanteric fractures treated with a dynamic hip screw or a proximal femoral nail. They noted significantly more patients who received PFN regained their pre injury walking ability and less shortening than in the other group [6]. In 2007, Lei-sheng Jiang in his study suggested that long PFN or long Gamma nail is a reliable implant for subtrochanteric fractures, leading to high rate of bone union and minimal soft tissue damage [7].

In 2008, Brian Aros B et al. [8] performed a study to determine whether patients who sustain an intertrochanteric fracture have better outcomes when stabilized using a sliding hip screw or an intramedullary nail. Adjusted secondary outcome measures showed significant increases in the intramedullary nail group relative to the sliding hip screw group for index hospital length of stay, days of rehabilitation services in the first 6 months after discharge and total expenditures for doctor and hospital services [8].

In 2013, Calderon et al. [9] did a study to show that patients with intertrochanteric fractures treated with a proximal femoral nail have a better postoperative course than those treated with

a DHS plate (dynamic hip screw). All patients were assessed at 2, 4, 8 and 16 weeks using the Harris scale and the visual analog scale pre- and postoperatively, as well as the operative time, incision size, intraoperative bleeding, onset of partial and/or total weight bearing, healing time, time to attain prior physical activity level, and radiographic result [9].

Allowing a minimally open approach, intramedullary nailing is closely linked to “biological internal fixation”, in addition to its mechanical benefits over plate fixation. Intramedullary fixation allows the surgeon to minimize soft tissue dissection thereby reducing surgical trauma, blood loss, infection, and wound complications Leung et al. (1992) Radford et al. (1993). The AO ASIF in 1996 therefore developed the Proximal Femoral Nail to reduce the risk of implant related complications. Therefore in addition to the 8 mm load bearing femoral neck screw, the PFN has a 6.5mm antirotation screw to increase the rotational stability of the neck fragment. An anatomic 60 neck valgus bend in the coronal plane, a narrower distal diameter and distal flexibility of the nail eliminates the need for routine reaming of the femoral shaft and also minimizes stress concentration and tension in the femoral shaft. This should reduce the risk of intraoperative and postoperative femoral shaft fractures.

PFN also has all the advantages of an intramedullary device such as decreasing the moment arm, can be inserted by closed technique which retains the fracture hematoma, decreases blood loss, minimizes soft tissue dissection and wound infections. Since its introduction in 1997 several clinical studies have shown good result ‘(with few intra operative problems and low rates of complications. The aim of our study was to assess the epidemiology and functional outcomes of proximal femoral fractures with this newer method of intramedullary fixation with proximal femoral nail by CRIF. We assessed the results with respect to intraoperative details, post operative results and functional outcome.

By virtue of its load-sharing characteristics, the shorter lever on the proximal fixation and its biologically friendly implantation techniques, intramedullary nail fixation of subtrochanteric fractures has resulted in high union rates. Although biomechanically and biologically superior to plate fixation, closed nailing techniques can be technically difficult as a result of the position of the proximal fragment which is flexed, abducted and externally rotated. Awkward starting trajectories have often resulted in eccentric nail channels in the proximal fragment. Starting points were often too lateral, resulting in varus alignment of the proximal fragment.

Lei-Sheng Jiang et al. in his study has no complications such as cutout or breakage of the implants, or periprosthetic fractures [7]. He recommended that the lag screw of PFN should be placed in the lower part of the femoral neck close to the femoral calcar, with screw tip reaching the subchondral bone 5 to 10 mm below the articular cartilage in anteroposterior view. In lateral view, it

should be placed in the centre of the femoral neck. There, the lag screw will be definitely placed in the area of best bone quality. Werner et al was the first who introduced the term Z-effect, detected in 5 (7.1%) of 70 cases. The incidence of cut-out of the neck screw in this study was 8.6%. The Z-effect phenomenon is referred as a characteristic sliding of the proximal screws to opposite directions during the postoperative weight-bearing period [10].

The reverse Z-effect described by Boldin et al occurred with movement of the hip pin towards the lateral side, which required early removal. The mechanism is similar, but here the hip pin is sliding back, whereas the neck screw remains impacted to the hole of the nail. In their prospective study of 55 patients with unstable intertrochanteric or subtrochanteric fractures, they

had 3 cases with Z effect and 2 with reverse Z-effect. The authors in an effort to prevent the Z-effect phenomenon suggest the use of a “ring” in the lateral side of the hip pin [4].

The most recent study evaluating the use of PFN is from Fogagnolo et al. who reported 46 patients with an average rate of intraoperative technical or mechanical complications of 23.4%. They also reported 2 implant failures and 1 fracture below the tip of the nail [11]. Simmermacher et al. [4], in a clinical multicenter study, reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. A cut-out of the neck screw occurred in 0.6% of cases [12-14]. In our study we did not encounter any such complication as poor reduction, mal rotation or cut out of screws (Table 7).

Table 7: Comparison with other studies.

	C Boldin ⁴ et al.	Dominigo ⁹ et al.	Fogagnolo ¹¹ et al.	Simmermacher ¹² et al.	Present Study with PFN
No. of patients	55	105	155	49	25
Duration of surgery	68 min	77 min	76 min	46 min	75 min
Bony union (months)	100% (4 months)	100% (9 months)	99% (6 months)	98% (6 months)	85% (6 months)
Failure of fixation	0%	11%	2%	0%	0%
Delayed union	-	-	0.7%	2%	-
Open reduction	10%	-	1.3%	34.6%	0%
Re-operation rate	10%	9%	12%	-	0%
Duration of hospital stay		12 days	17 days		12 days

In our 25 cases, excellent results were seen in 20%, good in 44% cases, fair in 28% cases and poor in 8% cases by PFN.

Conflict of Interests

Nil

Ethical Statement

- a. “All patients gave the informed consent prior being included into the study.
- b. “All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments”.
- c. “The study was approved by the Research Ethics Committee (or Institutional Review Board)”.

References

1. Boyd HB, Griffin (1949) Classification and treatment of trochanteric fractures. Arch surgery 58(6): 853-866.
2. Fielding JW, Magliato HJ (1966) Subtrochanteric fractures. Surg Gynec Obstetric 122(3): 555-560.
3. Singh M, Nagarath AR, Maini PS (1970) Changes in the trabecular pattern of the upper end of the femur as an index of osteoporosis. J Bone Joint Surg Am 52(3): 457-467.

4. Simmermacher RKJ, Bosch AM, Van der Werken C (1999) The AO/ASIF- Proximal femoral nail: a new device for the treatment of unstable proximal femoral fractures. Injury 30(5): 327-332.
5. Boldin C, Seibert FJ, Fankhauser F, Peicha G, Grechenig W, et al. (2003) The proximal femoral nail (PFN)-a minimal invasive treatment of unstable proximal femoral fractures: a prospective study of 55 patients with a follow-up of 15 months. Acta Orthop Scand 74(1): 53-58.
6. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hir-vensalo E (2005) Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail. A ran-domised study comparing post-operative rehabilitation. J Bone Joint Surg Br 87(1): 76-81.
7. Lei-Sheng Jiang, Lei Shen, Li-Yang Dai (2007) Intra medullary Fixation of subtrochanteric fractures with Long proximal femoral nail or Long Gamma Nail; Technical Notes and Preliminary Results. Ann Acad Med Singapore 36(10): 821-826.
8. Brian Aros B, Tosteson AN, Gottlieb DJ, Koval KJ (2008) Is a sliding hip screw or im nail the preferred implant for intertrochanteric fracture fixation. Clin orthrop Relat Res 466(11): 2827-2832.
9. Calderon A, Ramos T, Vilchez F, Mendoza-Lemus O, Pena V, et al. (2013) Proximal femoral intramedullary nail versus DHS plate for the treatment of intertrochanteric fractures. A prospective analysis. Acta Ortop Mex 27(4): 236-239.

10. Ekstrom W, Karlsson Thur C, Larsson S, Ragnarsson B, Alberts KA (2007) Functional outcome in treatment of unstable trochanteric and subtrochanteric fractures with the proximal femoral nail and the Medoff sliding plate. *J Orthop Trauma* 21(1): 18-25.
11. Fogagnolo F, Kfuri M, Paccola CA (2004) Intramedullary fixation of per trochanteric hip fractures with short AO ASIF PFN. *J Arch Orthop Trauma Surg* 124(1): 31-37.
12. Simmermacher RKJ, Bosch AM, Van der Werken C (1999) The AO/ASIF- Proximal femoral nail: a new device for the treatment of unstable proximal femoral fractures. *Injury* 30(5): 327-332.
13. De Lee JC, Clanton TO, Rockwood CA Jr (1981) Closed treatment of subtrochanteric fractures of the femur in a modified cast-brace. *J Bone Joint Surg Am* 63(5): 773-779.
14. Domingo LJ, Cecilia D, Herrera A, Resines C (2001) Trochanteric fractures treated with a proximal femoral nail. *International Orthopaedics* 25(5): 298-301.



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