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Outcome and complications of intertrochanteric femur fractures treated by proximal femoral nail

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Abstract
Purpose: This study was done to report the functional outcome and the complications of intertrochanteric fractures fixed with Proximal Femoral Nail (PFN) in Indian population.
Methods: 124 patients with intertrochanteric fractures fixed with PFN and with a minimum follow-up of 4 months were assessed. Functional outcome was calculated using Modified Harris Hip Score (HHS) and Parkers Mobility Score (PMS). Radiological outcome was assessed using hip radiographs and complications encountered during the follow-up period were noted.
Results: 117 patients had a good functional outcome with mean HHS of 71.2 and PMS 7.09. During first year, outcome and recovery was better for AO 31A1 and 31A2 fractures ($p < 0.05$). After one year, no difference was seen in outcome between fracture types. Patients less than 60 years had better outcome than those above 60 years ($p < 0.05$). Three patients expired during follow-up period. Nine patients had implant related complications with four of them requiring conversion to arthroplasty.
Conclusion: We conclude that PFN is a suitable implant for the treatment of intertrochanteric femur fractures in Indian population, with good outcome and less complications. Functional outcome was independent of fracture type and inversely related to the age of the patient.

Keywords: proximal femoral nail, intertrochanteric femur fractures, functional outcome, hip fractures

Introduction
The ideal implant for the treatment of intertrochanteric femur fractures is a topic of debate since several decades. Initially these fractures were fixed with extramedullary devices. Since the introduction of intramedullary devices, various generations of nails were used to fix these fractures. The Proximal femoral nail (PFN) was introduced in early 1997 to reduce the risk of implant-related complications seen in Gamma nails and Dynamic hip screw (DHS). Screw cutout usually occurred following varus collapse and concomitant rotation of the femoral head around the neck axis. In PFN, the rotational stability of the head-neck fragment was increased by the addition of a 6.5mm antirotation screw. The PFN has an anatomic 6° valgus bend in the coronal plane, a narrower distal diameter, and a flexible distal portion. All these features eliminated the need for routine reaming of the femoral shaft and also minimized stress concentration and tension in the femoral shaft, thereby reducing the incidence of peri-implant fractures. There are very few studies on the outcome of PFN in the treatment of intertrochanteric fractures in Indian population. In this study we aim to report the functional outcome and complications of operated cases of intertrochanteric fractures with PFN in Indian population.

Materials and Methods
This was a single centre multisurgeon study. Consent was obtained from all patients participating in the study. Data of all cases of intertrochanteric femur fractures that were surgically treated between May 2017 and June 2018 was analyzed. All patients with intertrochanteric femur fractures (AO type 31A1, 31A2, 31A3) that were fixed with PFN and with minimum post-operative follow-up of 4 months were included in the study. Intertrochanteric fractures treated with Dynamic hip screw or arthroplasty, patients with

neurological disorders, polytrauma patients and pathological fractures were excluded from the study.

Patient demographics, operative details, pre and post-operative radiographs of the patients were obtained from hospital records. The patients were divided into 3 groups based on fracture types (AO 31A1, AO 31A2, AO 31A3). The patients were assessed clinically during their follow-up visit to the hospital. Antero-posterior and lateral radiograph of the operated hip was done. The following parameters were assessed in the follow-up X-ray, 1) Fracture union, 2) Neck shaft angle, and 3) Screw cutout or backout. The functional outcome was assessed by the Modified Harris hip score (0-91) and Parkers Mobility score (0-9) [1, 2].

Study variables were analyzed and described with means and standard deviations. Comparisons were conducted on all study variables to determine the significance of the outcome. Student t-test and ANOVA for continuous variables with normal distributions, and Mann–Whitney test and Kruskal-Wallis for variables with skewed distributions were used. A P-value of less than 0.05 was considered to be statistically significant.

Results

After applying exclusion criteria, the total number patients included in the study were 124. These include 76 males and 48 females (1.6:1). The mean age of the patients was 61 years (±15). The youngest patient was 24 years old and the oldest was 92 years old. 47% (58) of the patients were between the age group of 60-80 years. In terms of fracture pattern, 42 patients had AO 31A1 fracture while the 31A2 and 31A3 groups had 64 and 18 patients respectively. All patients were operated under regional anaesthesia (spinal ± epidural) with fluoroscopic guidance in supine position in a fracture table. Proximal femur nails used included 180 and 250mm nails (130°, 135°) with 2 cephalomedullary screws (8mm, 6.5mm) and one or two distal locking bolts for 31A1 and 31A2 fractures. Long PFN (360-420mm) was used for 31A3 fractures.

During the follow-up period three patients expired. So, the final study group comprised only 121 patients. The mean follow-up period was 8 months (±3) with the maximum follow-up of 16 months and minimum of 4 months. For statistical purposes the follow-up period was divided into three groups namely 4-6 months, 7-11 months and more than 12 months (Table 1).

The mean duration of surgery was 148 min (±45 min). Duration of surgery included the time taken for initial closed reduction of fracture under fluoroscopy followed by incision to closure time. There was a significant difference in duration of surgery between the 3 fracture groups ($p < 0.00001$) with 31A3 fractures taking the longest time for fixation (mean: 209 min) while the type 1 fractures taking the least time (mean: 132 min).

Table 1: Patient demographics, follow-up and Duration of surgery

	AO 31A1	AO 31A2	AO 31A3
Male	30	37	9
Female	12	27	9
Total	42	64	18
Follow-up			
4-6 months	21	31	0
7-11 months	15	21	11
>12 months	5	11	6
Mean Duration of surgery (min)	132 (±33)	141 (±39)	209 (±39)

The functional outcome was assessed by the modified Harris hip score (HHS) and Parkers score (PMS). The mean HHS for entire study group was 71.2. There was a steady increase in the score with increasing follow-up period, with mean score of 72.4 and 80.5 at 6 months and 12 months respectively. Comparison of functional outcome between the three fracture types showed that within the first year of surgery AO type 1 fracture had better outcome than other two types ($P < 0.05$). As the follow-up increases, the outcome was similar in all three fracture types. Beyond one year there was no significant difference in the functional outcome between fracture types ($P > 0.05$). A similar result was seen with Parkers mobility score. The average score for entire study group was 7.09. Mean scores at 6 months and 12 months were 7.4 and 8.25 respectively. In terms of Parkers score, there was significant difference in functional outcome between fracture types in the first six months, while beyond six months there was no significant difference (Table 2) (Figure 1).

Table 2: Comparison of Functional outcome between fracture groups at various follow-up periods

Follow-up	Harris Hip Score (Mean)			P value	Parker mobility score (Mean)			P value
	AO 31A1	AO 31A2	AO 31A3		AO 31A1	AO 31A2	AO 31A3	
4-6 months	73.29	65.76	0	0.00596	7.71	6.21	0	0.0052
7-11 months	74.6	72.95	60.64	0.02291	7.2	7.42	5.82	0.1248
> 12 months	78.6	80.64	73.67	0.9353	8.2	8.64	6.67	0.1015

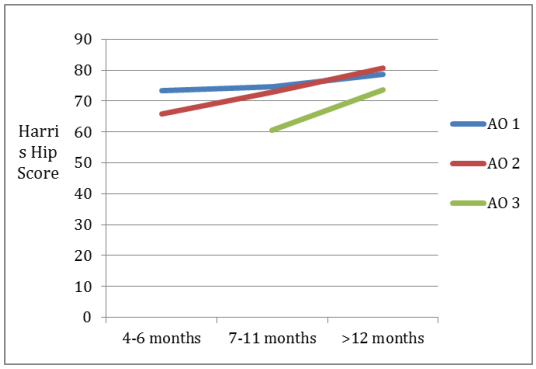

Fig 1: Graph showing mean Harris Hip Score of the three fracture groups in various follow-up intervals

The study group was divided into two groups with patients less than 60 years and other with patients more than 60 years. At any given point of time, the functional outcome of a patient less than 60 years was better than a patient of age more than 60 years, irrespective of the fracture pattern. Comparison of functional outcome (HHS, PMS) showed a significant difference in outcome between the two groups at 3-6 months, 7-11 months and beyond 12 months as well (Table 3) (Figure 2).

Table 3: Comparison of functional outcome between the two age groups at various follow-up periods

Follow-up	Harris Hip score (Mean)		P value	Parker Mobility score (Mean)		P value
	Age ≤ 60 years	Age > 60 years		Age ≤ 60 years	Age > 60 years	
4-6 months	74.35	64.3	0.00016	7.8	5.93	0.00034
7-11 months	78.43	62.18	<0.00001	8.26	5.6	<0.00001
> 12 months	86	75.38	0.02034	9	7.43	0.04182

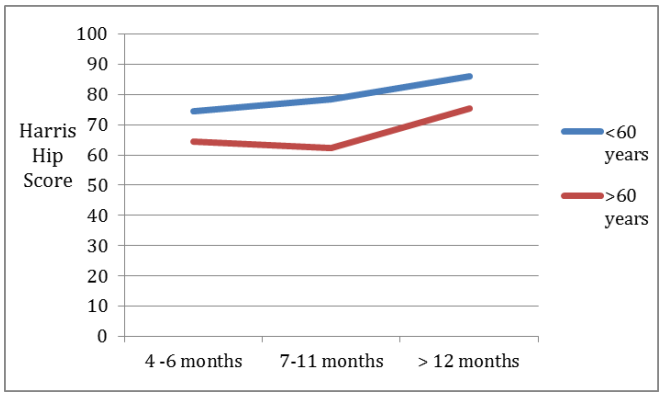

Fig 2: Graph showing mean harris hip score of the two age groups at various follow-up periods

Nine patients (7.2%) required reoperation due to implant related complications (Figure 3). Among them, 4 (3.2%) patients required revision due to screw cutout, 3 (2.4%) patients had screw migration (reverse Z effect) and 2 (1.6%) patients had post-operative wound infection. Three (2.4%) patients expired during the follow-up period. One patient died 7 days post-surgery while the remaining two died 5 months post-surgery due to medical comorbidities. Among those with reverse Z effect, 2 patients had penetration of the screw into acetabulum. Both the patients did not have any residual pain or discomfort following screw removal. The two patients with infection were managed with wound wash and intravenous antibiotics. Four patients required conversion to arthroplasty due to screw cutout and collapse. All the 4 patients had unstable intertrochanteric fracture. Complete union of fracture was seen in remaining 117 patients.

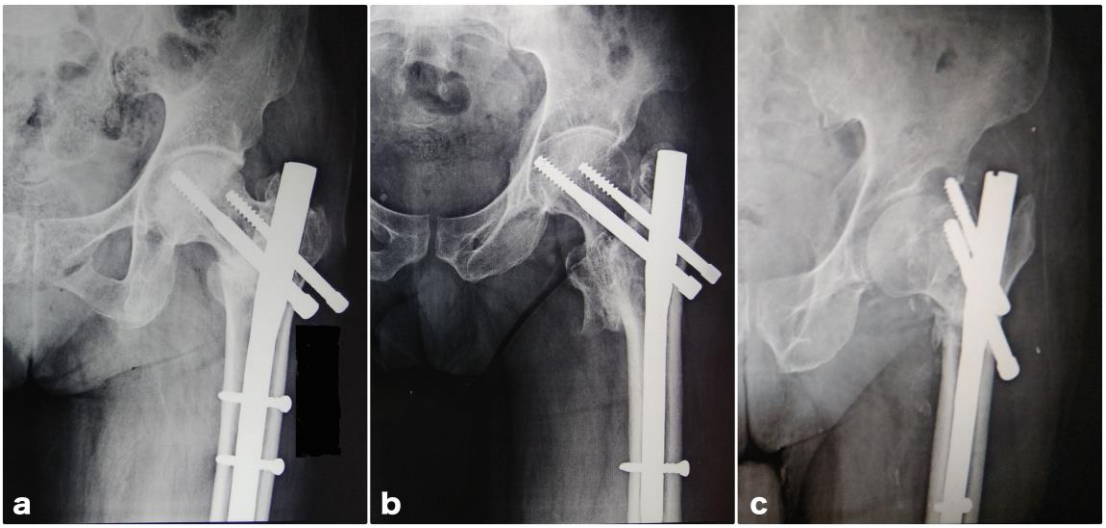

Fig 3: Radiographs showing complications seen in our study. a) 65 yr female, 6 months post-surgery showing reverse Z effect. b) 52 yr male, 6 months post-surgery showing reverse Z effect. c) 80 yr male, 4 months post-surgery showing screw cutout and collapse.

Discussion

The Proximal femoral nail was introduced by AO/ASIF because of its biomechanical advantages over the Gamma nails. These include (1) decreased incidence of implant cut-out and rotation of cervicocephallic fragment due to addition of de-rotation screw, (2) smaller valgus angle of 6°and (3) decreased incidence of stress fractures due to fluted tip. Since its introduction various studies have been done studying its outcome in treatment of intertrochanteric fractures. While its superiority in the treatment of stable AO 31A1 fractures is still under debate, there is sufficient evidence to show that PFN is a better implant in the treatment of unstable intertrochanteric fractures [3, 4].

In this study we have compared outcome of PFN in the treatment of AO type 31A1, 31A2 and 31A3 fractures. The maximum number of patients had 31A2 fracture comprising 51% of the total while 31A3 was the least comprising 15%. This was similar to the general prevalence of intertrochanteric fractures. Domingo *et al* in 2001 had a prevalence of 59% for 31A2 fractures while Korkmaz *et al* in 2014 had prevalence of 49% for 31A2 fractures [5, 6]. Majority of our patients (47%) were between 60-80 years with the mean age being 61 years. As per literature, the average age of incidence of intertrochanteric fractures is 66-76 years [7]. Age related osteoporosis and the increasing incidence of falls with age explains the exponential increase in the incidence of intertrochanteric fracture with aging. The male, female ratio of our study population was 1.6:1. This is different from other studies in literature where the ratio was 1:3 or 4 [8]. The higher prevalence of these fractures in ageing females is attributed to post-menopausal osteoporosis.

The minimum follow-up period in our study was four months, while the average follow-up was eight months. Heikkinen *et al* in 2005 studied 167 patients of hip fractures and showed that four-month follow-up period would be acceptable in hip fracture surveys because the socioeconomically most important variable, i.e. place of living, and activities of daily living functions do not change significantly after that period [9].

The average duration of surgery for our study population was 148 (±45) minutes. This is higher than similar studies in

literature. Seo JS *et al* in 2016 compared the surgical results of cephalomedullary nails in intertrochanteric fractures and reported a mean operative time of 77.9 minutes [10]. Altintas *et al* in 2014 reported a mean operative time of 61.3 minutes [11]. In all these studies the operative time was calculated from skin incision to closure. Our study the operative time included the initial time for positioning and closed reduction apart from skin incision to closure. This could explain the increased operative time of our study. In our study, the duration of surgery was dependent on the fracture type (p value< 0.00001), with AO type 3 fractures taking longest duration (209 minutes) and type 1 fractures taking shortest duration (132 minutes). Altintas *et al* had similar results and showed that AO type 1 fractures had the shortest operative time with least complications [11].

During the first year after surgery, the functional outcome of the patient was dependent on the fracture type with 31A1 and 31A2 fractures having better outcomes than type 3 fractures. This difference was seen only in the first year after surgery. Beyond one year there was no difference in outcome, with all three fracture types having similar outcomes. Korkmaz *et al* in 2014 studied 100 cases of intertrochanteric fractures with minimum follow-up of 12 months and showed that functional outcome is independent of the fracture type [6]. Paul O *et al* in 2012 studied 58 cases of stable and unstable intertrochanteric fractures and found no difference in the functional outcome between two groups at the end of one year [12].

In our study, the most important factor affecting the functional outcome was the age of the patient. Younger patients had better outcomes and early recovery to pre-injury status compared to older patients. The functional outcome was significantly lesser for patients more than 60 years compared to their counterparts who were less than 60 years, irrespective of the fracture type and follow-up period. Several studies in literature have similar result. Rethnam *et al* in 2007 studied the outcome of 42 patients above 60 years of age and found that most of them had poorer outcomes with higher complication rate [13]. Korkmaz *et al* in their study reported that HHS negatively correlated with ASA score and patient's age [6]. Pillai *et al* studied outcome of 1177 cases of hip fractures with four months follow-up and found that patients above 65 years of age had poorer outcomes and higher mortality rate [14].

Our results on implant related complications are in accordance with the existing literature on PFN related complications (Table 4). Previous studies have reported complication rates ranging from 4.5 - 9.3%, re-operation rates of 3 - 12%, and screw cutout rates of 1.2 – 5.4% [5, 10, 11, 15]. We had no cases of peri-implant fracture. Screw positioning and fracture reduction are the two factors that influence failure due to screw cutout. Screw placement in the superomedial quadrant carries the highest risk for cutout. The load-bearing femoral neck screw of the PFN should be positioned in the lower half of the femoral neck so that the antirotation screw can be placed in the femoral neck without perforating the cortex. Some authors have recommended that the tip of the femoral neck screw should lie 5 to 10 mm short of the subchondral bone. The antirotation screw should ideally be 15 to 20 mm shorter than femoral neck screw. Longer antirotation screws increases the cutout risk because in this situation, the thinner screw assumes a load-bearing function.

Table 4: Complications of PFN reported in various studies

	Domingo *et al*. [5]	**Rethnam *et al*.** [13]	**Korkmaz *et al*.** [6]	**Menezes *et al*.** [15]	**Seo *et al*.** [10]	**Simmermacher *et al*.** [16]	**Our study**
Mean age (years)	80	78	78	79	76	77	61
Mean follow-up (months)	6	6	31	12	11.5	4	8
Screw migration and reverse Z effect	-	7.1%	-	-	-	3.2%	2.4%
Failure due to screw cutout	1.3%	-	-	2%	5.4%	0.6%	3.2%
Reoperation rate	3.3%	16.6%	1%	12%	4.7%	7%	7.2%
Infection	1.3%	7.1%	1%	-	0.8%	1.9%	1.6%
Peri-implant fracture	0.3%	2.3%	-	0.7%	-	0	0
Mortality	16%	19%	8%	14.8%	-	19%	2.4%

Conclusion

In the light of the results obtained from the present study, we conclude that PFN is a suitable implant for the treatment of intertrochanteric femur fractures in Indian population, with good outcome and lesser complications. The outcome of the surgery had inverse relationship with the age of the patient. Patients with stable fractures had early recovery than unstable fractures, while long-term outcome was same for both the fractures.

References

1. Vishwanathan K, Akbari K, Patel AJ. Is the modified Harris hip score valid and responsive instrument for outcome assessment in the Indian population with pertrochanteric fractures? J Orthop. 2018; 15(1):40-46. doi:10.1016/j.jor.2017.12.001
2. Parker MJ, Palmer CR: A new mobility score for predicting mortality after hip fracture. J Bone Joint Surg Br. 1993; 75(5):797-8.
3. Zhang K, Zhang S, Yang J, Dong W, Wang S, Cheng Y *et al*. Proximal femoral nail vs. dynamic hip screw in treatment of intertrochanteric fractures: a meta-analysis. Med Sci Monit. 2014; 20:1628-33. doi:10.12659/MSM.890962
4. Zhang WQ, Sun J, Liu CY, Zhao HY, Sun YF. Comparing the Intramedullary Nail and Extramedullary Fixation in Treatment of Unstable Intertrochanteric Fractures. Sci Rep. 2018; 8(1):2321. doi: 10.1038/s41598-018-20717-2
5. Domingo L, Cecilia D, Herrera A, Resines C. Trochanteric fractures treated with a proximal femoral nail. International orthopaedics, 25(5):298-301. DOI 10.1007/s002640100275
6. Korkmaz MF, Erdem MN, Disli Z, Selcuk EB, Karakaplan M, Gogus A. Outcomes of trochanteric femoral fractures treated with proximal femoral nail: an analysis of 100 consecutive cases. Clin Interv Aging. 2014; 9:569-74. doi:10.2147/CIA.S59835. eCollection 2014.

7. Ahuja K, Sen S, Dhanwal D. Risk factors and epidemiological profile of hip fractures in Indian population: A case-control study. Osteoporosis and Sarcopenia, 2017; 3(3):138-148. Doi: 10.1016/j.afos.2017.08.097
8. Dhanwal DK, Dennison EM, Harvey NC, Cooper C. Epidemiology of hip fracture: Worldwide geographic variation. Indian J Orthop. 2011; 45(1):15-22. doi:10.4103/0019-5413.73656
9. Heikkinen T, Jalovaara P. Four or twelve months' follow-up in the evaluation of functional outcome after hip fracture surgery? Scand J Surg. 2005; 94(1):59-66. DOI: 10.1177/145749690509400115
10. Seo JS, Min HJ, Kim DM, Oh SM, Kim SM. Surgical Results of the Cephalomedullary Nail for the Femoral Intertrochanteric Fracture: Comparison between Non-experienced Surgeons and Experienced Surgeon. Hip & pelvis, 28(4):225-231. doi:10.5371/hp.2016.28.4.225
11. Altintas B, Biber R, Bail HJ. The learning curve of proximal femoral nailing. Acta Orthop Traumatol Turc. 2014; 48(4):396-400. doi:10.3944/AOTT.2014.13.0056.
12. Paul O, Barker JU, Lane JM, Helfet DL, Lorich DG. Functional and radiographic outcomes of intertrochanteric hip fractures treated with calcar reduction, compression, and trochanteric entry nailing. J Orthop Trauma. 2012; 26(3):148-54. doi: 10.1097/BOT.0b013e31821e3f8c.
13. Rethnam U, Cordell-Smith J, Kumar TM, Sinha A. Complex proximal femoral fractures in the elderly managed by reconstruction nailing - complications & outcomes: a retrospective analysis. J Trauma Manag Outcomes. 2007; 1(1):7. doi: 10.1186/1752-2897-1-7.
14. Pillai A, Eranki V, Shenoy R, Hadidi M. Age related incidence and early outcomes of hip fractures: a prospective cohort study of 1177 patients. J Orthop Surg Res. 2011; 6:5. doi: 10.1186/1749-799X-6-5.
15. Menezes DF, Gamulin A, Noesberger B. Is the proximal femoral nail a suitable implant for treatment of all trochanteric fractures? Clin Orthop Relat Res. 2005; 439:221-7. DOI: 10.1097/01.blo.0000176448.00020.fa
16. Simmermacher RK, Bosch AM, 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(5):327-32.