

Assessment of Intertrochanteric Fractures of Femur Managed Using Proximal Femoral Nail: A Retrospective Study

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Abstract:

Aim: This study aims to evaluate the clinical and radiological outcomes of intertrochanteric femur fractures managed using proximal femoral nail (PFN) fixation in elderly patients.

Methodology: This retrospective observational study included 84 patients aged 50 years and above with radiologically confirmed intertrochanteric femur fractures treated surgically using PFN. Patient demographics, fracture classification, intraoperative details, postoperative complications, fracture union, and functional outcomes (assessed by Harris Hip Score) were analyzed. Follow-up included clinical and radiological assessment until fracture union and functional recovery.

Results: The mean age was 68.2 ± 8.7 years with 60.7% male patients. Low-energy falls caused 71.4% of fractures. The average surgery duration was 56.3 ± 8.9 minutes and mean intraoperative blood loss was 128.6 ± 20.4 mL. Radiological union was achieved in 95.2% of patients within 14.2 ± 3.1 weeks. Implant-related complications occurred in 6.0% of cases. Functional outcomes were favorable, with a mean Harris Hip Score of 84.6 ± 9.2 ; 73.8% had excellent or good results. Postoperative complications and mortality rates were low.

Conclusion: PFN fixation is a safe and effective treatment for intertrochanteric femur fractures in elderly patients, offering satisfactory fracture healing, good functional recovery, and minimal complications. It is recommended as a preferred surgical option in this population.

Keywords: Complications, Femur, Fracture Union, Proximal Femoral Nail, Surgical Outcomes.

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Introduction

Intertrochanteric fractures of the femur are defined as fractures involving the upper end of the femur, extending through and between the greater and lesser trochanters, with or without propagation into the proximal femoral shaft. These fractures predominantly affect the elderly population, with a well-documented increase in incidence correlating with advancing age. Globally, the incidence of intertrochanteric fractures varies by region. Gulberg et al. have projected that the total number of hip fractures will rise to 2.6 million by 2025 and 4.5 million by 2050, with a significant proportion of this increase occurring in Asia—rising from 26% of global cases in 1990 to a projected 45% by 2050 [1,2]. Despite some evidence of regional declines in incidence, such as a 20% reduction reported in Denmark between 1997 and 2006, hip fractures remain a significant public health concern. The lifetime risk of sustaining a hip fracture at the age of 50 has been estimated at 5.6% in men and 20.0% in women [3].

Furthermore, several medical conditions associated with reduced bone mineral density—such as diabetes mellitus, hyperthyroidism, hyperparathyroidism, and Cushing's syndrome—are known to markedly elevate the risk of hip fractures.

Intertrochanteric fractures constitute the most frequently operated type of hip fracture and are associated with the highest postoperative mortality among surgically treated fractures [4]. This clinical burden is compounded by the substantial healthcare resources required for their management, especially in aging populations. Historically, nonoperative treatment was widely practiced due to limited surgical techniques and fixation options. Nowadays, conservative treatment is usually limited to nonambulatory patients with terminal illness, severe comorbidities that make anesthesia unsafe, or ongoing infection. Nonoperative care has high complication rates such as pressure sores, urinary tract infections, joint

contractures, pneumonia, thromboembolism, and disablement through deformity and shortening [5].

The history of surgical treatment has progressed from fixed nail plates and dynamic hip screws to current intramedullary fixation devices. Among these, the proximal femoral nail (PFN) has come to prominence due to its biomechanical benefits. These are intramedullary load sharing, a lower lever arm, better resistance to collapse in varus, and greater stability in osteoporotic bone. In addition, the PFN serves as a lateral buttress against displacement of the proximal fragment and provides a more biological form of fixation [6]. Although these theoretical and practical benefits exist, the best choice of fixation device, especially for unstable fracture patterns in osteoporotic elderly individuals, is currently the subject of much debate. Thus, this present retrospective analysis is conducted to assess the clinical and radiological results of intertrochanteric femur fractures treated with the proximal femoral nail (PFN). The main objective of the present study is to determine the efficacy, complications, and functional outcomes related to PFN in the treatment of intertrochanteric fractures in order to be a source of evidence-based recommendations on implant use in such scenarios.

Methodology

Study Design: This retrospective observational study was conducted at the Department of Orthopaedics, Government Medical College, and Hospital, Purnea, Bihar, India for one year. The aim of this study is to evaluate the clinical and radiological outcomes of intertrochanteric femur fractures managed with the proximal femoral nail (PFN).

Study Population and Sample Size: The study included 84 patients who were older than 50, diagnosed with intertrochanteric fractures and surgically treated with PFN. Patients were selected using a first-come, first-included approach. All participants provided informed written consent after being fully informed about the nature, objectives, and follow-up requirements of the study.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Age ≥ 50 years
- Radiologically confirmed intertrochanteric fracture of the femur
- Medically fit for surgery
- Treated with PFN fixation
- Provided informed consent and agreed to regular follow-up

Exclusion Criteria:

- Patients unfit for surgery
- Pathological or compound fractures
- Reoperations for failed previous fixation

- Patients who refused surgical treatment or follow-up

Preoperative Evaluation: All patients underwent thorough clinical assessment, including history, comorbidity review, and mechanism of injury. Radiographic evaluation included anteroposterior (AP) pelvis with both hips and lateral view of the affected hip. Fractures were classified according to the Orthopaedic Trauma Association (OTA) classification. Preoperative skin traction was applied to all patients.

Surgical Technique: All surgeries were performed under spinal anesthesia on a standard fracture table to ensure adequate reduction and imaging access. A standard PFN of 250 mm length was used in all cases.

- **Nail diameter** was determined by measuring the femoral canal at the isthmus on AP radiographs.
- **Neck-shaft angle** was calculated from the contralateral hip using a goniometer.

All procedures adhered to standard operative protocols for PFN fixation. Reduction quality, implant positioning, and intraoperative complications were noted.

Perioperative and Postoperative Management:

Prophylactic antibiotics (a combination of third-generation cephalosporin and aminoglycoside) were administered 30 minutes preoperatively and continued for 48 hours postoperatively. Thromboprophylaxis was achieved through early mobilization, manual calf compression, and use of compression stockings.

- Ankle and calf exercises were initiated on postoperative day one
- Non-weight-bearing ambulation was encouraged from postoperative day two, depending on patient condition
- Drains were removed within 24 hours, and wound inspections were conducted on days 3 and 6
- Sutures were removed on day 11

Follow-up and Outcome Measures: Patients were followed at monthly intervals until radiological union and subsequently at 6-month intervals for one year, then annually. At each visit, both clinical and radiological assessments were performed.

Clinical Outcomes:

- Wound condition
- Limb shortening
- Functional recovery measured by Harris Hip Score

Radiological Outcomes:

- Time to fracture union
- Degree of collapse at fracture site

- Implant-related complications, including screw cut-out, Z-effect, and malunion

Results

The results section summarizes the clinical and radiological outcomes observed in patients with intertrochanteric femur fractures treated using the proximal femoral nail (PFN). Data were systematically recorded and analyzed across key parameters including patient demographics, fracture patterns, intraoperative details, and postoperative outcomes. Tables are provided to present the data in a structured and concise manner, followed by a detailed interpretation of each.

A total of 84 patients diagnosed with intertrochanteric femur fractures were included in the study. The

mean age of the cohort was 68.2 ± 8.7 years, ranging from 52 to 89 years, indicating a predominantly elderly population. The majority of patients were male, comprising 60.7% ($n = 51$) of the sample, while females accounted for 39.3% ($n = 33$). Regarding the mechanism of injury, low-energy falls were the predominant cause, accounting for 71.4% ($n = 60$) of cases, consistent with fragility fractures commonly observed in the geriatric population. Road traffic accidents accounted for the remaining 28.6% ($n = 24$). Fracture classification according to the Orthopaedic Trauma Association (OTA) system revealed that 45.2% ($n = 38$) of fractures were type 31-A2, followed by 40.5% ($n = 34$) type 31-A1 fractures, and 14.3% ($n = 12$) type 31-A3 fractures, indicating a predominance of stable to moderately unstable fracture patterns (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 84)	
Variable	Value
Mean age (years)	68.2 ± 8.7 (Range: 52–89)
Gender	Male: 51 (60.7%)
	Female: 33 (39.3%)
Mechanism of injury	Low-energy fall: 60 (71.4%)
	Road traffic accident: 24 (28.6%)
OTA fracture classification	Type 31-A1: 34 (40.5%)
	Type 31-A2: 38 (45.2%)
	Type 31-A3: 12 (14.3%)

Table 2 displays the mean operative duration for proximal femoral nailing was 56.3 ± 8.9 minutes, indicating a relatively efficient surgical procedure. The average intraoperative blood loss was 128.6 ± 20.4 mL, reflecting the minimally invasive nature of the technique. Intraoperative complications were recorded in 6 patients (7.1%), comprising guidewire

breakage in 2 cases (2.4%), technical difficulties with nail insertion in 3 cases (3.6%), and cortical breach in 1 case (1.2%). Overall, the intraoperative profile suggests that PFN fixation is associated with a low complication rate and manageable operative parameters.

Table 2: Intraoperative Parameters	
Parameter	Mean $\pm$ SD / Frequency (%)
Duration of surgery (minutes)	56.3 ± 8.9
Intraoperative blood loss (mL)	128.6 ± 20.4
Intraoperative complications	6 (7.1%)
Guidewire breakage	2 (2.4%)
Difficulty with nail insertion	3 (3.6%)
Cortical breach	1 (1.2%)

As presented in Table 3, the mean time to radiological union in patients treated with proximal femoral nailing was 14.2 ± 3.1 weeks, indicating satisfactory healing within a typical timeframe. Fracture union was achieved in the majority of cases (95.2%, $n = 80$), while delayed union occurred in 3 patients (3.6%) and non-union was observed in only 1 patient

(1.2%). Implant-related complications were noted in 5 patients (6.0%). Among these, screw cut-out occurred in 2 cases (2.4%), Z-effect in 1 case (1.2%), and varus malunion in 2 cases (2.4%). These findings suggest that proximal femoral nailing provides reliable radiological outcomes with a low incidence of implant-related complications.

Table 3: Radiological Outcomes	
Outcome	Value / Frequency (%)
Time to radiological union (weeks)	14.2 ± 3.1
Fracture union	80 (95.2%)
Delayed union	3 (3.6%)
Non-union	1 (1.2%)
Implant-related complications	5 (6.0%)
Screw cut-out	2 (2.4%)
Z-effect	1 (1.2%)
Varus malunion	2 (2.4%)

Table 4 demonstrates the functional outcomes assessed using the Harris Hip Score (HHS) at final follow-up demonstrated favorable results in the majority of patients. The mean HHS was 84.6 ± 9.2 , reflecting generally good functional recovery. An excellent outcome (HHS 90–100) was achieved in 26 patients (31.0%), while 36 patients (42.8%) had

good outcomes (HHS 80–89). Fair outcomes (HHS 70–79) were noted in 16 patients (19.0%), and poor functional results (HHS <70) were observed in only 6 patients (7.1%). These findings indicate that proximal femoral nailing yields satisfactory functional results in most patients with intertrochanteric femur fractures.

Table 4: Functional Outcomes Based on Harris Hip Score at Final Follow-up	
Outcome Category	No. of Patients (%)
Excellent (90–100)	26 (31.0%)
Good (80–89)	36 (42.8%)
Fair (70–79)	16 (19.0%)
Poor (<70)	6 (7.1%)
Mean Harris Hip Score	84.6 ± 9.2

Table 5 displays postoperative complications and long-term follow-up outcomes revealed a low incidence of adverse events following proximal femoral nailing. Limb shortening greater than 1 cm was observed in 4 patients (4.8%), and superficial wound infections occurred in 3 patients (3.6%), all of which were managed conservatively. Residual hip pain or stiffness was reported by 9 patients (10.7%), but did not significantly impair daily function. Importantly,

there were no cases of deep infection, implant intolerance, or the need for revision surgery during the follow-up period. The 1-year postoperative mortality rate was 2.4% ($n = 2$), attributed to unrelated medical causes. These findings suggest that PFN offers a favorable safety profile and satisfactory long-term tolerance in elderly patients with intertrochanteric fractures.

Table 5: Postoperative Complications and Long-Term Follow-up Outcomes	
Complication / Outcome	Frequency (%)
Limb shortening >1 cm	4 (4.8%)
Superficial wound infection	3 (3.6%)
Residual hip pain or stiffness	9 (10.7%)
Deep infection	0 (0%)
Implant intolerance	0 (0%)
Revision surgery required	0 (0%)
1-year postoperative mortality	2 (2.4%)

Discussion

The present research assesses the clinical and radiological success of intertrochanteric femur fractures treated with the proximal femoral nail (PFN) in a series of 84 patients. Our results show good outcomes in terms of the efficiency of surgery, fracture healing, functional recovery, and long-term safety. These findings correlate with the available literature favoring PFN as a reliable treatment option for intertrochanteric fractures.

The average age of our population was 68.2 years, with the majority of male patients (60.7%) and low-energy fall as the initial mechanism of injury (71.4%). These are consistent with previous studies, for example, Lecky et al., 2021 which found comparable ages and mechanisms of injury in their groups [7]. Most fractures in our investigation were OTA type 31-A2 (45.2%), suggesting stable to moderately unstable fracture patterns, which are typically managed with PFN.

In our study, a mean operating time of 56.3 minutes and mean intraoperative blood loss of 128.6 mL. These values are similar to those reported by Upadhyay et al., 2018 who noted shorter operation times and less blood loss in patients treated with PFN than in those receiving hemiarthroplasty [8]. Intraoperative complications within our group were low at 7.1%, and consisted of guidewire fracture, nail insertion difficulty, and cortical breach. These rates are in agreement with those in the literature, which highlights the technical adequacy of PFN fixation. Radiologically, our study confirmed a high union rate of 95.2% and a mean time to union of 14.2 weeks [9].

The complications related to the implant were rare, with screw cut-out, Z-effect, and varus malunion being seen in 2.4%, 1.2%, and 2.4% of cases, respectively. The results are comparable to those of Ziegler et al., 2017 with a non-union rate of 1.2% and complications related to the implant in an equal group [10]. Functional outcomes, evaluated on the Harris Hip Score, were found to have 73.8% of patients with excellent or good results with a mean score of 84.6. These outcomes are comparable to those of other literature who also observed the same functional outcomes in patients who received PFN [11]. The complications following operation in our study were rare, including limb shortening more than 1 cm in 4.8% of the patients and superficial wound infection in 3.6%. Significantly, no deep infection, intolerance to the implant, or revision surgery was seen. The mortality following 1 year postoperatively was 2.4%, which is in accordance with the result by Ersin et al., 2023 who noticed a mortality rate of 5.33% in their series [12].

In comparison to other treatment methods, including dynamic hip screw (DHS) and hemiarthroplasty, PFN has various benefits. According to a network meta-analysis by Cheng et al., 2020, PFNA (a form of PFN) was found to be the most desirable surgical procedure for intertrochanteric fractures with fewer losses of blood and greater Harris Hip Scores [13]. Likewise, Singh et al., 2017 found lower complication rates and shorter operating times in patients treated with PFN compared to DHS or hemiarthroplasty [14].

Conclusion

This retrospective study reinforces that proximal femoral nailing (PFN) is a safe and effective way of treating intertrochanteric femur fracture among an elderly population. The outcomes showed good operative parameters, with a mean duration of surgery of 56.3 minutes and little intraoperative blood loss. The radiological results were very good, with a union rate of 95.2% and low rates of implant-related complications. Functional recovery, as quantified by the Harris Hip Score, was adequate in most patients. Its low postoperative mortality and complication

rates further reinforce PFN's role as an initial fixation method, enhancing the best fracture healing and functional rehabilitation outcomes in the high-risk group.

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