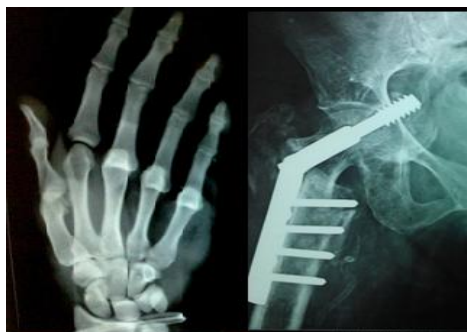




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Proximal femoral nailing as the preferred treatment for intertrochanteric fractures in the elderly

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Abstract

Background: Intertrochanteric fractures are among the most common fragility fractures in elderly patients, often associated with significant morbidity and functional impairment. Proximal femoral nailing (PFN) has emerged as a preferred fixation technique due to its biomechanical stability and potential for early mobilization.

Aim of the study: To evaluate the effectiveness of proximal femoral nailing in elderly patients with intertrochanteric fractures, focusing on perioperative details, fracture healing, functional recovery, and complication profile.

Methods: A prospective observational study was conducted at BSMMU, Dhaka, between September 2022 and September 2024, involving 18 elderly patients with intertrochanteric fractures managed with PFN. Demographic data, comorbidities, fracture type, perioperative parameters, functional outcomes (Harris Hip Score, Visual Analog Scale), and complications were recorded and analyzed.

Result: The mean age was 67.17 ± 10.99 years, with a slight female predominance (55.6%). Osteoporosis was present in 55.6% of patients. The average operative time was 63.9 ± 8.8 minutes with mean intraoperative blood loss of 95 ± 56.7 ml. Radiological union was achieved at 14.5 ± 1.6 weeks, and full weight-bearing at 12.3 ± 2.1 weeks. Functional outcomes improved significantly, with mean Harris Hip Score increasing from 47.6 at one month to 88.8 at 12 months, and mean VAS decreasing from 7.5 preoperatively to 0.7 at 12 months. Independent ambulation was achieved in 61.1% of patients at six months. Complications were minimal, with superficial infection, screw cut-out, and thigh pain observed in one case each (5.6%).

Conclusion: Proximal femoral nailing is an effective and reliable treatment for intertrochanteric fractures in elderly patients, offering early mobilization, satisfactory fracture union, and favorable functional outcomes with low complication rates.

Keywords: Intertrochanteric fracture, elderly, proximal femoral nailing, Harris hip score

Introduction

Intertrochanteric fractures are defined as extracapsular fractures of the proximal femur that occur between the greater and lesser trochanters. They are among the most common fragility fractures in the elderly, strongly associated with low-energy trauma in the background of osteoporosis and frailty [1]. The global burden of these fractures is rising rapidly due to increasing life expectancy and aging populations. It is estimated that worldwide, more than 2.9 million hip fractures occur annually, and intertrochanteric fractures constitute a major proportion of them [2]. In Bangladesh, the incidence of hip fractures, including intertrochanteric fractures, has been rising alongside demographic shifts, particularly in the elderly. A local study reported that intertrochanteric fractures accounted for 85% of all femur fractures, with a prevalence of 180 per 210 among the senior population [3]. These fractures carry substantial clinical and socioeconomic consequences. Elderly patients often have multiple comorbidities, poor bone quality, and limited physiological reserve, which increase the risk of postoperative complications, delayed rehabilitation, and mortality [4]. Functional impairment after such injuries is profound, frequently leading to loss of independence, prolonged hospitalization, and increased need for social or family support.

The economic impact is also considerable, placing strain not only on families but also on the healthcare system in resource-constrained countries such as Bangladesh [5].

Treatment of intertrochanteric fractures aims at stable fixation, early mobilization, and restoration of pre-injury functional status. Over the years, surgical management has evolved considerably. Extramedullary devices such as dynamic hip screws were traditionally employed, but their use has been associated with mechanical complications, higher failure rates in unstable fractures, and delayed return to function [6]. In contrast, intramedullary devices, particularly proximal femoral nails (PFN), have gained popularity as the preferred fixation method [7]. PFN provides several biomechanical advantages, including shorter lever arm, load-sharing design, reduced risk of implant failure, and suitability for both stable and unstable fracture patterns. It also allows minimally invasive insertion, reduced operative blood loss, and earlier postoperative mobilization [8]. Numerous clinical studies have highlighted that PFN fixation results in improved fracture stability, lower complication rates, reduced surgical time, and better functional outcomes compared with conventional methods. In elderly patients with osteoporotic bones, PFN has been shown to provide superior resistance against varus collapse and screw cut-out, two major causes of fixation failure [9]. Furthermore, the ability to achieve early weight bearing is particularly valuable in geriatric patients, as it reduces the risks of complications related to prolonged immobilization, such as pneumonia, thromboembolism, and pressure sores [10]. Despite the proven efficacy of PFN, challenges remain, especially in resource-limited settings. Delayed hospital presentation, shortage of implants, and lack of trained surgical expertise can affect outcomes in Bangladesh and similar countries [11]. Therefore, local data on perioperative outcomes, functional recovery, and complication profiles are essential to strengthen evidence-based practice and guide treatment strategies tailored to the regional context. The present study was undertaken to evaluate proximal femoral nailing as the preferred treatment for intertrochanteric fractures in elderly patients, focusing on perioperative details, fracture healing, functional recovery, and complication outcomes.

Methodology and Materials

This was a prospective observational study conducted in the Department of Orthopaedic Surgery at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, between September 2022 and September 2024. The study included elderly patients with intertrochanteric femoral fractures who were treated with proximal femoral nailing (PFN). A total of 18 patients fulfilling the inclusion criteria were enrolled. The diagnosis of intertrochanteric fracture was made based on clinical evaluation and radiographic confirmation (anteroposterior pelvis with hip and lateral views).

Inclusion Criteria

- Patients aged 30-90 years with intertrochanteric femoral fractures.
- Both genders.
- Closed fractures, both stable and unstable patterns, classified according to Boyd and Griffin classification.
- Patients who were medically fit for anesthesia and surgery.

Exclusion Criteria

- Pathological or open fractures.

- Associated ipsilateral femoral neck or shaft fractures.
- Polytrauma cases.
- Patients with previous surgery on the affected hip.
- Patients who were unable to provide consent or comply with follow-up.

Ethical Implications

Approval was obtained from the Institutional Review Board (IRB) of BSMMU, Dhaka, before initiation of the study. Written informed consent was taken from all participants. Patient confidentiality was strictly maintained, and all data were used solely for research purposes.

Surgical Procedure

All patients underwent proximal femoral nailing using a cephalo-medullary intramedullary device with a neck screw and anti-rotation hip pin. The surgery was performed under spinal or general anesthesia depending on anesthetist preference. Closed reduction was attempted in all patients, and open reduction was carried out when closed methods failed. Both short and long PFNs were used according to fracture configuration and surgeon preference.

Data Collection

Data were collected using a structured case record form. Preoperatively, detailed demographic and clinical information including age, gender, and comorbidities (diabetes, hypertension, COPD) were recorded. Bone quality was assessed using bone mineral density (DEXA scan), categorized as normal, osteopenia, or osteoporosis. Mechanism of injury, side of involvement, and fracture classification were documented.

Postoperatively, patients were mobilized with non-weight bearing or partial weight bearing as tolerated, under supervision of physiotherapists. Progression to full weight bearing was encouraged once there was radiographic evidence of callus formation. Duration of hospital stay, time to radiological union (defined as cortical bridging in at least three cortices on orthogonal radiographs), and time to full weight bearing were recorded.

Pain was assessed using the Visual Analog Scale (VAS) and functional outcomes were evaluated with the Harris Hip Score (HHS) at 1, 3, 6, and 12 months follow-up. Mobility status at 6 months was categorized as independent ambulation, walker-assisted, or bedridden. Postoperative complications such as wound infection, screw cut-out, and thigh pain were recorded.

Statistical Analysis

Data were analyzed using SPSS version 26 (IBM, Armonk, USA). Quantitative variables were expressed as mean $\pm$ standard deviation, while qualitative variables were presented as frequency and percentage.

Results

The study included 18 patients treated with PFN fixation. The demographic and comorbidity distribution are shown in Table 1. The largest group was aged 61-70 years (8, 44.4%), followed by 71-85 years (6, 33.3%). Two (11.1%) were aged 51-60 years, while 1 (5.6%) each was in the 31-40 and 41-50 years groups. The mean age was 67.17 ± 10.99 years. Females were 10 (55.6%) and males 8 (44.4%). Hypertension was present in 8 (44.4%), diabetes in 6 (33.3%), COPD in 2 (11.1%), and 5 (27.8%) had no comorbidity. Bone mineral density showed osteoporosis in 10 (55.6%), osteopenia in 6 (33.3%), and normal density in 2 (11.1%). Injury occurred

mainly due to fall from standing height in 14 (77.8%), with 3 (16.7%) from fall from height and 1 (5.6%) from road traffic accident. The right and left sides were equally involved (9, 50% each). According to Boyd and Griffin classification, type II was most common (8, 44.4%), followed by type I (7, 38.9%), type III (2, 11.1%), and type IV (1, 5.6%) (Table 2). Perioperative details are shown in Table 3. The mean timing of surgery was 6.11 ± 1.68 days, operative duration 63.89 ± 8.79 minutes, and blood loss 95.00 ± 56.67 ml. Closed reduction was performed in 16 (88.9%), open reduction in 2 (11.1%). Short PFN was used in 15 (83.3%) and long PFN in 3 (16.7%). Postoperative recovery showed hospital stay of 5.94 ± 2.16 days, radiological union at 14.50 ± 1.58 weeks, and full weight bearing at 12.3 ± 2.1 weeks (Table 4). Functional and pain outcomes are given in Table 5. The mean preoperative VAS score was 7.5 ± 0.86 . At one month, the VAS score was 4.33 ± 0.77 with a Harris Hip Score of 47.56 ± 5.62 . At three months, the VAS score reduced to 2.22 ± 0.81 and Harris Hip Score improved to 59.56 ± 5.92 . At six months, the VAS score was 1.67 ± 0.84 with Harris Hip Score 80.22 ± 4.81 . At twelve months, the mean VAS was 0.72 ± 0.75 and Harris Hip Score 88.78 ± 6.29 . Independent ambulation was achieved in 11 (61.1%), walker-assisted mobility in 6 (33.3%), and 1 (5.6%) remained bedridden (Figure 1). Postoperative complications included superficial wound infection, screw cut-out, and thigh pain in 1 (5.6%) each, while 15 (83.3%) had no complications (Table 6).

Table 1: Demographic and comorbidity profile of patients treated with PFN (n=18)

Variables	Frequency (n)	Percentage (%)
Age (years)		
31-40	1	5.6
41-50	1	5.6
51-60	2	11.1
61-70	8	44.4
71-85	6	33.3
Mean ± SD	67.17±10.99	
Gender		
Female	10	55.6
Male	8	44.4
Comorbidities		
Diabetes mellitus	6	33.3
Hypertension	8	44.4
COPD	2	11.1
No major comorbidity	5	27.8

Table 2: Baseline characteristics of the study population (n=18)

Variable	Frequency (n)	Percentage (%)
Bone Mineral Density (DEXA)		
Normal	2	11.1
Osteopenia	6	33.3
Osteoporosis	10	55.6
Mechanism of Injury		
Fall from standing height	14	77.8
Fall from height	3	16.7
Road traffic accident	1	5.6
Side involved		
Right	9	50
Left	9	50
Boyd and Griffin classification		
Type I	7	38.9
Type II	8	44.4
Type III	2	11.1
Type IV	1	5.6

Table 3: Perioperative details of PFN fixation (n=18)

Variable	Frequency (n)	Percentage (%)
Timing of surgery (days), Mean ± SD	6.11±1.68	
Operative duration (minutes), Mean ± SD	63.89±8.79	
Intraoperative blood loss (ml), Mean ± SD	95.00±56.67	
Method of reduction		
Closed reduction	16	88.9
Open reduction	2	11.1
Implant length used		
Short PFN	15	83.3
Long PFN	3	16.7

Table 4: Postoperative recovery and fracture healing among patients

Variable	Mean $\pm$ SD
Hospital stay (days)	5.94 ± 2.16
Time to radiological union (weeks)	14.50 ± 1.58
Time to full weight bearing (weeks)	12.3 ± 2.1

Table 5: Functional and pain outcomes of participants

Time	VAS Score (Mean $\pm$ SD)	Harris Hip Score (Mean $\pm$ SD)
Pre-operative	7.5 ± 0.86	—
Post-operative at 1 month	4.33 ± 0.77	47.56 ± 5.62
Post-operative at 3 month	2.22 ± 0.81	59.56 ± 5.92
Post-operative at 6 month	1.67 ± 0.84	80.22 ± 4.81
Post-operative at 12 month	0.72 ± 0.75	88.78 ± 6.29

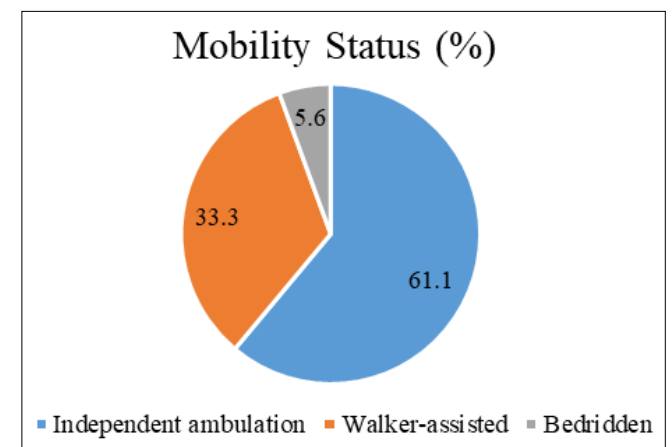


Fig 1: Mobility status at 6 months among study subjects (n=18)

Table 6: Postoperative complications of patients treated with PFN (n=18)

Complication	Frequency (n)	Percentage (%)
Superficial wound infection	1	5.6
Screw cut-out	1	5.6
Thigh pain	1	5.6
No complication	15	83.3

Discussion

Intertrochanteric fractures are among the most common hip fractures in the elderly, often associated with significant morbidity, mortality, and loss of independence. With the aging population, the incidence of these fractures is steadily increasing, highlighting the need for effective treatment strategies. Proximal femoral nailing (PFN) has emerged as a preferred surgical option due to its biomechanical stability, minimal invasiveness, and favorable functional outcomes compared to conventional methods. This study aimed to evaluate the effectiveness of PFN in managing intertrochanteric fractures in elderly patients. In this study,

patients were predominantly elderly (mean age 67.2 ± 11.0 years) with a slight female preponderance (55.6%). This age profile is consistent with findings from other studies, where advancing age is commonly observed among participants [12-14]. Previous studies have consistently reported a higher prevalence of female cases, largely linked to osteoporosis and greater life expectancy, which contribute to increased fracture risk. [15, 16]. In our study, hypertension was observed in 44.4% of patients, diabetes mellitus in 33.3%, and chronic obstructive pulmonary disease in 11.1%. This pattern aligns with contemporary hip-fracture studies [17, 18]. We found that the majority of patients demonstrated reduced bone mass: 55.6% had osteoporosis and a further 33.3% had osteopenia on DEXA. This high prevalence of low bone mineral density is consistent with the established association between reduced BMD and intertrochanteric fracture: patients with lower proximal femoral BMD are more likely to sustain intertrochanteric rather than femoral-neck fractures, reflecting the role of osteoporosis in trochanteric fragility [19]. Our sample had an equal distribution between right and left sides (50% each). Several studies have reported a higher incidence of intertrochanteric fractures on the left side, although the exact reasons for this trend remain uncertain [12, 20]. Fracture morphology according to Boyd and Griffin showed a predominance of Type I and II injuries in our study (38.9% and 44.4%, respectively), with fewer unstable Type III and IV fractures. Boyd and Griffin's classification remains clinically useful for indicating fracture stability and guiding fixation strategy: Types I-II are typically more amenable to standard fixation techniques, whereas Types III-IV denote increased comminution and instability and often necessitate implants that provide greater mechanical control (e.g., cephalomedullary nails). Similarly, Malik *et al.* documented fracture patterns comprising 30% Type I, 46.67% Type II, 13.33% Type III, and 10% Type IV [21]. The mean injury-to-surgery interval was 6.11 ± 1.68 days, mainly due to delayed presentation and the need to optimize comorbid conditions. Although early stabilization within 48 hours improves survival [22], delays are common in elderly patients with comorbidities. According to our study, mean operative duration was 63.9 ± 8.8 minutes, and mean intraoperative blood loss was 95 ± 56.7 ml. Studies reported mean PFN operative times in the range of ~50-80 minutes and blood loss often well under 200-300 ml, especially when short nails are used [23, 24]. Closed reduction was successful in 88.9% of cases, which is comparable to contemporary practice where closed reduction is feasible for the majority of intertrochanteric patterns [25]. A short PFN was used in 83.3% of patients, consistent with literature supporting short nails for most intertrochanteric fractures due to ease of insertion, less soft-tissue disruption, shorter surgical time, and less blood loss (with long nails retained for specific indications such as subtrochanteric extension or ipsilateral femoral shaft pathology) [23, 26]. In this study, the mean postoperative hospital stay was 5.94 ± 2.16 days, comparable to Jonnes *et al.* [27], who reported shorter stays with PFN (6.5 days) than DHS (11.8 days). Radiological union occurred earlier with PFN (16.78 ± 2.76 weeks), consistent with Yu *et al.* [28]. As an intramedullary device, PFN offers better load-sharing and stability, promoting faster healing [29]. In our observation, patients reached full weight bearing at 12.3 ± 2.1 weeks. Pain improved markedly from a preoperative VAS of 7.5 to 0.72 at 12 months, with HHS rising from 47.6 at 1 month to 88.8 at 12 months. By six months, 61.1% of patients walked independently, most others with a walker, and only one was

bedridden. These findings are comparable to Sonkaria *et al.*, who reported a mean HHS of 88.8 at six months with mostly excellent outcomes [30]. Systematic reviews confirm PFN allows earlier weight-bearing and shorter hospital stay than DHS, with equal or better functional scores at one year [31]. Complication rates in our study were low: superficial wound infection (5.6%), screw cut-out (5.6%), and thigh pain (5.6%), with 83.3% encountering no complications. In a 40-patient cohort treated with PFN, complications occurred in approximately 8%—largely infections and trochanteric fractures [32]. A study also highlighted medial thigh discomfort, particularly among females with Type 2 fractures [33].

Limitations of the study

- Lack of a control group (e.g., Dynamic Hip Screw) prevented direct comparative analysis with other treatment modalities.
- Delays in surgery due to patient comorbidities and logistical issues may have influenced outcomes.

Conclusion

Proximal femoral nailing demonstrated excellent functional recovery, reduced pain, and early mobilization in elderly patients with intertrochanteric fractures, with minimal complications. Despite the limitations of small sample size and short follow-up, PFN can be considered the preferred fixation method in this patient population, particularly in osteoporotic fractures. Larger multicenter studies with longer follow-up are recommended to validate these findings and to compare PFN directly with alternative fixation methods.

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