

Research Article

Comparison Between Proximal Femoral Nailing and Proximal Femoral Locking Plate in Closed Subtrochanteric Fracture

Avishek Bhadra^{1,*} , Gulam Mustofa¹ , Zahid Hasan Hemal² , Sabbir Ahmed¹ ,
Ashikur Rahman¹ 

¹Department of Orthopedics, President Abdul Hamid Medical College and Hospital, Kishoreganj, Bangladesh

²Department of Orthopedics, Mymensingh Medical College and Hospital, Mymensingh, Bangladesh

Abstract

Background: Subtrochanteric femoral fractures are unstable injuries characterized by high mechanical stress, cortical bone predominance and an increased risk of fixation failure. Optimal implant selection remains controversial, particularly for unstable fracture patterns. This study aimed to compare the outcomes of proximal femoral nailing and locking plate fixation in the management of closed subtrochanteric femoral fractures. **Methods:** This comparative study was conducted at the Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Bangladesh, from January to December 2025. Fifty adult patients with closed subtrochanteric femoral fractures were divided into two groups: proximal femoral nailing (PFN, n=25) and proximal femoral locking plate fixation (PFLP, n=25). Intraoperative parameters, postoperative recovery, radiological union, functional outcomes using the Harris Hip Score and complications were evaluated. Statistical analysis was performed using SPSS version 25.0, with significance set at $p < 0.05$. **Results:** The mean operative time was significantly shorter in the proximal femoral nailing group (85.4 ± 12.5 min) than in the locking plate group (110.6 ± 15.3 min). Intraoperative blood loss was lower with nailing (180 ± 40 mL vs. 270 ± 60 mL). Time to partial weight bearing (4.8 ± 1.2 vs. 6.2 ± 1.6 weeks) and radiological union (17.6 ± 3.1 vs. 20.8 ± 3.7 weeks) were significantly earlier with nailing. Mean Harris Hip Score was higher following nailing (83.5 ± 6.4 vs 77.2 ± 7.8). **Conclusion:** Proximal femoral nailing provides superior operative efficiency, faster recovery and improved functional outcomes compared with proximal femoral locking plate fixation.

Keywords

Subtrochanteric Fracture, Proximal Femoral Nail, Locking Plate, Harris Hip Score, Functional Outcome

1. Introduction

Subtrochanteric femoral fractures constitute a complex group of proximal femoral injuries characterized by high bio-mechanical stress and a strong tendency toward instability [1].

These fractures typically occur within 5 cm distal to the lesser trochanter and are associated with substantial deforming forces from surrounding musculature, leading to difficulties in

*Correspondence: Avishek Bhadra (abbhadra1012@gmail.com)

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achieving and maintaining reduction [2]. They commonly result from high-energy trauma in younger individuals and low-energy falls in elderly patients with osteoporotic bone, contributing to significant morbidity and prolonged functional impairment [3].

The management of subtrochanteric fractures is primarily surgical, with the objectives of restoring anatomical alignment, achieving stable fixation and facilitating early mobilization [4]. However, the unique anatomical and biomechanical characteristics of this region, including dense cortical bone and limited vascular supply, predispose these fractures to delayed union, non-union and implant-related complications [5]. Consequently, the choice of fixation device remains a subject of ongoing debate.

Intramedullary devices, particularly proximal femoral nails, have gained widespread acceptance due to their load-sharing properties, reduced bending moments and minimally invasive insertion technique [6]. Several studies have reported shorter operative time, reduced blood loss and earlier weight bearing with proximal femoral nailing, especially in unstable fracture patterns [7, 8]. These advantages are attributed to the biomechanical superiority of intramedullary fixation, which aligns closer to the mechanical axis of the femur [9].

In contrast, proximal femoral locking plates represent an extramedullary fixation option that provides angular stability and allows controlled fracture reduction under direct visualization [10]. Locking plate constructs have been advocated in fractures with complex morphology, narrow medullary canals, or when intramedullary fixation is technically challenging [11]. Despite these theoretical advantages, multiple studies have reported higher rates of implant failure, delayed union and reoperation with locking plates, particularly in osteoporotic bone and unstable fracture configurations [12].

Previous comparative studies evaluating proximal femoral nailing and proximal femoral locking plate fixation have demonstrated inconsistent results. While some authors have shown superior functional outcomes and faster fracture union with intramedullary nails, others have reported comparable clinical and radiological outcomes between the two methods [13, 14]. Variations in patient demographics, fracture patterns, surgical technique and follow-up duration contribute to these discrepancies.

Furthermore, data from low- and middle-income countries remain limited, particularly from secondary-level teaching hospitals where resource availability, implant cost and surgical expertise may influence outcomes. There is a need for region-specific evidence to guide implant selection and optimize patient care.

Therefore, the present study aimed to compare proximal femoral nailing and proximal femoral locking plate fixation in the treatment of closed subtrochanteric femoral fractures, focusing on intraoperative parameters, postoperative recovery, functional outcomes and complication profiles.

2. Materials & Methods

2.1. Methodology

This comparative observational study was conducted in the Department of Orthopaedics, President Abdul Hamid Medical College Hospital, Kishoreganj, Dhaka, Bangladesh, from January to December 2025. A total of 50 adult patients with closed subtrochanteric femoral fractures were included. Patients were equally allocated into two groups: proximal femoral nailing (PFN, n=25) and proximal femoral locking plate fixation (PFLP, n=25).

2.2. Selection Criteria

2.2.1. Inclusion Criteria

- 1) Adult patients aged 18 years or older
- 2) Closed subtrochanteric femoral fractures
- 3) Fractures classified as AO types A, B, or C
- 4) Patients fit for surgical intervention

2.2.2. Exclusion Criteria

- 1) Open or pathological fractures
- 2) Polytrauma patients requiring staged procedures
- 3) Previous ipsilateral hip or femoral surgery
- 4) Associated neurovascular injury
- 5) Patients medically unfit for anesthesia

2.3. Data Collection Procedure

All eligible patients were evaluated at admission using a standardized proforma. Baseline demographic data, injury mechanism, fracture side and fracture classification were recorded. Radiological assessment included anteroposterior and lateral radiographs of the affected femur. Surgical fixation was performed by experienced orthopedic surgeons using either PFN or PFLP based on preoperative planning and implant availability. Intraoperative parameters such as operative time, blood loss, fluoroscopy exposure and need for open reduction were documented. Postoperatively, patients followed a standardized rehabilitation protocol. Clinical and radiological follow-up was conducted at regular intervals to assess fracture healing, time to weight bearing, complications and functional outcomes. Functional assessment was performed using the Harris Hip Score at six months. Informed consent was secured from all participants and patient confidentiality was strictly maintained throughout the study.

2.4. Statistical Analysis

Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation and compared using independent sample t-tests. Categorical variables were analyzed using chi-square or Fisher's exact test. A p-value

less than 0.05 was considered statistically significant.

3. Results

Table 1 shows baseline characteristics of 50 patients. Mean age was similar in the PFN and PFLP groups (54.6 ± 10.2 vs

55.8 ± 9.6 years). Males constituted the majority in both groups (64% vs 60%). Right-sided fractures were more common (54%). Road traffic accidents were the main cause of injury (58%). AO Type C fractures were most frequent (40%), followed by Type B (38%) and Type A (22%), with comparable distribution between groups.

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n = 50).

Characteristics		PFN Group (n=25)	PFLP Group (n=25)	Total (n=50)
Age (years)		54.6 ± 10.2	55.8 ± 9.6	55.2 ± 9.9
Gender	Male	16 (64%)	15 (60%)	31 (62%)
	Female	9 (36%)	10 (40%)	19 (38%)
Side of Fracture	Right	13 (52%)	14 (56%)	27 (54%)
	Left	12 (48%)	11 (44%)	23 (46%)
Mode of Injury	Road Traffic Accident	15 (60%)	14 (56%)	29 (58%)
	Fall from Height	8 (32%)	9 (36%)	17 (34%)
	Others (e.g., slip)	2 (8%)	2 (8%)	4 (8%)
Fracture Pattern (AO Classification)	Type A	6 (24%)	5 (20%)	11 (22%)
	Type B	10 (40%)	9 (36%)	19 (38%)
	Type C	9 (36%)	11 (44%)	20 (40%)

Table 2. Intraoperative Characteristics of PFN and PFLP Fixation.

Parameter	PFN Group (Mean $\pm$ SD)	PFLP Group (Mean $\pm$ SD)	p-value
Duration of Surgery (minutes)	85.4 ± 12.5	110.6 ± 15.3	<0.001
Intraoperative Blood Loss (mL)	180 ± 40	270 ± 60	<0.001
Fluoroscopy Exposure (seconds)	58 ± 10	42 ± 8	<0.001
Need for Open Reduction	5 (20%)	13 (52%)	0.019
Mean Hospital Stay (days)	7.2 ± 2.1	9.4 ± 2.8	0.002

Table 2 presents intraoperative parameters. Mean operative time was shorter in the PFN group (85.4 ± 12.5 vs 110.6 ± 15.3 minutes). Blood loss was lower with PFN (180 ± 40 vs 270 ± 60 mL). Fluoroscopy time was higher in the PFN group ($58 \pm$

10 vs 42 ± 8 seconds). Open reduction was required in 20% of PFN cases and 52% of PFLP cases. Hospital stay was shorter following PFN (7.2 ± 2.1 vs 9.4 ± 2.8 days).

Table 3. Postoperative and Functional Outcomes Following PFN and PFLP Fixation.

Outcome Parameter	PFN Group (n=25)	PFLP Group (n=25)	p-value
Time to Partial Weight Bearing (weeks)	4.8 ± 1.2	6.2 ± 1.6	0.001

Outcome Parameter	PFN Group (n=25)	PFLP Group (n=25)	p-value
Time to Radiological Union (weeks)	17.6 $\pm$ 3.1	20.8 $\pm$ 3.7	0.001
Varus Collapse (>5°)	2 (8%)	5 (20%)	0.226
Limb Length Discrepancy (>1 cm)	1 (4%)	3 (12%)	0.3
Mean Harris Hip Score at 6 Months	83.5 $\pm$ 6.4	77.2 $\pm$ 7.8	0.003
Excellent/Good Results (HHS $\geq$ 80)	19 (76%)	13 (52%)	0.08

Table 3 describes postoperative outcomes. Time to partial weight bearing was earlier in the PFN group (4.8 $\pm$ 1.2 vs 6.2 $\pm$ 1.6 weeks). Radiological union occurred sooner with PFN (17.6 $\pm$ 3.1 vs 20.8 $\pm$ 3.7 weeks). Mean Harris Hip Score at six

months was higher in the PFN group (83.5 $\pm$ 6.4 vs 77.2 $\pm$ 7.8). Excellent or good outcomes were achieved in 76% of PFN patients and 52% of PFLP patients.

Table 4. Comparison of Postoperative Complications Between PFN and PFLP Groups.

Complication	PFN Group (n=25)	PFLP Group (n=25)	Total (%)
Superficial Infection	1 (4%)	3 (12%)	4 (8%)
Deep Infection	0 (0%)	1 (4%)	1 (2%)
Implant Failure	1 (4%)	3 (12%)	4 (8%)
Delayed Union	2 (8%)	4 (16%)	6 (12%)
Non-union	0 (0%)	2 (8%)	2 (4%)
Reoperation	1 (4%)	2 (8%)	3 (6%)

Table 4 summarizes complications. Superficial infection occurred in 4% of PFN and 12% of PFLP patients. Implant failure was seen in 4% and 12%, respectively. Delayed union

occurred in 8% of PFN and 16% of PFLP patients. Non-union and reoperation were more frequent in the PFLP group. Overall, complications were fewer in the PFN group.



Figure 1. Pre-operative anteroposterior and lateral radiographs of a closed subtrochanteric fracture of the right femur.

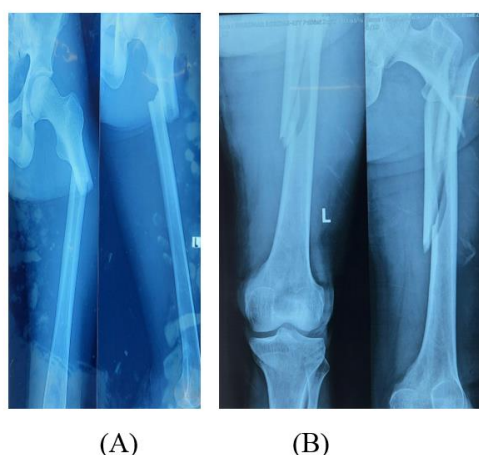


Figure 2. Pre-operative radiographs of a comminuted subtrochanteric fracture of the left femur.

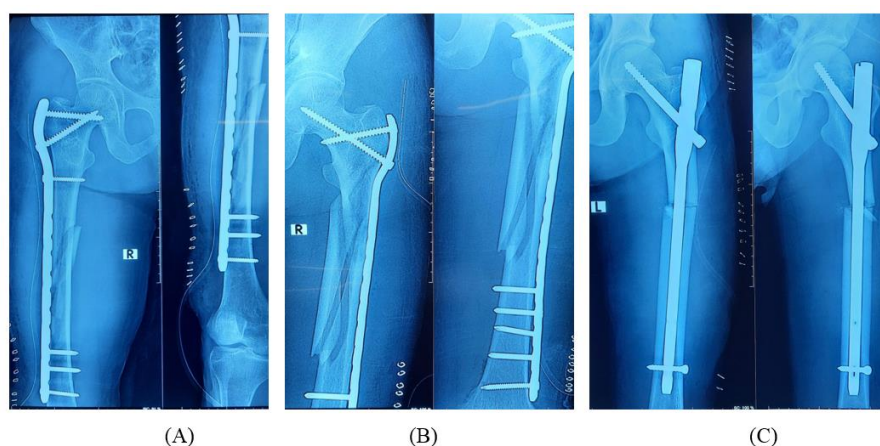


Figure 3. post-operative radiographs showing internal fixation of subtrochanteric fractures using a Proximal Femoral Locking Plate (PFLP) and Proximal Femoral Nailing (PFN).

4. Discussion

Subtrochanteric femoral fractures remain one of the most demanding injuries in orthopedic trauma due to high biomechanical stresses, unstable fracture patterns and a tendency toward fixation failure. The present comparative observational study evaluated proximal femoral nailing and proximal femoral locking plate fixation for closed subtrochanteric fractures and demonstrated meaningful differences in intraoperative parameters, postoperative recovery and functional outcomes, thereby contributing clinically relevant evidence to an ongoing debate.

In this study, proximal femoral nailing was associated with significantly shorter operative time and reduced intraoperative blood loss compared with proximal femoral locking plate fixation. These findings are consistent with those reported by Pradhan et al., who observed that intramedullary fixation minimizes surgical exposure and preserves soft tissue integrity,

leading to improved operative efficiency [7]. Roy et al. similarly reported shorter surgical duration with proximal femoral nailing, attributing this to the percutaneous technique and reduced need for fracture manipulation [8]. In contrast, locking plate fixation often requires extensive dissection and precise plate contouring, which may prolong operative time.

The need for open reduction was significantly higher in the locking plate group, a finding also reported by He et al., who noted that indirect reduction is frequently insufficient when using extramedullary implants in unstable fracture configurations [12]. Increased surgical exposure may partly explain the significantly longer hospital stay observed among patients treated with proximal femoral locking plates. Mirbolook et al. demonstrated that prolonged operative time and soft tissue disruption were associated with delayed postoperative recovery and extended hospitalization [13].

Postoperative recovery parameters favored proximal femoral nailing in the present study. Time to partial weight bearing was significantly shorter in the nailing group, reflecting the biomechanical stability of intramedullary fixation. Nirup and

Reddy reported similar findings, emphasizing that load-sharing implants facilitate earlier mobilization and reduce complications related to prolonged immobilization [14]. Early weight bearing is particularly important in elderly patients to prevent deconditioning and systemic complications.

Radiological union occurred significantly earlier in the proximal femoral nailing group. Yu et al. explained that intramedullary devices align closer to the mechanical axis of the femur, reducing bending moments at the fracture site and promoting callus formation [6]. In contrast, extramedullary fixation creates a longer lever arm, increasing mechanical strain and potentially delaying fracture healing. These biomechanical principles are particularly relevant in subtrochanteric fractures, where cortical bone predominates.

Functional outcomes assessed using the Harris Hip Score at six months were significantly better in the proximal femoral nailing group. Singh et al. reported superior functional recovery following intramedullary fixation, attributing improved outcomes to early mobilization and stable fixation [15]. Although the proportion of excellent or good results was higher with proximal femoral nailing, this difference did not reach statistical significance, suggesting that both implants can achieve acceptable long-term function when union is achieved.

Complication analysis revealed numerically higher rates of implant failure, delayed union and non-union in the locking plate group. He et al. reported a high failure rate of proximal femoral locking plates, particularly in osteoporotic bone, due to stress concentration at the plate–bone interface [12]. Yu et al. further highlighted that extramedullary implants are more susceptible to mechanical failure under cyclical loading [6]. Although statistical significance was not observed in the present study, the trend is clinically important and aligns with previously published literature.

Recent systematic reviews and meta-analyses further support the preferential use of intramedullary fixation. Zeelenberg et al. demonstrated lower rates of mechanical failure and improved functional outcomes with intramedullary devices compared with extramedullary fixation for unstable proximal femoral fractures [9]. Similarly, the Cochrane review by Lewis et al. concluded that cephalomedullary nails offer biomechanical advantages and facilitate earlier mobilization [16].

In resource-limited healthcare settings, the reduced operative time, shorter hospital stays and faster rehabilitation associated with proximal femoral nailing may translate into significant clinical and economic benefits. Overall, the findings of this study reinforce existing evidence that proximal femoral nailing provides superior outcomes compared with proximal femoral locking plate fixation in the management of closed subtrochanteric femoral fractures.

5. Limitations and Recommendations

The study was limited by a modest sample size and short follow-up duration. Future multicenter randomized studies

with longer follow-up are recommended to validate these findings and assess long-term functional and implant-related outcomes.

6. Conclusion

Proximal femoral nailing demonstrated superior intraoperative efficiency, earlier mobilization, faster fracture union and better functional outcomes compared with proximal femoral locking plate fixation. These findings support the preferential use of intramedullary fixation for closed subtrochanteric femoral fractures, particularly in unstable patterns, to optimize clinical recovery and reduce complication risk.

Abbreviations

PFN	Proximal Femoral Nailing
PFLP	Proximal Femoral Locking Plate Fixation
SPSS	Statistical Package for the Social Sciences

Author Contributions

Avishek Bhadra: Conceptualization, Supervision, Resources, Writing – original draft.

Gulam Mustofa: Methodology, Data curation, Investigation.

Zahid Hasan Hemal: Formal analysis, Software, Validation.

Sabbir Ahmed: Data curation, Visualization, Writing – review & editing.

Ashikur Rahman: Investigation, Project administration.

Conflicts of Interest

There are no conflicts of interest.

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