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Original article

Proximal Femoral Nail Versus Proximal Femoral Locking Compression Plate in the Treatment of Unstable Trochanteric Fracture in Adults

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Submission Date : 22 Jan 2026
Accepted Date : 28 Feb 2026
Published Date : 30 March 2026
DOI: https://doi.org/10.3329/jrpmc.v11i1.90042

Abstract

Background:
Unstable trochanteric fractures are common in adults and require stable fixation to enable early mobilization and reduce morbidity. Proximal femoral nail and proximal femoral locking compression plate are frequently used implants, but direct comparative data from local clinical settings remain limited.

Objective:
This study compared operative, radiological, and functional outcomes between these two fixation methods.

Methods:
This cross-sectional analytical study was conducted in the Department of Orthopaedic Surgery, Sylhet M.A.G. Osmani Medical College Hospital, Sylhet from January 2017 to December 2018. Twelve adults with unstable trochanteric fractures were enrolled and allocated equally to nail or plate fixation. After clinical assessment and informed consent, fixation was performed as per group allocation. Patients were followed for 24 weeks, assessing operative variables, mobilization milestones, radiological union, complications, and functional outcome using the Harris Hip Score. Statistical significance was set at $p<0.05$.

Results:
Operation time was slightly longer with the nail (137.5 min) than the plate (116.7 min). Incision length was significantly shorter with the nail (11.2 cm vs 17.5 cm). Hospital stay was similar in both groups (3 days). The nail allowed earlier mobilization, with partial weight bearing at 3.3 weeks versus 9 weeks, and full weight bearing at 11 weeks versus 20 weeks in the plate group. Radiological union was identical (20 weeks), with 66.7% in each group uniting by 18 weeks. Complication rates were comparable, including implant failure (1 per group) and varus deformity (2 per group). Limb length discrepancy occurred only in the nail group (33.3%). Functional recovery at 24 weeks was similar, with mean scores of 81.0 (nail) and 83.2 (plate).

Conclusion:
Both implants were effective, but PFN offered advantages in minimal surgical exposure and earlier mobilization, supporting its preference in most unstable fractures.

Keywords: Trochanteric fracture; Proximal femoral nail, Locking compression plate; Functional outcome

Citation: Paul R,Chakma SJ,Hossain AZ,Turja AC,Siddique MTA,Fattah IU.Proximal Femoral Nail Versus Proximal Femoral Locking Compression Plate in The Treatment of Unstable Trochanteric Fracture in Adults.J Rang Med Col.2026 Mar;11(1):146-152.doi: https://doi.org/10.3329/jrpmc.v11i1.90042

Introduction:

Trochanteric fractures are extracapsular injuries occurring between the basilar neck and the lesser trochanter and represent one of the most common fracture patterns of the proximal femur in adults.[1] Proximal femoral fractures make up over half of all such fractures and are increasing globally due to an aging population. Estimates predict a significant rise in hip fractures in the future.[2] While such fractures commonly result from low-energy falls in older adults, high-energy trauma remains an important cause among younger patients.[3] Unstable trochanteric fractures, characterized by posteromedial comminution, reverse obliquity, or subtrochanteric extension, present major challenges in orthopedic treatment. Inadequate stabilization can result in complications such as varus collapse, limb shortening, and implant failure.[4] Early mobilization after fixation is important to lower the chances of pulmonary complications, venous thromboembolism, and prolonged immobility in these typically frail patients. Choosing an implant that offers good stability for early weight bearing is essential. The dynamic hip screw (DHS) has been commonly used for intertrochanteric fractures, but it has risks in unstable fractures, including excessive sliding, medial migration of the femoral shaft, varus collapse, and a higher risk of screw cut-out, all of which may compromise fracture healing and functional outcomes.[5] These limitations have prompted the search for more biomechanically advantageous fixation strategies. Intramedullary fixation devices, particularly the Proximal Femoral Nail (PFN), have gained popularity due to their superior biomechanical properties. Positioned close to the weight-bearing axis of the femur, PFN offers better load-sharing capacity, a shorter lever arm, and greater resistance to deforming forces compared to extramedullary devices.[6] Further design modifications, such as improved proximal screw configuration and enhanced rotational stability, have strengthened PFN's role in managing unstable fracture patterns.[7] Additionally, PFN insertion typically requires minimal soft-tissue disruption, which may support quicker rehabilitation and reduce perioperative morbidity. Extramedullary angular-stable locking plates, such as the Proximal Femoral Locking Compression Plate (PFLCP), represent another viable treatment option. These plates provide fixed-angle stability through multiple locking screws, allowing secure fixation in osteoporotic and comminuted bone.[8] Their ability to buttress the lateral wall is particularly beneficial in unstable patterns where lateral support is compromised. Studies have highlighted the potential of locking plates to maintain reduction and minimize implant-related complications even in complex fracture configurations.[9] Despite the advantages offered by both PFN and PFLCP, current evidence remains inconclusive regarding which implant yields superior outcomes in unstable trochanteric fractures. Some comparative studies suggest better biomechanical performance and earlier mobilization with PFN, whereas others report similar or occasionally better results with PFLCP depending on fracture morphology and patient factors.[10]The study highlights the need for more clinical research in resource-limited areas like Bangladesh. It aims to compare Proximal Femoral Nail (PFN) and Proximal Femoral Locking Compression Plate (PFLCP) for treating unstable trochanteric fractures, focusing on operative variables, radiological outcomes, complications, and functional recovery to guide evidence-based implant selection.

Methods:

This cross-sectional analytical study was conducted in the Department of Orthopaedic Surgery, Sylhet M.A.G. Osmani Medical College Hospital, Sylhetfrom 1 January 2017 to 31 December 2018. The study population included all adult patients with trochanteric fractures admitted during this period. A total of 12 patients who fulfilled the selection criteria were enrolled and divided equally into Group A (PFN) and Group B (PFLCP), each comprising six patients. Allocation was done by lottery for the first patient and alternately for subsequent patients. The study included adults >18 years with traumatic, closed AO/OTA 31-A2 and 31-A3 trochanteric fractures involving one side at one segment. Patients with open fractures, pathological fractures (other than age-related osteoporosis), infection, polytrauma, bilateral fractures, pre-existing hip or knee deformity limiting activity, non-ambulant,severe comorbidities, or declined participation were excluded. Both qualitative and quantitative data were collected using a pre-designed questionnaire prepared through literature review and expert consultation after ethical approval. After admission, detailed history and clinical examination were performed, eligibility was confirmed, and informed written consent was obtained. Surgical fixation was performed using PFN or PFLCP as per group allocation. Patients were followed up for 24 weeks, and functional outcome was assessed using the Harris Hip Score.The primary variables included length of incision, operative time, postoperative hospital stay, time to partial and full weight bearing, radiological union, complications, and functional outcome, as specified in the study objectives. Data were analyzed using SPSS, with results expressed as mean and standard deviation or frequency and percentage. Appropriate statistical tests, including t-tests and Fisher's exact test, were applied, with significance set at $p<0.05$.

Results:

The mean age of the PFN group was 60.83 ± 16.25 years, while the PFLCP group had a mean age of 49.83±28.02 years; (p=0.425). The age distribution showed 50% of PFN patients were above 60 years, compared to 33.3% in PFLCP. Both groups had the same sex distribution. Road traffic accidents caused 50% of injuries in PFN and 16.7% in PFLCP, while falls caused injuries in the remaining patients. Fractures were equally distributed (Table-I).

The operative time was longer for the PFN group (137.50±14.05 minutes) than the PFLCP group (116.67±25.43 minutes; (p=0.054). Incision length was shorter in the PFN group (11.17 cm) compared to the PFLCP group (17.50 cm) (p=0.009). Most PFLCP patients had incisions ≥11 cm (Table-II)

The average hospital stay after surgery was the same for both groups at 3.00±1.26 days (p>0.05). Two-thirds of patients were discharged within 2–3 days. Patients treated with PFN started partial weight bearing much earlier than those treated with PFLCP, with times of 3.33±2.07 weeks and 9.00±5.02 weeks, respectively. PFN patients also achieved full weight bearing sooner than PFLCP patients (11.00±7.97 weeks vs 20.00±3.10 weeks; p=0.028).Two-thirds of PFN patients achieved full weight bearing by 6 weeks, PFLCP patients

Table-I: Demographic profile and fracture characteristics of the participants (N=12)

Demographic profile and fracture characteristics	PFN Group (n=6) no. (%)	PFLCP Group (n=6) no. (%)	p-value
Age, mean ± SD (years)	60.83±16.25	49.83 ± 28.02	0.425
Age Category			
Up to 60 years	3(50.0)	4(66.7)	
Above 60 years	3(50.0)	2(33.3)	
Sex			>0.05
Male	3(50.0)	3(50.0)	
Female	3(50.0)	3(50.0)	
Cause of Injury			0.545
Road traffic accident	3(50.0)	1(16.7)	
Fall	3(50.0)	5(83.3)	
Side of Involvement			>0.05
Right	3(50.0)	3(50.0)	
Left	3(50.0)	3(50.0)	

Table-II: Operative details comparing PFN and PFLCP procedures (N=12)

Operative details	PFN Group (n=6)	PFLCP Group (n=6)	p-value
Operation time (min), mean±SD	137.50±14.05	116.67±25.43	0.054
Operation Time Distribution			
71–100 min	0	2	
101–130 min	2	3	
131–150 min	4	1	
Incision length (cm), mean±SD	11.17±3.43	17.50±3.33	0.009
Incision Length Categories			
6–10 cm	3	0	
11–15 cm	3	2	
16–20 cm	0	4	

required 18 weeks. The mean time to radiological union was identical in both groups at 20.00±3.10 weeks (p>0.05). In each group, 66.7% united by 18 weeks, while the remaining 33.3% achieved union by 24 weeks (Table-III).

In the PFN group, one patient had a wound infection (16.7%), two (33.3%) developed limb length discrepancies, and two (33.3%) had varus deformity, with one implant failure. In the PFLCP group, no wound infections or discrepancies occurred, but there were two (33.3%) varus deformities and one (16.7%)implant failure. No valgus deformity or persistent pain was reported in either group (Table-IV).

The mean Harris Hip Score (HHS) was similar in the PFN and PFLCP groups, with scores of 81.00±17.23 and 83.17±14.09 respectively (p=0.816). In the PFN group, HHS scores varied, with two patients in the lower range and none in higher categories. The PFLCP group had one patient in a middle range and one in a higher range. Overall, 66.7% of PFN participants had excellent outcomes, while 50% in PFLCP did, with no significant differences between groups (Table-V).

Table-III: Postoperative recovery outcomes in PFN and PFLCP patients (N=12)

Postoperative outcomes	PFN Group (n=6)	PFLCP Group (n=6)	p-value
Length of hospital stay (days), mean±SD	3.00±1.26	3.00±1.26	>0.05
Hospital Stay Distribution			
2–3 days	4	4	
4–5 days	2	2	
Time to partial weight bearing (weeks), mean±SD	3.33±2.07	9.00±5.02	0.029
Partial Weight Bearing Categories			
2–6 weeks	6	4	0.061
12–18 weeks	0	2	
Time to full weight bearing (weeks), mean±SD	11.00±7.97	20.00±3.10	
Full Weight Bearing Categories			
6 weeks	4	0	0.039
18 weeks	0	4	
24 weeks	2	2	
Time to Radiological Union			
Mean ± SD (weeks)	20.00±3.10	20.00±3.10	>0.05
18 weeks	4(66.7%)	4(66.7%)	
24 weeks	2(33.3%)	2(33.3%)	

Table-IV: Postoperative complications following PFN and PFLCP fixation (N=12)

Postoperative complications	PFN Group (n=6) no. (%)	PFLCP Group (n=6) no. (%)	p-value
Wound infection	1(16.7)	0(0)	>0.05
Local pain	0(0)	0(0)	-
Implant failure	1(16.7)	1(16.7)	-
Limb length discrepancy >2 cm	2(33.3)	0(0)	>0.05
Varus deformity	2(33.3)	2(33.3)	-
Valgus deformity	0(0)	0(0)	-

Table-V: Harris hip score at 24 weeks in PFN and PFLCP patients (N=12)

Harris Hip Score Category	PFN Group (n=6) no. (%)	PFLCP Group (n=6) no. (%)	p-value
55–65	2(33.3)	0(0)	
66–75	0(0)	1(16.7)	
76–85	1(16.7)	0(0)	
86–95	0(0)	1(16.7)	
Mean ± SD	81.00±17.23	83.17 ± 14.09	0.816
Outcome Category			
Excellent	4(66.7)	3(50.0)	
Good	0(0)	0(0)	
Fair	0(0)	2(33.3)	0.545
Poor	2(33.3)	1(16.7)	

Discussion:

The present study compared the outcomes of Proximal Femoral Nail (PFN) and Proximal Femoral Locking Compression Plate (PFLCP) in the management of unstable trochanteric fractures, an injury pattern described by Russellet al[11] as one of the most complex extracapsular fractures of the proximal femur and emphasized by Rьedi et al[12] as increasingly prevalent due to global aging and osteoporosis. In our findings, the PFN group had a slightly longer operative time (137.50±14.05 minutes) than the PFLCP group (116.67±25.43 minutes), though the difference was not statistically significant, suggesting that both implants require similar technical effort. However, the significantly smaller incision length in PFN (11.17±3.43 cm) relative to PFLCP (17.50±3.33 cm; p=0.009) reflects the minimally invasive nature of intramedullary fixation, consistent with the observations of Kokoroghiannis et al and Simmermacher et al, who noted that PFN insertion requires less soft-tissue exposure, thereby lowering perioperative morbidity.[13,14] The wider exposure required for PFLCP aligns with the mechanical principles described by Floyd et al, who highlighted the need for greater visualization in plate placements to ensure alignment along the lateral cortex.[15] The most clinically meaningful difference in this study was the markedly earlier mobilization observed in PFN patients, with partial weight bearing beginning at 3.33±2.07 weeks compared to 9.00±5.02 weeks after PFLCP (p=0.029), and full weight bearing beginning at 11.00±7.97 weeks compared to 20.00±3.10 weeks (p=0.028). These results closely support the biomechanical superiority of intramedullary nails described by Kokoroghiannis et al, who emphasized the nail's favorable load-sharing characteristics and shorter lever arm, reducing varus forces that delay mobilization.[13] Simmermacher et al also reported enhanced resistance to rotational and axial deformation with PFN, further explaining why PFN patients in our study were able to mobilize earlier.[14] The delayed mobilization in the PFLCP group is consistent with the findings of Zha et al, who showed that PFLCP performance depends heavily on lateral wall integrity, which is often compromised in unstable fracture patterns.[16] Early weight bearing is particularly important in elderly patients because prolonged immobility greatly increases risks of pneumonia, venous thromboembolism, and muscle wasting, as emphasized by Kulkarni et al, underscoring the clinical advantage of PFN demonstrated in our results.[17] Radiological union occurred at a mean of 20.00±3.10 weeks in both groups, with identical distributions at 18 and 24 weeks, demonstrating that both implants provide adequate mechanical stability for bone healing. This parallels the findings of Singh et al, who reported no significant difference in radiological union between PFN and locking plates.[18] Our complication rates were low and similar between groups, with PFN showing one case each of wound infection, implant failure, and limb length discrepancy, while PFLCP showed comparable implant failure and varus deformity rates. These outcomes reflect the mechanical risks described by Haq et al, who reported that unstable patterns predispose to varus collapse irrespective of implant choice, and highlight that both fixation methods are safe when applied with careful reduction. Functional outcomes measured by Harris Hip Score (HHS) were also comparable, with PFN achieving a mean HHS of 81.00±17.23 and PFLCP achieving 83.17±14.09 (p=0.816). This agrees with Singh et al, who found that although intramedullary nails often allow earlier functional recovery, long-term results tend to equalize between implants once union occurs.[18] The similarity in functional outcomes despite earlier mobilization in PFN suggests that both implants can restore sufficient mechanical stability to permit return of function, supporting the broader biomechanical observations of Rüedi et al and the clinical insights of Floyd et al regarding plate behavior in osteoporotic bone.[12,15] PFN offers clear advantages in terms of incision size and early mobilization, critical factors in elderly populations at risk of immobility-related complications, while PFLCP remains a valuable alternative in cases requiring anatomical reduction or when intramedullary fixation is contraindicated. Thus, although both implants achieved comparable union and functional outcomes, PFN may be the preferred option in most unstable trochanteric fractures due to its superior biomechanical profile and earlier rehabilitation potential.

Limitation:

Limitations include a small sample size, single-center focus, and a follow-up period of only six months, which may miss long-term issues.

Conclusion:

This comparative study demonstrates that both proximal femoral nail (PFN) and proximal femoral locking compression plate (PFLCP) are effective fixation methods for unstable trochanteric fractures, achieving similar rates of radiological union, complication profiles, and functional outcomes at 24 weeks. PFN, however, offers distinct perioperative advantages, including a significantly smaller incision and earlier initiation of partial and full weight bearing, which may enhance early rehabilitation. Despite these differences, operative time, hospital stay, and overall Harris Hip Score did not differ significantly between the two groups. Therefore, while both implants are viable options, PFN may be preferred when prioritizing minimally invasive surgery and accelerated postoperative mobilization.

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