

Comparison Between Proximal Femoral Nailing and Dynamic Hip Screw Fixation for the Treatment of Intertrochanteric Fractures

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Abstract

Background: Intertrochanteric fractures continue to make up a significant portion of everyday orthopedic practice, and their incidence is on the rise with increasing life expectancy. Previously, the dynamic Hip Screw, an extra-medullary device, was used for fixation. However, over the past decade, there has been a growing preference for intramedullary fixation methods such as Proximal Femoral Nailing. Despite this, there is no general consensus on their routine use.

Aim of the study: To evaluate and compare the functional outcomes between Dynamic Hip Screw (DHS) and Proximal Femoral Nail (PFN) for the management of intertrochanteric fractures.

Methods: This prospective comparative study was conducted in the Department of Orthopaedic Surgery, BSMMU, Dhaka, from September 2022 to September 2024, where 36 patients were allocated on the basis of fixation technique into the Dynamic Hip Screw (DHS Group) and Proximal Femoral Nail (PFN Group) groups; after they have met selection criteria. The assessment was done preoperatively and postoperatively on 1, 3, 6 and 12 months by using VAS score and Harris Hip Score. The analyses of different variables were done according to standard statistical analysis using software 'Statistical Package for Social Science' (SPSS) version 26, IBM®, Armonk, USA. p-value of <0.05 was considered significant.

Result: The mean age of patients was 67.19 ± 10.01 years, with females comprising 58.3%. Most injuries (80.5%) were from falls, and 41.7% had a Singh Index $\leq$ III. Left-sided fractures (55.6%) and Boyd & Griffin Type I–II (80.5%) were most common. Closed reduction was achieved in 94.4% (DHS) and 88.9% (PFN). Operative time, blood loss, and hospital stay were significantly higher in DHS than PFN. Earlier union was seen with PFN (14.50 ± 1.58 vs 16.78 ± 2.76 weeks). Both groups showed significant VAS and HHS improvements, though differences were insignificant. Excellent outcomes were higher with PFN (44.4% vs 33.3%), and better results were noted in younger males, stable fractures, and TAD ≤ 25 mm.

Conclusion: DHS and PFN are both safe and effective techniques for the management of intertrochanteric fracture, with relatively better outcomes in the PFN group. Also, peri-operative parameters were in favor of the PFN group.

Keywords: Dynamic hip screw; Intertrochanteric fracture; Proximal femoral nail

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Citation: Md Golam Shaikh Ferdous, Khandker Md Nurul Arifeen, Md. Nazrul Islam, Debashish Dey, Aminur Rasul, Aynun Nahar Rabeya Diba. Comparison between Proximal Femoral Nailing and Dynamic Hip Screw Fixation for the Treatment of Intertrochanteric Fractures. Journal of Orthopedics and Sports Medicine. 7 (2025): 500-506.

Received: September 29, 2025

Accepted: October 17, 2025

Published: October 23, 2025

Introduction

Intertrochanteric fractures are most commonly observed in elderly individuals, particularly those with osteoporosis [1]. The prevalence of these fractures has increased, mainly due to a longer life expectancy and a more sedentary lifestyle resulting from urbanization [2]. The challenging nature of treating these fractures is attributed to poor bone quality and a complex fracture pattern. The main difficulties in treating these fractures are instability and osteoporosis, which can lead to complications in the fixation procedures [3]. Fractures in the intertrochanteric region account for 38-50% of all femoral fractures and 5-20% of all fractures. These fractures are prevalent among the elderly, with an occurrence of 180 out of 10000, but they can also occur at any age [4]. About half of intertrochanteric fractures are considered unstable fractures [1]. They may occur in younger patients due to high-speed trauma, such as a motor vehicle accident, while in older patients, they can result from minor trauma. These fractures are more frequent in women than in men due to women experiencing senile osteoporosis at an earlier age [2]. The importance of fracture pattern is well described in the Kyle classification, which identifies four fundamental patterns indicating greater instability and challenges in realignment and stabilization. Kyle types III and IV represent unstable fractures. Instability may result from a lack of posteromedial calcar support, a deficiency in posterolateral support, or insufficient lateral femoral wall support [5]. The objective when treating an intertrochanteric fracture is to restore the patient to their pre-injury condition as quickly as possible [6]. Numerous elements impact the functional results in these individuals, such as effective internal fixation, minimal anesthesia duration, early mobilization, and the overall health of the patient. Maintaining the ability to walk is a crucial aspect of treating such fractures [7]. Significant efforts have been dedicated to enhancing the biomechanical design and implants for fixing these fractures over the years [1]. Unstable intertrochanteric fractures are significantly more difficult to handle compared to stable fractures; achieving a stable reduction involves establishing medial and posterior cortical contact between the main proximal and distal fragments to withstand varus and posterior displacing forces [8]. The two main choices for treating these fractures are typically intramedullary fixation or extra-medullary fixation. The Dynamic Hip Screw (DHS) is often utilized for extra-medullary fixation, while the Proximal Femoral Nail (PFN) and Gamma nail are commonly employed for intramedullary fixation [9]. Dynamic Hip Screw (DHS) or a sliding hip screw (SHS) is a collapsible fixation device that allows the proximal fragment of the fracture to collapse on the fixation device resulting in the stability of the fracture ends [10]. Several studies have indicated that the DHS achieves more compression of the fracture, is less technically challenging, and is more cost-effective, contradicting some

literature showing the PFN to have an advantage over the DHS. The aim of the study was to compare functional, radiological, and perioperative outcomes, including pain relief and complications, between Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) in the treatment of intertrochanteric fractures.

Methodology and Materials

This was a prospective comparative study carried out in the Department of Orthopaedic Surgery at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from September 2022 to September 2024. A total of 36 patients with intertrochanteric fractures of the femur were enrolled based on pre-defined inclusion and exclusion criteria. Patients were randomly allocated into two groups using an odd-even admission sequence:

- **DHS group (n=18):** Patients with odd serial numbers of admission and treated with Dynamic Hip Screw fixation
- **PFN group (n=18):** Patients with even serial numbers of admission and treated with Proximal Femoral Nail fixation

Inclusion criteria

- Adult patients aged 30–90 years
- Both genders
- Both sides of femur included
- Stable and unstable intertrochanteric fractures confirmed by radiographs

Exclusion criteria

- Open or pathological fractures
- Previous hip surgery
- Associated femoral neck or shaft fractures
- Polytrauma cases
- Patients unable to give consent or comply with minimum 12 months follow-up

Ethical implications

With the permission of academic committee of department of orthopaedic surgery, BSMMU, initial work up was started, then approval of research protocol and ethical clearance by the Institutional Review Board (IRB) of BSMMU, Dhaka was obtained. Data taken from the participants will be regarded as confidential and kept locked under investigator for purposeful use only. Due respect will be given to all the subjects.

Surgical procedure

- DHS fixation was performed using standard lateral approach with side plate and lag screw

- PFN fixation was performed using a cephalo-medullary intramedullary device with neck screw and anti-rotation hip pin. Both procedures were carried out under spinal or general anesthesia as per anesthetist's preference. Closed reduction was attempted in all cases, with open reduction performed if closed methods failed

Data collection

Data were collected using a structured case record form. Preoperatively, each patient underwent detailed history taking, physical examination, and standard radiographic evaluation including pelvis AP view with proximal thigh, and AP and lateral views of the affected hip. Bone quality was assessed using Singh's Index, and fractures were classified according to Boyd and Griffin's classification. Routine preoperative investigations and anesthetic fitness were obtained for all patients. Intraoperatively, operative time (minutes), blood loss (ml), method of reduction (closed or open), and Tip Apex Distance (TAD, mm) were recorded. Postoperatively, information regarding length of hospital stay (days), time to radiological fracture union (weeks), pain assessment by Visual Analog Scale (VAS), functional outcome using the Harris Hip Score (HHS) at 1, 3, 6, and 12 months, as well as postoperative complications such as infection, screw cut-out, Z-effect, non-union, or mal-union were documented. The primary outcome of the study was functional outcome assessed by the Harris Hip Score, while secondary outcomes included pain relief (VAS), radiological fracture union, perioperative parameters, postoperative complications, and final outcome grading (Excellent, Good, Fair, Poor). All patients were followed up clinically and radiologically at 1, 3, 6, and 12 months after surgery.

Statistical analysis

Data were analyzed using SPSS version 26 (IBM, USA). Qualitative variables were presented as frequency and percentage and compared using the Chi-square test, while quantitative variables were expressed as mean $\pm$ standard deviation and analyzed with the Independent t-test or Mann-Whitney U test, as appropriate. A p-value < 0.05 was considered statistically significant, with a 95% confidence interval applied for all analyses.

Result

Table 1 showed the demographic characteristics of participants (N=36). The mean age was similar between DHS (67.22 $\pm$ 9.24 years) and PFN (67.17 $\pm$ 10.99 years) groups (p=1). Most patients were 61–70 years old (41.7%). Females were slightly more (58.3%) than males. Retired individuals (41.7%) and housewives (36.1%) were most common, with no significant group differences. According to Singh's Index, the majority were in grade IV (33.3%) and grade III (30.6%). The predominant mechanism of injury was fall from standing

height (80.5%). The right side was affected in 44.4% and left side in 55.6% of cases. By Boyd and Griffin classification, type II fractures were most frequent (41.6%), followed by type I (38.9%) (Table 2). The timing of surgery was similar between DHS (5.78 $\pm$ 1.93 days) and PFN (6.11 $\pm$ 1.68 days) groups (p=0.606). However, operative duration (87.5 $\pm$ 14.55 vs. 63.89 $\pm$ 8.79 minutes, p=0.0001) and intraoperative blood loss (211.67 $\pm$ 63.08 vs. 95.00 $\pm$ 56.67 ml, p=0.0001) were significantly higher in the DHS group. Most fractures were managed with closed reduction in both groups. The mean tip-apex distance was comparable (22.33 $\pm$ 4.96 vs. 20.56 $\pm$ 4.05 mm, p=0.265) (Table 3). Table 4 highlighted that mean hospital stay was significantly longer in DHS patients (8.00 $\pm$ 1.94 days) compared to PFN (5.94 $\pm$ 2.16 days, p=0.003). Similarly, fracture union time was delayed in DHS (16.78 $\pm$ 2.76 weeks) compared to PFN (14.50 $\pm$ 1.58 weeks, p=0.008). Preoperative pain was high in both groups (8.00 $\pm$ 1.03 vs. 7.50 $\pm$ 0.86, p=0.171). A steady reduction was observed over time, with minimal pain at 12 months (1.06 $\pm$ 1.00 vs. 0.72 $\pm$ 0.75). Although intra-group improvement was statistically significant over time (p=0.001), no significant inter-group differences were noted at any follow-up point (Table 5). Both groups showed progressive improvement over time, with significant intra-group changes. At 12 months, mean scores were 86.50 $\pm$ 6.52 for DHS and 88.78 $\pm$ 6.29 for PFN (p=0.355). Final outcome categories revealed excellent to good results in the majority, with no significant difference between groups (p=0.781) (Table 6). In the DHS group, superficial wound infection and screw cut-out occurred in 11.1% each, with no Z-effect. In the PFN group, 5.6% had superficial infection, 5.6% screw cut-out, and 5.6% Z-effect. Most patients had no postoperative complications: 77.8% in DHS and 83.3% in PFN (**Figure 1**). Table 7 presented that Harris Hip Score was significantly associated with fracture type (p=0.008) and tip-apex distance (≤ 25 mm: 90.07 $\pm$ 4.61 vs. > 25 mm: 79.13 $\pm$ 4.19, p=0.001). Age and gender did not show statistically significant associations.

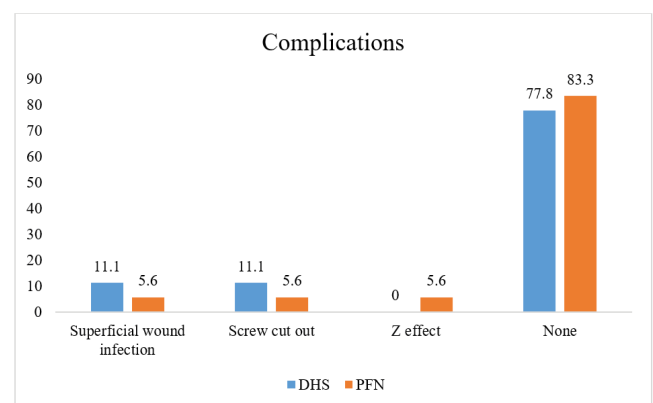


Figure 1: Postoperative complications of study population (N=36).

Table 1: Demographic characteristics of the study population (N=36).

Variables	DHS, n (%)	PFN, n (%)	Total, n (%)	P-value
Age, (years)				
31-40	1 (5.6)	1 (5.6)	2 (5.5)	0.854
41-50	0(0)	1 (5.6)	1 (2.8)	
51-60	3 (16.7)	2 (11.1)	5 (13.9)	
61-70	7 (38.9)	8 (44.4)	15 (41.7)	
71-85	7 (38.9)	6 (33.3)	13 (36.1)	
Mean± SD	67.22± 9.24	67.17± 10.99	67.19± 10.01	1
Gender				
Female	11 (61.1)	10 (55.6)	21 (58.3)	0.735
Male	7 (38.9)	8 (44.4)	15 (41.7)	
Occupation				
Retired	9 (50)	6 (33.3)	15 (41.7)	0.758
House maker	6 (33.3)	7 (38.9)	13 (36.1)	
Business	2 (11.1)	3 (16.7)	5 (13.9)	
Office worker	1 (5.6)	1 (5.6)	2 (5.5)	
Manual Labor	0 (0.0)	1 (5.6)	1 (2.8)	

Table 2: Baseline characteristics of the study population (N=36).

Variables	DHS, n (%)	PFN, n (%)	Total, n (%)	P-value
Singh's Index				
I	0 (0.0)	0 (0.0)	0 (0.0)	0.98
II	2 (11.1)	2 (11.1)	4 (11.1)	
III	6 (33.3)	5 (27.8)	11 (30.6)	
IV	6 (33.3)	6 (33.3)	12 (33.3)	
V	3 (16.7)	3 (16.7)	6 (16.7)	
VI	1 (5.6)	2 (11.1)	3 (8.3)	
Mechanism of Injury				
Fall on standing Height	15 (83.3)	14 (77.8)	29 (80.5)	0.889
Fall from height	2 (11.1)	3 (16.7)	5 (13.9)	
Road Traffic Accident	1 (5.6)	1 (5.6)	2 (5.6)	
Involved limb				
Right	7 (38.9)	9 (50)	16 (44.4)	0.502
Left	11 (61.1)	9 (50)	20 (55.6)	
Boyd and Griffin Classification				
Type I	7 (38.9)	7 (38.9)	14 (38.9)	0.996
Type II	7 (38.9)	8 (44.4)	15 (41.6)	
Type III	3 (16.7)	2 (11.1)	5 (13.9)	
Type IV	1 (5.6)	1 (5.6)	2 (5.6)	

Table 3: Perioperative details among participants (N=36).

Variables	DHS, Mean± SD	PFN, Mean± SD	P-value
Timing of Surgery (days)	5.78± 1.93	6.11± 1.68	0.606
Operative duration (min)	87.50± 14.55	63.89± 8.79	0.0001
Blood Loss (ml)	211.67± 63.08	95.00± 56.67	0.0001
Method of Fracture Reduction, n (%)			
Closed Reduction	17 (94.4)	16 (88.9)	0.546
Open Reduction	1 (5.6)	2 (11.1)	
Tip Apex Distance (mm), n (%)			
≤ 25	13 (72.2)	15 (83.3)	0.423
> 25	5 (27.8)	3 (16.7)	
Mean± SD	22.33± 4.96	20.56± 4.05	0.265

Table 4: Postoperative course and fracture union of study subjects.

Variables	DHS, Mean± SD	PFN, Mean± SD	P-value
Hospital Stay (days)	8.00± 1.94	5.94± 2.16	0.003
Fracture Union (weeks)	16.78± 2.76	14.50± 1.58	0.008

Table 5: Pain assessment (VAS Score) among patients.

VAS Score	DHS, Mean± SD	PFN, Mean± SD	P-value
Pre-operative	8.00 ±1.03 (7-10)	7.5 ±0.86 (6-10)	0.171
Post-operative at 1month	4.44 ±0.78 (3-6)	4.33 ±0.77 (3-6)	0.65
Post-operative at 3month	2.61 ±0.85 (2-4)	2.22 ±0.81 (1-4)	0.226
Post-operative at 6month	1.78 ±0.88 (0-3)	1.67 ±0.84 (0-3)	0.696
Post-operative at 12month	1.06 ±1.00 (0-3)	0.72 ±0.75 (0-3)	0.372
P-value	0.001	0.001	

Table 6: Outcome of the study (N=36).

Variables	DHS	PFN	P-value
Functional Outcome (Harris Hip Score), Mean± SD			
Post-operative at 1month	45.94 ±6.08 (35-55)	47.56 ±5.62 (36-55)	0.462
Post-operative at 3month	59.39 ±5.20 (50-70)	59.56 ±5.92 (50-70)	0.938
Post-operative at 6month	78.44 ±5.45 (70-86)	80.22 ±4.81 (72-87)	0.389
Post-operative at 12month	86.50 ±6.52 (75-96)	88.78 ±6.29 (77-98)	0.355
P-value	0.001	0.001	
Final outcome, n (%)			
Excellent (90-100)	6 (33.3)	8 (44.4)	0.781
Good (80-89)	8 (44.4)	7 (38.9)	
Fair (70-79)	4 (22.2)	3 (16.7)	
Poor (<70)	0 (0.0)	0 (0.0)	

Table 7: Subgroup analysis of Harris Hip Score.

Variables	Harris Hip score	P-value
Age Group		
31-40 (n=2)	95.00 ±0.00 (95)	0.139
41-50 (n=1)	98	
51-60 (n=5)	86.20 ±6.69 (79-93)	
61-70 (n=15)	87.67 ±7.37 (75-96)	
71-80 (n=13)	86.23 ±4.57 (77-94)	
Gender		
Female (n=21)	86.24 ±6.01 (75-96)	0.087
Male (n=15)	89.60 ±6.66 (75-98)	
Fracture Type		
Type I (n=14)	91.86 ±3.63 (88-98)	0.008
Type II (n=15)	86.13 ±4.96 (76-95)	
Type III (n=5)	81.40 ±7.67 (77-95)	
Type IV (n=2)	85.00 ±14.14 (75-95)	
TAD		
≤25mm (n=28)	90.07 ±4.61 (79-98)	0.001
>25mm (n=8)	79.13 ±4.19 (75-88)	

Discussion

The mean age of our study population was 67.19 ± 10.01 years (range 38–80), with no significant difference between the DHS and PFN groups. This result was comparable to the studies done by Das et al. [3] and Singh et al. [11] where the authors have reported an average age of 68.8 years and 65 years, respectively [3,11]. Also, in this study around 77.8% of the patients were above 60 years of age. Similar reports have been reported by Gill et al. [12] where 66% of the cases in their study were >60 years [12]. Intertrochanteric fractures are common in the elderly due to osteoporosis and associated comorbidities that increase fall risk. In this study, intertrochanteric fractures were more common in females (58.3%), with no significant difference between DHS and PFN groups. Similar studies reported 55–72% female cases [3,6,12,13]. The higher prevalence in women is mainly due to osteoporosis and longer life expectancy, which increase fracture risk [14]. The Singh Index, a radiological tool for assessing bone quality in the proximal femur, showed ≤III in 41.7% of patients, with no significant difference between groups. This aligns with findings by Das et al. [3] and Xu et al. [15]. A lower Singh Index reflects greater bone loss and higher fracture risk. In the present study, 80.5% of fractures resulted from falls from standing height, with no significant difference between groups. Similar findings were reported by Karanam et al. [13] and Gupta et al. [16]. Such fractures are often linked to osteoporosis and age-related declines in mobility, strength, and coordination. The prevalence of inter-trochanteric fracture on the left side was higher than

on the right side with no significant difference between the two groups. Intertrochanteric fractures being more common on the left side has been observed in several studies [3,17], however the reasons for this observation are not entirely clear. Boyd and Griffin's Type I fracture accounted for 38.9% of cases, Type II accounted for 41.6%, Type III accounted for 13.9%, and Type IV accounted for 5.6%, however, there was no significant difference between the two groups. Results were comparable to the study done by Kumar et al. [18]. The mean interval from injury to surgery was 5.78 ± 1.93 days in the DHS group and 6.11 ± 1.68 days in the PFN group. The delay in surgery was mainly due to late hospital presentation and the need for preoperative optimization of comorbid patients. Although early fixation within 48 hours is associated with better survival [19], delays are often necessary in elderly patients with intertrochanteric fractures to manage underlying conditions. According to our study, the mean operative duration was significantly longer in DHS than PFN group (87.50 ± 14.55 vs 63.89 ± 8.79 min). Similar results were found by other studies, where operative duration was significantly higher in DHS group [3,12,13,17]. DHS requires more extensive dissection for barrel plate placement, while PFN uses a smaller incision with less tissue manipulation, reducing operative time and tissue damage. In this current study, the mean intra-operative blood loss was significantly higher in DHS than the PFN group (211.67 ± 63.08 ml vs 95.00 ± 56.67 ml). The results were comparable with the study of Khanra et al. [20], where authors have shown a significantly higher amount of intraoperative blood loss in DHS than PFN group. The reason for this observation is due to the extensive nature of tissue dissection needed for DHS fixation, which leads to increased blood loss. Open fracture reduction was required in 11.1% of cases in the PFN group and 5.6% of cases in the DHS group. The results were comparable to those of Duymus et al. [21]. 72.2% and 83.3% of the cases in the DHS and PFN groups had Tip Apex Distance (TAD) ≤25mm, respectively; however, there was no significant difference between the groups. A TAD of under 25mm is considered safe, while a TAD greater than 25mm could lead to potential issues such as implant penetration, non-union, and cut-through [22]. In this current study the mean length of postoperative hospital stay was significantly higher in DHS than PFN group (8.00 ± 1.94 days vs 5.94 ± 2.16 days). The results were similar to the observation of Jonnes et al. [23]. Fracture union occurred faster in the PFN group than the DHS group (14.50 ± 1.58 vs 16.78 ± 2.76 weeks), similar to findings by Yu et al. [24] and Kamboj et al. [25]. PFN, being an intramedullary device, offers better load-sharing and stability, promoting early healing [26]. In contrast, DHS, as an extramedullary device, is associated with higher mechanical stress and periosteal stripping, which may delay fracture healing. The VAS Score improved significantly following surgery to 1.06 ± 1.00 (0-3) in the DHS group and 0.72 ± 0.75 , (0-3) in the PFN group, and

the difference between the groups was not significant. Similar results were reported by Gill et al. [12] where VAS score improved to 2.5 in DHS and 1.65 in PFN group [12]. The Harris Hip Score improved postoperatively to 86.50 ± 6.52 in the DHS group and 88.78 ± 6.29 in the PFN group, with no significant difference. Similar results were reported by Yu et al. [24] and Gurung et al. [27]. However, some studies observed significantly better outcomes with PFN compared to DHS [6,20]. At final follow-up, excellent outcomes were seen in 33.3% (DHS) and 44.4% (PFN), good outcomes in 44.4% and 38.9%, and fair outcomes in 22.2% and 16.7%, respectively. Comparable findings were reported by Prakash et al. [6] and Khanra et al. [20] both showing better functional results with PFN than DHS [6,20]. 11.1% in DHS and 5.6% in PFN group developed superficial wound infection. 11.1% and 5.6% cases developed Screw cut-out in their consequent follow-up, respectively. 5.6% cases in PFN group developed Z effect. Functional outcomes were significantly better in younger patients, males, those with stable fracture patterns, and TAD ≤ 25 mm. Better scores in males may relate to higher bone density and muscle strength. Stable fractures allow earlier, more effective rehabilitation, while a TAD < 25 mm ensures stronger fixation, reducing implant failure and supporting faster recovery.

Limitations of the Study

Every research has its limitations. Though optimum attention was given by the researcher, there were some confines which the researcher couldn't address.

- Small sample size
- There is a chance of selection bias due to purposive sampling
- No randomization of the cases
- Researcher was not blinded
- Long term outcome couldn't be assessed due to short follow up duration

Conclusion

Dynamic Hip Screw and Proximal Femoral Nail fixation techniques are both safe and effective procedures for the management of intertrochanteric fracture. Both techniques had significant improvement in functional outcome scores. Also, comparatively better functional scores were observed in patients managed with Proximal Femoral Nailing but were statistically insignificant. Furthermore, the Proximal Femoral Nail had better peri-operative outcomes in terms of Operative duration, Blood loss, Post-operative hospital stay, and Radiological union.

Recommendation

- A study conducted at multiple centers

- Extended follow-up duration to investigate long-term results
- It is advisable to have a larger sample size, randomization, and a blinded study for a thorough analysis

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee.

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