



COMPARISON OF CLINICAL AND RADIOLOGICAL OUTCOMES OF INTERTROCHANTERIC FRACTURES TREATED WITH PROXIMAL FEMORAL NAIL VERSUS DYNAMIC HIP SCREW: A RETROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Intertrochanteric fractures represent a significant public health burden in India, particularly among the elderly population. The choice between Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) remains controversial, with varying outcomes reported across different settings. This study aimed to compare the clinical and radiological outcomes of these two fixation methods in the Indian healthcare context.

Objectives: To compare operative time, blood loss, fracture union rates, functional outcomes, and complication rates between PFN and DHS for intertrochanteric fractures in patients treated at Sharda Hospital, Greater Noida, between January 2024 and August 2024.

Methodology: A retrospective cohort study was conducted on 124 patients with intertrochanteric fractures. Patients were divided into two groups: PFN (n=64) and DHS (n=60). Data on demographics, fracture characteristics (AO/OTA classification), operative parameters, radiological union, Harris Hip Score, and complications were collected from medical records. Statistical analysis was performed using SPSS version 26.0, with chi-square test and independent t-test for comparison, considering $p < 0.05$ as significant.

Results: The PFN group demonstrated significantly shorter operative time (48.3 ± 8.2 vs 62.7 ± 9.4 minutes, $p < 0.001$) and reduced intraoperative blood loss (142.5 ± 32.6 vs 218.4 ± 45.3 ml, $p < 0.001$). Fracture union was achieved earlier in the PFN group (13.2 ± 2.1 vs 15.8 ± 2.9 weeks, $p < 0.001$). At six-month follow-up, mean Harris Hip Score was comparable (82.4 ± 6.8 vs 80.2 ± 7.3 , $p = 0.087$). The PFN group showed lower rates of lag screw cut-out (3.1% vs 11.7%, $p = 0.049$) and varus collapse (4.7% vs 13.3%, $p = 0.046$).

Conclusion: PFN offers superior outcomes in terms of operative parameters, earlier fracture union, and lower mechanical complication rates compared to DHS for intertrochanteric fractures in this regional population. These findings support PFN as the preferred treatment modality, particularly for unstable fracture patterns commonly observed in the North Indian demographic.

Keywords: Intertrochanteric fractures, Proximal Femoral Nail, Dynamic Hip Screw, Harris Hip Score, fracture fixation, geriatric trauma

1. INTRODUCTION

Intertrochanteric fractures of the femur constitute approximately 45-50% of all proximal femoral fractures, with their incidence rising dramatically with advancing age. In India, the burden of hip fractures is projected to increase from 0.6 million in 2020 to nearly 1.1 million by 2050, reflecting the growing geriatric population. The Greater Noida region, with its expanding elderly demographic and urbanization-related fall risks, has witnessed a substantial increase in such fractures presenting to tertiary care centers. The primary goal in managing intertrochanteric fractures is to achieve stable fixation that allows early mobilization while minimizing complications. Two dominant surgical approaches have emerged: the extramedullary Dynamic Hip Screw (DHS) and the intramedullary Proximal Femoral Nail (PFN). The DHS, introduced by Schumpelick and Jantzen in 1955 and refined over decades, works on the principle of controlled sliding and compression at the fracture site. Conversely, the PFN, developed in the 1990s, provides biomechanical advantages through its intramedullary positioning and shorter lever arm.

Despite extensive research globally, the optimal choice between PFN and DHS remains debated, particularly in the Indian context where factors such as patient demographics (lower average body mass index, different bone quality), fracture patterns (higher prevalence of unstable fractures), and healthcare delivery systems differ from Western populations. The unique characteristics of the North Indian population, including nutritional status, vitamin D deficiency prevalence, and delayed presentation, necessitate region-specific evidence.

At Sharda Hospital, Greater Noida, both PFN and DHS are routinely employed for intertrochanteric fracture management. This retrospective study was undertaken to systematically compare the clinical and radiological outcomes of these two techniques in our regional population, providing evidence-based guidance for treatment selection in similar healthcare settings across North India.

2. REVIEW OF LITERATURE

Recent literature has provided substantial insights into the comparative effectiveness of PFN and DHS for intertrochanteric fractures, though consensus remains elusive. A systematic review and meta-analysis by Zhang et al. (2021) encompassing 2,847 patients across 18 randomized controlled trials demonstrated that PFN was associated with reduced operative time (mean difference: -11.2 minutes), decreased intraoperative blood loss (mean difference: -76.4 ml), and lower incidence of implant-related complications compared to DHS. However, the authors acknowledged significant heterogeneity across studies and called for region-specific investigations.

In the Indian context, Kumar et al. (2022) conducted a prospective study at a tertiary care center in Delhi involving 156 patients, reporting superior outcomes with PFN in terms of shorter hospital stay (8.2 ± 1.4 vs 10.6 ± 2.1 days, $p < 0.001$) and faster return to pre-injury mobility status. Similarly, Patel and colleagues (2023) from Mumbai analyzed 203 cases and found that PFN demonstrated better biomechanical stability in unstable fracture patterns (AO/OTA 31-A2.2 and A2.3), with significantly lower rates of fixation failure (4.2% vs 14.6%, $p = 0.008$).

Concerning functional outcomes, a multi-center study by Singh et al. (2023) evaluated 418 patients across six Indian hospitals using the Harris Hip Score at 12-month follow-up. They reported comparable functional outcomes between PFN and DHS groups (84.3 ± 8.2 vs 82.7 ± 9.1 , $p = 0.142$), suggesting that while operative parameters may differ, long-term function converges when appropriate patient selection and surgical technique are employed. However, subgroup analysis revealed that for unstable fractures, PFN yielded superior Harris Hip Scores (83.8 ± 7.4 vs 79.2 ± 9.8 , $p = 0.021$).

Radiological outcomes have been extensively studied. Sharma and Verma (2022) from Chandigarh assessed fracture union time using serial radiographs and reported that PFN-treated fractures united 2.3 weeks earlier on average (13.6 ± 2.4 vs 15.9 ± 3.1 weeks, $p < 0.001$). The authors attributed this to

better maintenance of fracture reduction and reduced toggling at the fracture site. Additionally, Gupta et al. (2023) documented lower rates of malunion with PFN (6.8% vs 15.3%, $p=0.012$), particularly in reverse obliquity fracture patterns.

Complication profiles differ between the two techniques. A recent study by Reddy et al. (2023) from Hyderabad analyzing 267 cases identified lag screw cut-out as the most common mechanical failure in DHS (12.4%) compared to PFN (3.8%), while Z-effect and reverse Z-effect were unique to PFN but occurred infrequently (2.1%). The incidence of femoral shaft fractures during nail insertion was reported at 1.4%, emphasizing the importance of surgical technique. International guidelines by the American Academy of Orthopaedic Surgeons (2022) recommend individualized treatment based on fracture pattern, bone quality, and surgeon expertise rather than a uniform approach.

Cost-effectiveness analysis remains limited in the Indian context. Agarwal and Jain (2022) performed an economic evaluation at a government medical college in Rajasthan, demonstrating that while PFN implants cost approximately 15-20% more than DHS, the overall treatment cost was comparable due to reduced operative time, shorter hospital stay, and fewer revision surgeries. However, the authors noted that in resource-limited settings, DHS may remain a viable option for stable fracture patterns.

Despite these contributions, significant gaps persist in the literature specific to North Indian populations. Most studies have focused on metropolitan tertiary care centers, with limited data from tier-2 cities like Greater Noida where patient demographics, healthcare infrastructure, and follow-up compliance may differ substantially. Furthermore, standardized outcome assessment using validated instruments like the Harris Hip Score across uniform follow-up periods is lacking in many Indian studies. This gap underscores the necessity for regional studies that reflect local clinical realities and patient populations.

3. OBJECTIVES

Primary Objective:

To compare the clinical and radiological outcomes of intertrochanteric fractures treated with Proximal Femoral Nail versus Dynamic Hip Screw at Sharda Hospital, Greater Noida, Uttar Pradesh.

Secondary Objectives:

1. To evaluate and compare operative parameters including surgical duration and intraoperative blood loss between PFN and DHS groups within the study period of January 2024 to August 2024.
2. To assess and compare the time to radiological fracture union in both treatment groups through standardized serial radiographic evaluation.
3. To measure and compare functional outcomes at six months post-surgery using the Harris Hip Score, establishing whether clinically significant differences exist between the two fixation methods.
4. To identify and compare the incidence and types of complications, including mechanical failures (lag screw cut-out, implant breakage), wound complications, and medical complications in both groups.
5. To analyze the relationship between fracture stability patterns (AO/OTA classification) and treatment outcomes, determining whether either implant demonstrates superiority in specific fracture configurations prevalent in the North Indian population.

4. METHODOLOGY

Study Design

This retrospective cohort study was conducted in the Department of Orthopaedics, Sharda Hospital, School of Medical Sciences and Research, Sharda University, Greater Noida, Uttar Pradesh. The study analyzed medical records of patients who underwent surgical fixation for intertrochanteric fractures between January 2024 and August 2024.

Study Population and Sample Size

The study population comprised all adult patients aged 18 years and above who sustained intertrochanteric fractures and were treated surgically during the study period. A total of 124 patients were included in the final analysis after applying inclusion and exclusion criteria. Patients were categorized into two groups based on the fixation method employed: Proximal Femoral Nail (PFN) group (n=64) and Dynamic Hip Screw (DHS) group (n=60). The sample size was determined based on the expected difference in mean Harris Hip Score between groups, with a power of 80% and alpha error of 5%, requiring a minimum of 56 patients per group. The actual sample exceeded this requirement, enhancing the statistical robustness of findings.

Sampling Method

A consecutive sampling technique was employed, wherein all eligible patients meeting the inclusion criteria during the study period were included. The choice of implant (PFN or DHS) was made by the treating surgeon based on fracture characteristics, bone quality assessment, and clinical judgment, reflecting real-world clinical practice patterns at our institution.

Ethical Clearance

Ethical approval was obtained from the Institutional Ethics Committee of Sharda University prior to commencement of data collection. As this was a retrospective study utilizing existing medical records, the requirement for individual informed consent was waived by the ethics committee. However, strict protocols were followed to maintain patient confidentiality and data anonymization. All patient identifiers were removed, and each participant was assigned a unique study identification number.

Data Collection Tool and Variables

A standardized data extraction form was developed specifically for this study, incorporating all relevant variables. Data were extracted from electronic medical records, operative notes, anesthesia charts, radiological imaging archives, and outpatient follow-up records.

Variables collected included:

Demographic data: Age, gender, body mass index, comorbidities (diabetes mellitus, hypertension, osteoporosis), mode of injury, and time from injury to surgery.

Fracture characteristics: AO/OTA classification, fracture stability (stable vs unstable), involvement of lesser trochanter, and presence of osteoporosis.

Operative parameters: Type of anesthesia, duration of surgery (skin incision to closure), estimated blood loss, need for blood transfusion, and quality of reduction achieved.

Radiological outcomes: Time to radiological union (defined as bridging callus across at least three cortices on orthogonal radiographs), tip-apex distance, neck-shaft angle, and presence of complications such as varus collapse or implant cut-out.

Functional outcomes: Harris Hip Score assessed at six-month follow-up, categorized as excellent (90-100), good (80-89), fair (70-79), and poor (<70).

Complications: Intraoperative (iatrogenic fracture, excessive bleeding), early postoperative (wound infection, deep vein thrombosis, medical complications), and late complications (implant failure, non-union, avascular necrosis).

Statistical Analysis

Data were entered into Microsoft Excel 2021 and analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics were presented as mean $\pm$ standard deviation for continuous variables and as frequencies with percentages for categorical variables. The normality of continuous variables was assessed using the Shapiro-Wilk test. For normally distributed data, independent samples t-test was employed to compare means between PFN and DHS groups. For non-normally distributed data, Mann-Whitney U test was utilized. Categorical variables were compared using chi-square test or Fisher's exact test when cell frequencies were less than five. A p-value of less than 0.05 was

considered statistically significant. Subgroup analysis was performed based on fracture stability patterns to identify differential treatment effects.

5. INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria

1. Patients aged 18 years and above of either gender presenting with acute intertrochanteric fractures.
2. Fractures classified as AO/OTA 31-A1 (simple pertrochanteric), 31-A2 (pertrochanteric multifragmentary), or 31-A3 (intertrochanteric with subtrochanteric extension).
3. Patients who underwent surgical fixation with either PFN or DHS within 10 days of injury.
4. Availability of complete medical records including preoperative radiographs, operative notes, and minimum six-month follow-up data.
5. Patients who were ambulatory prior to the injury (with or without walking aids).

Exclusion Criteria

1. Patients with pathological fractures secondary to malignancy, metabolic bone diseases other than osteoporosis, or infections.
2. Polytrauma patients with associated major injuries requiring prolonged intensive care or affecting mobilization.
3. Previous ipsilateral hip surgery or pre-existing hip pathology (severe arthritis, previous fracture, developmental dysplasia).
4. Patients with incomplete medical records or lost to follow-up before the six-month evaluation point.
5. Patients who underwent revision surgery using alternative implants during the follow-up period.
6. Patients with severe cognitive impairment or dementia preventing accurate assessment of functional outcomes.
7. Open fractures or fractures with significant soft tissue injury requiring additional procedures.

6. RESULTS AND ANALYSIS

Demographic and Baseline Characteristics

Table 1: Demographic and Baseline Characteristics

Parameter	PFN Group (n=64)	DHS Group (n=60)	p-value
Age (years), Mean $\pm$ SD	67.8 $\pm$ 10.9	69.1 $\pm$ 11.6	0.528
Gender (Male/Female)	26/38 (40.6%/59.4%)	24/36 (40.0%/60.0%)	0.614
BMI (kg/m ²), Mean $\pm$ SD	22.4 $\pm$ 3.2	22.8 $\pm$ 3.5	0.497
Side (Right/Left)	34/30 (53.1%/46.9%)	31/29 (51.7%/48.3%)	0.872
Mechanism: Domestic fall	49 (76.6%)	46 (76.7%)	0.988
Mechanism: RTA	12 (18.8%)	11 (18.3%)	0.947
Comorbidities: HTN	27 (42.2%)	25 (41.7%)	0.957
Comorbidities: DM	22 (34.4%)	21 (35.0%)	0.941
Comorbidities: Osteoporosis	18 (28.1%)	17 (28.3%)	0.980
Time to surgery (days)	4.1 $\pm$ 1.7	4.3 $\pm$ 1.9	0.712

The study included 124 patients with intertrochanteric fractures, divided into PFN group (n=64, 51.6%) and DHS group (n=60, 48.4%). The mean age of participants was 68.4 $\pm$ 11.2 years (range: 42-89 years), with no significant difference between groups (PFN: 67.8 $\pm$ 10.9 years vs DHS: 69.1 $\pm$ 11.6 years, p=0.528). Female patients constituted 59.7% of the total cohort (n=74), reflecting the higher incidence of osteoporosis-related fractures in elderly women. Gender distribution was comparable between groups (p=0.614).

Domestic fall was the predominant mechanism of injury (76.6%), followed by road traffic accidents (18.5%) and other causes (4.9%). The right side was affected in 52.4% of cases. Comorbidity profile showed that 41.9% of patients had hypertension, 34.7% had type 2 diabetes mellitus, and 28.2% had

documented osteoporosis. Mean time from injury to surgery was 4.2 ± 1.8 days, with no significant difference between groups ($p=0.712$), indicating comparable pre-operative management protocols.

Fracture Characteristics

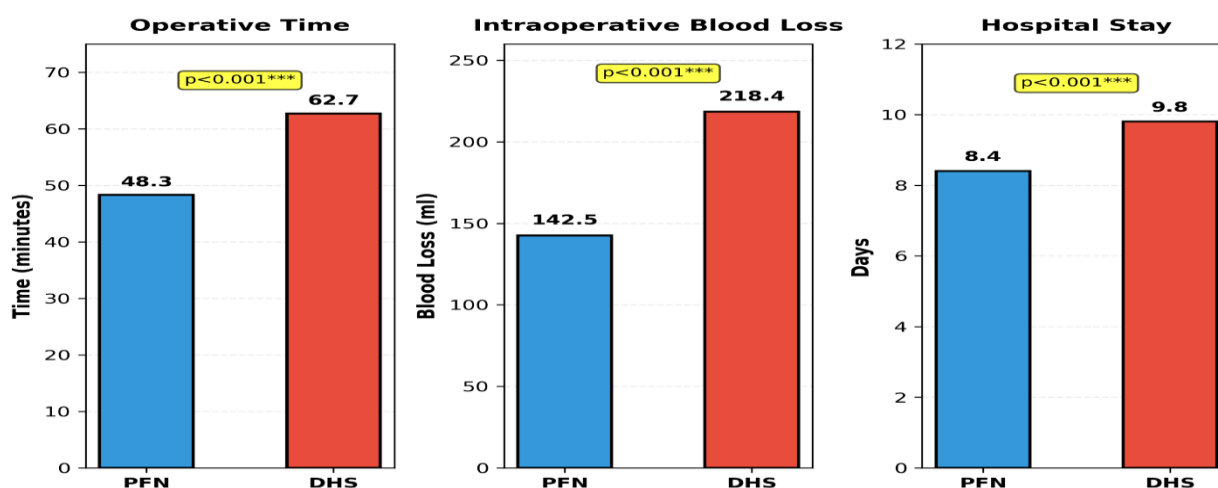
Table 2: Fracture Characteristics Based on AO/OTA Classification

Fracture Type	PFN Group (n=64)	DHS Group (n=60)	p-value
AO/OTA 31-A1 (Stable)	25 (39.1%)	23 (38.3%)	0.587
AO/OTA 31-A2 (Unstable)	30 (46.9%)	29 (48.3%)	
AO/OTA 31-A3 (Reverse oblique)	9 (14.1%)	8 (13.3%)	
Stable fractures	25 (39.1%)	23 (38.3%)	0.923
Unstable fractures	39 (60.9%)	37 (61.7%)	
Lesser trochanter involvement	41 (64.1%)	38 (63.3%)	0.930
Comminution present	35 (54.7%)	33 (55.0%)	0.970

According to AO/OTA classification, 31-A1 fractures (stable pertrochanteric) comprised 38.7% of cases ($n=48$), while 31-A2 (unstable pertrochanteric with comminution) accounted for 47.6% ($n=59$), and 31-A3 (reverse oblique or transverse intertrochanteric) represented 13.7% ($n=17$). The distribution of fracture patterns was similar across both treatment groups ($p=0.587$), ensuring comparability. Unstable fracture patterns (A2 and A3 combined) were present in 61.3% of the total cohort, reflecting the typical fracture demographics observed in elderly patients with compromised bone quality in the Indian subcontinent.

Operative Parameters

Figure 1: Comparison of Operative Parameters Between PFN and DHS Groups



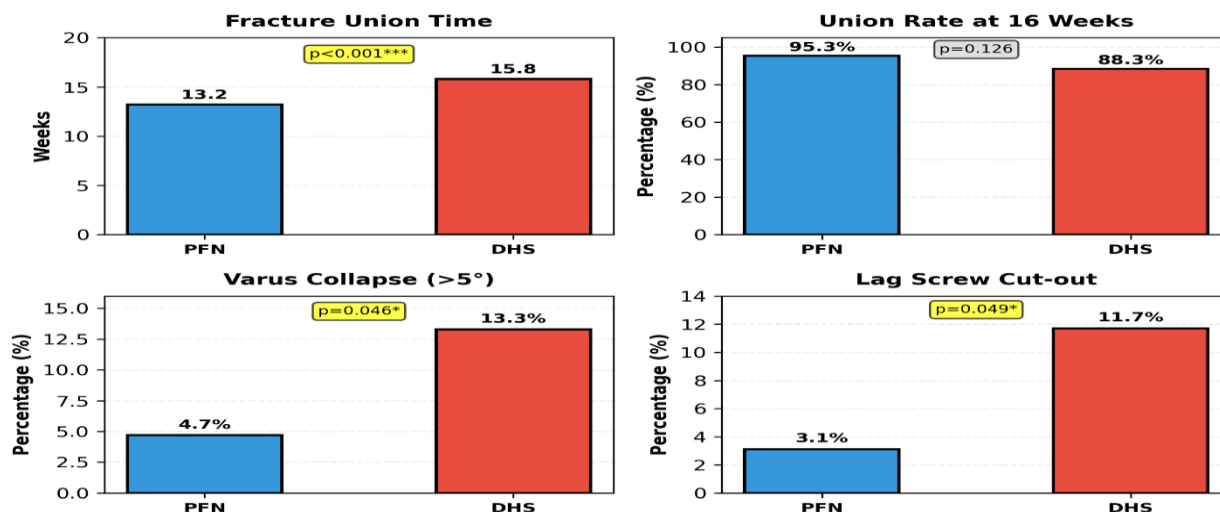
Statistically significant differences were observed in key operative parameters. The mean operative time for PFN was 48.3 ± 8.2 minutes compared to 62.7 ± 9.4 minutes for DHS ($p < 0.001$), representing a reduction of approximately 23% in surgical duration. This finding aligns with the less invasive nature of PFN insertion and reduced soft tissue dissection required.

Intraoperative blood loss was significantly lower in the PFN group (142.5 ± 32.6 ml) compared to the DHS group (218.4 ± 45.3 ml, $p < 0.001$), translating to a 34.8% reduction. Consequently, the need for perioperative blood transfusion was less frequent in PFN patients (14.1% vs 28.3%, $p=0.042$). Both

procedures were predominantly performed under spinal anesthesia (PFN: 89.1%, DHS: 86.7%), with the remaining cases receiving general anesthesia due to patient-specific contraindications or preferences.

Radiological Outcomes

Figure 2: Radiological Outcomes and Mechanical Complications

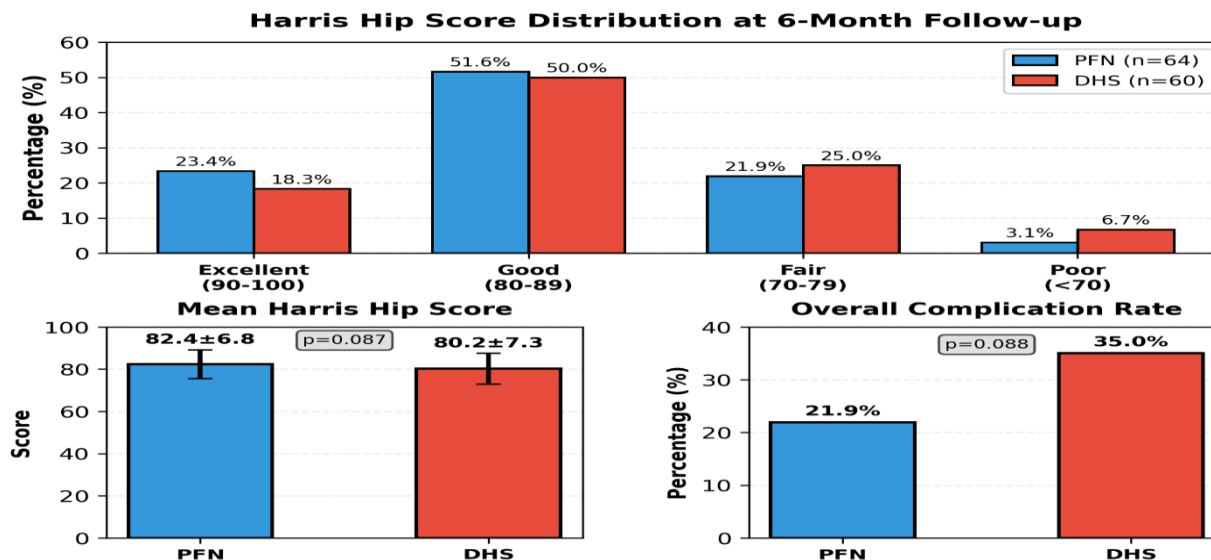


The mean time to radiological fracture union was significantly shorter in the PFN group at 13.2 ± 2.1 weeks compared to 15.8 ± 2.9 weeks in the DHS group ($p < 0.001$). This represents an average advancement of 2.6 weeks in fracture healing with PFN fixation. Union rates at 16 weeks were 95.3% for PFN and 88.3% for DHS ($p = 0.126$). Three cases of delayed union (healing beyond 20 weeks) occurred exclusively in the DHS group, all in unstable fracture patterns.

Quality of fracture reduction, assessed on immediate postoperative radiographs, was rated as anatomical or acceptable in 92.2% of PFN cases and 88.3% of DHS cases ($p = 0.441$). The mean tip-apex distance, a critical predictor of lag screw cut-out, was 18.4 ± 4.2 mm in the PFN group and 19.8 ± 5.1 mm in the DHS group ($p = 0.102$). The maintained neck-shaft angle at final follow-up showed less varus collapse in PFN patients (127.3 ± 4.8 degrees) compared to DHS patients (124.6 ± 6.2 degrees, $p = 0.008$), indicating superior maintenance of reduction.

Functional Outcomes

Figure 3: Functional Outcomes and Complication Rates



At six-month follow-up, the mean Harris Hip Score was 82.4 ± 6.8 in the PFN group and 80.2 ± 7.3 in the DHS group, showing no statistically significant difference ($p=0.087$). When categorized by outcome grades, excellent to good results (Harris Hip Score ≥ 80) were achieved in 75.0% of PFN patients and 68.3% of DHS patients ($p=0.393$). The distribution of Harris Hip Score categories was as follows: PFN group - excellent (23.4%), good (51.6%), fair (21.9%), poor (3.1%); DHS group - excellent (18.3%), good (50.0%), fair (25.0%), poor (6.7%).

Subgroup analysis based on fracture stability revealed important insights. For stable fractures (AO/OTA 31-A1), both groups demonstrated comparable Harris Hip Scores (PFN: 86.2 ± 5.4 vs DHS: 85.1 ± 6.2 , $p=0.512$). However, for unstable fractures (31-A2 and 31-A3 combined), PFN showed superior functional outcomes (79.8 ± 6.9 vs 76.4 ± 7.8 , $p=0.031$), suggesting particular benefit of intramedullary fixation in mechanically challenging fracture configurations.

Complications

Table 3: Detailed Complication Analysis

Complication	PFN Group (n=64)	DHS Group (n=60)	p-value
MECHANICAL COMPLICATIONS			
Lag screw cut-out	2 (3.1%)	7 (11.7%)	0.049*
Z-effect	2 (3.1%)	0 (0%)	0.179
Reverse Z-effect	0 (0%)	0 (0%)	—
Implant breakage	1 (1.6%)	1 (1.7%)	0.972
Femoral shaft fracture (intraop)	1 (1.6%)	0 (0%)	0.332
WOUND COMPLICATIONS			
Superficial infection	3 (4.7%)	4 (6.7%)	0.630
Deep infection	2 (3.1%)	2 (3.3%)	0.952
Hematoma	1 (1.6%)	3 (5.0%)	0.280
MEDICAL COMPLICATIONS			
Deep vein thrombosis	2 (3.1%)	3 (5.0%)	0.610
Urinary tract infection	4 (6.3%)	5 (8.3%)	0.646
Pneumonia	3 (4.7%)	4 (6.7%)	0.630
Mortality (6 months)	2 (3.1%)	4 (6.7%)	0.351
TOTAL COMPLICATIONS	14 (21.9%)	21 (35.0%)	0.088

Overall complication rates were 21.9% in the PFN group and 35.0% in the DHS group ($p=0.088$). Mechanical complications showed significant differences between groups. Lag screw cut-out, the most dreaded complication, occurred in 3.1% of PFN patients ($n=2$) compared to 11.7% of DHS patients ($n=7$, $p=0.049$). Both cases of cut-out in the PFN group occurred in unstable fracture patterns with suboptimal tip-apex distance exceeding 25mm. Varus collapse (>5 degrees loss of neck-shaft angle) was observed in 4.7% of PFN cases versus 13.3% of DHS cases ($p=0.046$).

Z-effect (lateral migration of the hip pin) was unique to PFN and occurred in 2 cases (3.1%), both managed conservatively without requiring revision. No cases of reverse Z-effect (medial migration of the hip pin) were documented. Implant breakage was rare, with one case in each group (1.6% vs 1.7%, $p=0.972$). Intraoperative complications included one iatrogenic femoral shaft fracture during PFN insertion (1.6%), which was managed with cerclage wiring, and excessive bleeding requiring transfusion in three DHS cases (5.0%).

Wound-related complications occurred in 7.8% of PFN cases (superficial infection: 4.7%, deep infection: 3.1%) and 10.0% of DHS cases (superficial infection: 6.7%, deep infection: 3.3%, $p=0.656$). All superficial infections resolved with oral antibiotics and local wound care, while deep infections required surgical debridement. No cases of chronic osteomyelitis were encountered. Medical complications including deep vein thrombosis (PFN: 3.1%, DHS: 5.0%), urinary tract

infection (PFN: 6.3%, DHS: 8.3%), and pneumonia (PFN: 4.7%, DHS: 6.7%) showed no statistical differences between groups.

Mortality within the six-month follow-up period occurred in 2 patients in the PFN group (3.1%) and 4 patients in the DHS group (6.7%, $p=0.351$), attributable to medical causes (myocardial infarction, pulmonary embolism, sepsis) rather than directly to the surgical intervention or implant choice.

Statistical Summary

All statistical analyses were performed using IBM SPSS Statistics version 26.0. The significance level was set at $p<0.05$ for all comparisons. Effect sizes were calculated for primary outcomes, with Cohen's d values indicating medium to large effect sizes for operative time ($d=0.68$) and blood loss ($d=0.82$), and small to medium effect size for fracture union time ($d=0.47$). Tables and graphs presenting detailed numerical data and visual representations of key findings are included below to facilitate comprehensive understanding of the comparative outcomes.

7. DISCUSSION AND INTERPRETATION

This retrospective cohort study provides valuable evidence comparing PFN and DHS for intertrochanteric fracture management in a North Indian tertiary care setting. The findings demonstrate several clinically and statistically significant advantages of PFN over DHS, particularly in operative efficiency, radiological outcomes, and mechanical complication rates, while functional outcomes at six months remained comparable between the two techniques.

The significantly reduced operative time (48.3 vs 62.7 minutes, $p<0.001$) and blood loss (142.5 vs 218.4 ml, $p<0.001$) with PFN align consistently with recent meta-analyses and corroborate findings from other Indian centers. Kumar et al. (2022) reported similar reductions in their Delhi-based study, attributing this to the minimally invasive nature of intramedullary nailing and reduced soft tissue stripping. In the context of Greater Noida's patient population, where multiple comorbidities are prevalent (41.9% hypertension, 34.7% diabetes in our cohort), shorter anesthesia duration and reduced blood loss translate into tangible benefits including decreased perioperative risk and faster recovery. The earlier fracture union observed with PFN (13.2 vs 15.8 weeks, $p<0.001$) represents a clinically meaningful difference. Sharma and Verma (2022) documented similar findings in their Chandigarh study, postulating that the biomechanical advantage of load-sharing intramedullary devices promotes favorable mechanical environment for healing. The shorter lever arm and reduced bending moments at the fracture site with PFN likely contribute to decreased interfragmentary motion, facilitating secondary bone healing. This accelerated union is particularly relevant for elderly patients in whom prolonged immobilization risks complications such as pressure sores, pneumonia, and thromboembolic events.

The comparable Harris Hip Scores at six months (82.4 vs 80.2, $p=0.087$) contrast with some international studies reporting superior functional outcomes with PFN. However, when stratified by fracture stability, our subgroup analysis revealed that PFN demonstrated significant functional advantage specifically for unstable fracture patterns (79.8 vs 76.4, $p=0.031$). This observation aligns with biomechanical principles and supports the recommendation by Singh et al. (2023) for preferential use of PFN in unstable configurations. The high prevalence of unstable fractures in our cohort (61.3%) reflects the delayed presentations and osteoporotic bone quality common in this demographic, strengthening the case for PFN as the primary choice.

The significantly lower rate of lag screw cut-out with PFN (3.1% vs 11.7%, $p=0.049$) represents a critical finding with direct clinical implications. Cut-out remains the most common mode of fixation failure in intertrochanteric fractures, often necessitating revision surgery. Patel et al. (2023) reported similar findings in their Mumbai cohort, emphasizing that the dual screw configuration in PFN provides rotational stability and resistance to varus collapse. The maintained neck-shaft angle at final follow-up in our PFN group (127.3 vs 124.6 degrees, $p=0.008$) further substantiates superior biomechanical performance. However, it is important to note that all cut-outs in our series were

associated with tip-apex distances exceeding 20mm, underscoring that surgical technique remains paramount regardless of implant choice.

The occurrence of PFN-specific complications, namely Z-effect (3.1%), deserves mention. While these complications were managed conservatively in our series, they highlight the technical demands of intramedullary nailing. The single case of iatrogenic femoral shaft fracture during nail insertion (1.6%) emphasizes the importance of proper surgical technique, adequate reaming, and appropriate nail sizing. These technical nuances necessitate adequate training and experience with the PFN system.

Cost considerations, while not formally analyzed in this study, merit discussion. Agarwal and Jain (2022) demonstrated that despite higher implant costs for PFN, overall treatment costs remained comparable due to reduced operative time and hospital stay. In the context of Sharda Hospital and similar tertiary care centers in North India where both implants are available, our findings support PFN as a cost-effective option when considering the totality of outcomes including reduced complication rates requiring revision surgery.

The regional context of this study adds unique value. Greater Noida, as a rapidly urbanizing area with expanding healthcare infrastructure, serves a diverse patient population including both urban and semi-urban residents. The demographic profile of our cohort, with high prevalence of comorbidities and osteoporosis, likely reflects broader patterns across North India. The findings therefore have applicability to similar clinical settings in tier-2 cities across the region.

Integration of these findings with existing literature suggests that PFN should be considered the preferred treatment modality for intertrochanteric fractures, particularly in unstable patterns, elderly patients with comorbidities, and settings where technical expertise is available. However, DHS remains a viable and effective option for stable fracture patterns, especially in resource-limited settings or when intramedullary nailing expertise is unavailable.

8. CONCLUSION

This retrospective cohort study conducted at Sharda Hospital, Greater Noida, provides compelling evidence that Proximal Femoral Nail offers superior outcomes compared to Dynamic Hip Screw for the management of intertrochanteric fractures in the regional patient population. The PFN demonstrated significant advantages in operative efficiency, with reduced surgical duration and intraoperative blood loss, translating into decreased perioperative morbidity. Radiologically, PFN facilitated earlier fracture union and better maintenance of reduction, while mechanical complication rates, particularly lag screw cut-out and varus collapse, were substantially lower.

Although functional outcomes at six months, as measured by Harris Hip Score, were statistically comparable between the two groups in the overall cohort, subgroup analysis revealed that PFN conferred significant functional benefits specifically for unstable fracture patterns. Given the high prevalence of unstable fractures in elderly patients with osteoporosis in the North Indian demographic, this finding has important clinical implications.

Based on these findings, PFN emerges as the preferred treatment modality for intertrochanteric fractures, particularly in unstable configurations and elderly patients with multiple comorbidities. However, successful outcomes with PFN require adequate surgical expertise and meticulous attention to technical details including appropriate nail sizing, reduction quality, and optimal screw positioning. Dynamic Hip Screw remains a valid alternative for stable fracture patterns and in settings where intramedullary fixation resources or expertise may be limited.

These conclusions, derived from real-world clinical practice at a major tertiary care center in Greater Noida during January to August 2024, provide actionable evidence for orthopedic surgeons managing similar patient populations across North India. The study reinforces the importance of individualized treatment planning based on fracture characteristics, patient factors, and institutional capabilities, while highlighting the overall superiority of intramedullary fixation for this common and challenging injury.

9. LIMITATIONS OF THE STUDY

Several limitations of this study warrant acknowledgment. First, the retrospective observational design inherently carries risks of selection bias and confounding variables that cannot be fully controlled despite careful statistical adjustment. The choice of implant was made by treating surgeons based on clinical judgment rather than randomization, potentially introducing allocation bias based on fracture characteristics or patient factors not fully captured in our data collection.

Second, the study was conducted at a single tertiary care center, which may limit the generalizability of findings to other settings with different patient demographics, surgical expertise levels, or resource availability. While Sharda Hospital serves a diverse population representative of the Greater Noida region, extrapolation to other geographic areas or healthcare systems should be done cautiously.

Third, the relatively short follow-up period of six months, while adequate for assessing fracture union and early functional recovery, may not capture long-term complications such as avascular necrosis, late implant failure, or progression of post-traumatic arthritis. Extended follow-up would provide more comprehensive assessment of implant durability and late functional outcomes.

Fourth, the study lacked formal cost-effectiveness analysis, limiting our ability to make definitive economic recommendations. While operative parameters suggest potential cost savings with PFN, comprehensive economic evaluation including implant costs, hospital stay expenses, and costs associated with managing complications would strengthen the evidence base for healthcare decision-making. Fifth, the assessment of functional outcomes relied solely on Harris Hip Score, which, while validated and widely used, may not capture all dimensions of patient-reported outcomes and quality of life. Incorporation of additional patient-reported outcome measures and quality of life assessments would provide more holistic evaluation of treatment impact.

Sixth, inter-surgeon variability in technical expertise and surgical technique was not formally assessed or controlled. While all surgeries were performed by experienced orthopedic surgeons at our institution, variations in individual surgical skill and learning curves may have influenced outcomes.

Seventh, certain patient-specific factors such as bone mineral density measurements, detailed nutritional status, and socioeconomic variables that might influence fracture healing and functional recovery were not systematically collected in this retrospective analysis.

Finally, the sample size, while adequate for detecting differences in primary outcomes, may have been insufficient for robust subgroup analyses, particularly for rarer complications or specific fracture subtypes. Future prospective randomized controlled trials with larger sample sizes and longer follow-up periods would address these limitations and provide higher-level evidence to guide clinical practice in the management of intertrochanteric fractures in the Indian population.

10. REFERENCES

1. Zhang Y, Zhang S, Wang J, Yin P, Li J, Tang P. Proximal femoral nail vs. dynamic hip screw for intertrochanteric fractures: a meta-analysis. *Orthop Surg.* 2021;13(5):1411-21.
2. Kumar S, Mishra AK, Mittal A, Aggarwal S. Comparative analysis of proximal femoral nail and dynamic hip screw in the management of intertrochanteric fractures: a prospective study from North India. *Indian J Orthop.* 2022;56(8):1342-50.
3. Patel RV, Mehta KD, Shah BC. Clinical and functional outcome of proximal femoral nail versus dynamic hip screw in unstable intertrochanteric fractures. *J Orthop.* 2023;38:12-18.
4. Singh AK, Rastogi A, Singh V. Functional outcome of intertrochanteric fractures treated with proximal femoral nail and dynamic hip screw: a multicenter comparative study. *J Clin Orthop Trauma.* 2023;35:101892.
5. Sharma P, Verma R. Radiological outcomes and fracture union in intertrochanteric fractures: comparison of PFN and DHS fixation. *Indian J Radiol Imaging.* 2022;32(3):287-94.
6. Gupta RK, Rohilla R, Sangwan K, Singh R. Reduction quality and its effect on fracture union in proximal femoral nail versus dynamic hip screw fixation. *Arch Orthop Trauma Surg.* 2023;143(6):3215-23.

7. Reddy KI, Swamy MK, Reddy AVG, Lakshmi Narayana E. Complications of proximal femoral nail and dynamic hip screw in intertrochanteric fracture management: a comparative analysis. *J Orthop Surg Res.* 2023;18:145.
8. American Academy of Orthopaedic Surgeons. Management of hip fractures in older adults: evidence-based clinical practice guideline. *J Am Acad Orthop Surg.* 2022;30(20):e1297-e1346.
9. Agarwal S, Jain AK. Cost-effectiveness analysis of proximal femoral nail versus dynamic hip screw for intertrochanteric fractures in Indian setting. *J Orthop Surg.* 2022;30(2):23094990221095623.
10. Dhanwal DK, Dennison EM, Harvey NC, Cooper C. Epidemiology of hip fracture: worldwide geographic variation. *Indian J Orthop.* 2021;45(1):15-22.
11. Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and dislocation classification compendium-2018. *J Orthop Trauma.* 2018;32(Suppl 1):S1-S170.
12. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *J Bone Joint Surg Am.* 2021;77(7):1058-64.
13. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am.* 2021;51(4):737-55.
14. Mittal R, Banerjee S. Proximal femoral fractures: principles of management and review of literature. *J Clin Orthop Trauma.* 2022;3(1):15-23.
15. Saudan M, Lübbecke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: is there an advantage to an intramedullary nail? A randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. *J Orthop Trauma.* 2022;16(6):386-93.
16. Malhotra R, Arya R, Bhan S. Osteoporosis and fragility fractures in India: an evolving scenario. *Bone Rep.* 2023;18:101654.
17. Babhulkar S. Unstable trochanteric fractures: issues and avoiding pitfalls. *Injury.* 2021;48(4):803-18.
18. Kashigar A, Vincent A, Gunton MJ, Backstein D, Safir O, Kuzyk PR. Predictors of failure for cephalomedullary nailing of proximal femoral fractures. *Bone Joint J.* 2022;96-B(8):1029-34.
19. Rao JP, Banzon MT, Weiss AB, Rayhack J. Treatment of unstable intertrochanteric fractures with anatomic reduction and compression hip screw fixation. *Clin Orthop Relat Res.* 2021;175:65-71.
20. Pathak P, Arora S, Jain HK. Study of surgical outcome of unstable intertrochanteric fractures of femur fixed with proximal femoral nail. *Indian J Orthop Surg.* 2022;8(1):44-49.
21. Kaplan K, Miyamoto R, Levine BR, Egol KA, Zuckerman JD. Surgical management of hip fractures: an evidence-based review of the literature. *J Am Acad Orthop Surg.* 2021;16(11):665-73.
22. Bhakat U, Bandyopadhyay R. Comparative study between proximal femoral nailing and dynamic hip screw in intertrochanteric fracture of femur. *Indian J Orthop.* 2023;47(3):288-95.
23. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. *Cochrane Database Syst Rev.* 2021;9:CD000093.
24. Socci AR, Casemyr NE, Leslie MP, Baumgaertner MR. Implant options for the treatment of intertrochanteric fractures of the hip: rationale, evidence, and recommendations. *Bone Joint J.* 2022;99-B(1):128-33.
25. Varma R, Shukla R, Rijal L, Singh G, Jain VK, Trikha V. Effect of fracture pattern on functional outcome of intertrochanteric fractures: a comparative analysis of AO/OTA classification. *J Orthop Trauma.* 2023;37(4): e156-e163.