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Original Research Article

Comparative Study of Proximal Femoral Nail versus Dynamic Hip Screw Fixation in Elderly Patients with Intertrochanteric Femur Fractures: A Prospective Cohort Analysis

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Abstract:

Background: Intertrochanteric femur fractures are common in the elderly population and are associated with significant morbidity and functional decline. Optimal surgical fixation remains a subject of debate, particularly between intramedullary and extramedullary devices. This study aimed to compare clinical, radiological, and functional outcomes of proximal femoral nail (PFN) and dynamic hip screw (DHS) fixation in elderly patients with intertrochanteric femur fractures.

Material and Methods: This prospective cohort study was conducted from March 2015 to March 2017 at a tertiary care center and included 120 elderly patients (≥60 years) with intertrochanteric femur fractures. Patients were allocated into two groups based on the fixation method used: PFN (n=60) and DHS (n=60). Demographic variables, intraoperative parameters, postoperative mobilization, radiological union, complications, and functional outcomes were assessed. Functional evaluation was performed using the Harris Hip Score at 6 weeks, 3 months, 6 months, and 12 months postoperatively. Statistical analysis was carried out using appropriate parametric and non-parametric tests, with a p value <0.05 considered significant.

Results: Baseline demographic and fracture characteristics were comparable between the two groups. The PFN group demonstrated significantly shorter operative time (58.4 ± 9.6 vs 74.8 ± 11.2 minutes; p<0.01) and lower intraoperative blood loss (118 ± 32 vs 182 ± 44 mL; p<0.01). Earlier mobilization and shorter hospital stay were observed in the PFN group (p<0.01). Mean time to fracture union was significantly shorter with PFN fixation (14.6 ± 2.3 weeks) compared to DHS (16.8 ± 2.9 weeks; p<0.01). Functional outcomes were superior in the PFN group at all follow-up intervals, with higher Harris Hip Scores at 12 months (88.7 ± 5.4 vs 83.1 ± 5.9; p<0.01). Mechanical complications, particularly varus collapse, were less frequent in the PFN group.

Conclusion: Proximal femoral nail fixation provides better functional recovery, earlier mobilization, and fewer mechanical complications compared to dynamic hip screw fixation in elderly patients with intertrochanteric femur fractures, supporting its preferential use in this population.

Keywords: Intertrochanteric Femur Fracture; Proximal Femoral Nail; Dynamic Hip Screw; Elderly; Functional Outcome.

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Introduction

Intertrochanteric femur fractures represent a major subset of geriatric hip fractures and are frequently encountered in elderly patients with osteoporotic bone. Contemporary clinical series indicate that these injuries account for roughly half of hip fractures and are associated with substantial early mortality and loss of independence, underscoring the importance of timely operative stabilization and structured postoperative rehabilitation.[1] Current surgical management is dominated by two implant strategies: an extramedullary sliding construct (dynamic hip screw/sliding hip screw) and intramedullary cephalomedullary devices (proximal femoral nails and related designs).[1]

The choice of implant is clinically important because intertrochanteric fractures are

heterogeneous, and the proportion of unstable patterns may be increasing in older populations.[3] Unstable configurations have a higher propensity for varus collapse, excessive fracture impaction, and fixation failure when mechanical support is suboptimal, potentially compromising limb length, abductor mechanics, and functional recovery.[3] Evidence-based guidance for hip fractures in older adults emphasizes management pathways that facilitate early mobilization and optimize outcomes, but implant selection for extracapsular fractures still depends on fracture morphology, bone quality, and resource considerations.[2]

Comparative clinical evidence has not been entirely uniform. The INSITE randomized clinical trial reported similar 1-year outcomes between intramedullary nails and sliding hip screws for trochanteric fractures, supporting the view that sliding hip screws remain a reasonable lower-cost alternative for many patients.[4] Conversely, pooled analyses have suggested that cephalomedullary devices may reduce some failure-related endpoints or offer modest advantages in selected outcomes, with cumulative meta-analytic data indicating evolving results over time and systematic reviews noting small but measurable differences in functional recovery favoring intramedullary fixation in some settings.[5,6] Irrespective of implant choice, technical factors remain critical; classic work on tip–apex distance demonstrated a strong association between lag-screw position and cut-out risk, reinforcing that meticulous reduction and implant placement are essential determinants of success.[7]

Given the ongoing debate—particularly in elderly patients where fracture stability and functional restoration are central—prospective comparative studies remain valuable to contextualize implant performance within local patient profiles and care pathways. The present prospective cohort study was therefore designed to compare proximal femoral nail and dynamic hip screw fixation in elderly patients with intertrochanteric femur fractures, focusing on perioperative parameters, radiological union, complications, and functional outcomes.

Material and Methods

Study Design and Setting: This prospective cohort study was conducted at a tertiary care teaching hospital to compare clinical, radiological, and functional outcomes of PFN and DHS fixation in elderly patients with intertrochanteric femur fractures. The study period extended from March 2015 to March 2017. Written informed consent was obtained from all participants or their legally authorized representatives prior to enrollment.

Study Population: Elderly patients presenting with fresh intertrochanteric fractures of the femur were screened for eligibility. Patients were enrolled consecutively and allocated into two cohorts based on the fixation method used: PFN group and DHS group. The choice of implant was determined by the treating surgeon, considering fracture pattern, bone quality, and intraoperative feasibility.

Inclusion Criteria

- Age ≥60 years
- Radiologically confirmed intertrochanteric fracture of the femur
- Closed fractures
- Injury-to-surgery interval ≤14 days
- Ambulatory status prior to injury (with or without assistive devices)

Exclusion Criteria

- Pathological fractures (excluding osteoporosis-related fractures)
- Polytrauma patients with associated injuries affecting mobilization
- Open intertrochanteric fractures
- Previous surgery on the ipsilateral hip or femur
- Patients medically unfit for anesthesia or surgery
- Cognitive impairment precluding reliable functional assessment

Sample Size Estimation: The sample size was calculated assuming a moderate effect size for functional outcome differences between PFN and DHS fixation, based on previously reported variability in hip function scores in similar populations. With an alpha error of 0.05 and a power of 80%, a minimum of 52 patients per group was required. To account for potential loss to follow-up, a total of 120 patients were enrolled, with 60 patients in each group.

Preoperative Assessment: All patients underwent detailed clinical evaluation, including demographic data, mechanism of injury, comorbidities, and pre-injury ambulatory status. Standard anteroposterior radiographs of the pelvis with both hips and lateral views of the affected hip were obtained. Fractures were classified according to the AO/OTA classification system. Routine laboratory investigations and anesthetic fitness assessments were performed preoperatively.

Surgical Technique: All surgeries were performed under spinal or combined spinal–epidural anesthesia with the patient positioned supine on a fracture table. Closed reduction was attempted in all cases under fluoroscopic guidance.

- **PFN Group:** Internal fixation was performed using a standard proximal femoral nail inserted through a minimally invasive approach. Proximal lag screw and anti-rotation screw placement was confirmed fluoroscopically,

ensuring appropriate tip–apex distance and fracture reduction.

- **DHS group:** Fixation was carried out using a dynamic hip screw with side plate through a lateral approach. Accurate placement of the lag screw in the femoral head and restoration of neck–shaft angle was ensured intraoperatively.

All procedures were performed by senior orthopedic surgeons experienced in both techniques.

Postoperative Management: Postoperatively, all patients received standard antibiotic prophylaxis and thromboprophylaxis as per institutional protocol. Early mobilization was encouraged, with bedside sitting initiated on the first postoperative day. Weight-bearing status was determined based on fracture stability and fixation quality. Physiotherapy protocols were standardized for both groups.

Outcome Measures: Patients were followed at 6 weeks, 3 months, 6 months, and 12 months postoperatively. Outcome assessment included:

- **Intraoperative Parameters:** duration of surgery, intraoperative blood loss
- **Radiological Outcomes:** time to fracture union, implant position, and complications such as varus collapse or implant failure
- **Functional Outcome:** assessed using the Harris Hip Score at each follow-up visit
- **Complications:** surgical site infection, implant-related complications, reoperation, and mortality

Fracture union was defined radiographically as the presence of bridging callus across at least three cortices along with the absence of pain at the fracture site during weight bearing.

Statistical Analysis: Data were entered into a standardized database and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were analyzed using the chi-square test or Fisher's exact test, as applicable. A p-value <0.05 was considered statistically significant.

Results

A total of 120 elderly patients with intertrochanteric femur fractures were included and followed prospectively, with equal distribution between the PFN and DHS cohorts. Baseline demographic variables, laterality, injury mechanism, fracture subtype distribution, time to surgery, and comorbidity burden were comparable between groups, indicating that the two cohorts were clinically well-matched at enrollment (Table 1).

Perioperative assessment demonstrated clear procedural differences between the two fixation strategies. The PFN group showed greater operative efficiency with reduced surgical invasiveness as reflected by shorter operative duration and lower intraoperative blood loss, whereas the DHS group required comparatively longer operative exposure. However, the PFN technique was associated with greater intraoperative imaging utilization, reflecting the higher fluoroscopic dependence of intramedullary fixation (Table 2).

Postoperative recovery milestones favored the PFN cohort. Patients treated with PFN achieved key mobilization targets earlier and progressed more rapidly to functional ambulation milestones, which was accompanied by a shorter inpatient stay. These patterns suggest a more accelerated early postoperative course following intramedullary fixation in this elderly cohort (Table 3).

Radiological follow-up demonstrated a more favorable healing trajectory in the PFN group, with earlier consolidation and a lower tendency toward mechanical deterioration during the healing phase. In contrast, the DHS cohort displayed a higher frequency of alignment-related compromise during follow-up, indicating a comparatively greater risk of mechanical collapse with extramedullary fixation in this study population (Table 4).

Functional outcome analysis showed a consistent advantage for PFN across the entire follow-up period. The PFN group demonstrated superior hip function at early review, and this benefit was sustained at intermediate and late follow-up, indicating that the early rehabilitation advantage translated into a durable functional improvement through one year (Table 5).

Complication surveillance indicated that overall infectious complications were infrequent and broadly comparable between groups. Mechanical and outcome-relevant adverse events—including clinically significant limb length discrepancy and the requirement for reoperation—occurred less often in the PFN cohort, while short-term mortality within one year remained low in both groups without an evident between-group difference (Table 6).

Table 1: Baseline Demographic and Clinical Characteristics

Variable	PFN Group (n = 60)	DHS Group (n = 60)	p value
Mean age (years)	71.6 ± 6.8	72.1 ± 7.2	0.68
Male: Female	28: 32	30: 30	0.71
Right-sided fracture, n (%)	34 (56.7)	36 (60.0)	0.71
Low-energy fall, n (%)	52 (86.7)	50 (83.3)	0.61
AO/OTA 31-A1 fractures, n (%)	26 (43.3)	24 (40.0)	0.71
AO/OTA 31-A2 fractures, n (%)	34 (56.7)	36 (60.0)	0.71
Mean injury-to-surgery interval (days)	4.2 ± 1.6	4.5 ± 1.8	0.32
≥1 medical comorbidity, n (%)	38 (63.3)	40 (66.7)	0.70

Table 2: Intraoperative Parameters

Parameter	PFN Group	DHS Group	p value
Mean operative time (minutes)	58.4 ± 9.6	74.8 ± 11.2	<0.01
Mean intraoperative blood loss (mL)	118 ± 32	182 ± 44	<0.01
Fluoroscopy time (seconds)	92 ± 18	68 ± 15	<0.01
Open reduction required, n (%)	6 (10.0)	9 (15.0)	0.41

Table 3: Postoperative Mobilization and Hospital Stay

Variable	PFN Group	DHS Group	p value
Time to sitting (days)	1.3 ± 0.5	1.8 ± 0.6	<0.01
Time to assisted ambulation (days)	3.1 ± 1.0	4.6 ± 1.2	<0.01
Partial weight bearing initiated (days)	4.2 ± 1.4	6.1 ± 1.8	<0.01
Mean hospital stays (days)	7.2 ± 1.9	9.1 ± 2.3	<0.01

Table 4: Radiological Outcomes

Outcome	PFN Group	DHS Group	p value
Mean time to union (weeks)	14.6 ± 2.3	16.8 ± 2.9	<0.01
Union by 16 weeks, n (%)	52 (86.7)	44 (73.3)	0.07
Varus collapse, n (%)	4 (6.7)	11 (18.3)	0.04
Implant failure, n (%)	2 (3.3)	6 (10.0)	0.14

Table 5: Functional Outcome (Harris Hip Score)

Follow-up interval	PFN Group	DHS Group	p value
6 weeks	61.8 ± 7.4	56.3 ± 6.9	<0.01
3 months	72.6 ± 6.8	66.9 ± 7.1	<0.01
6 months	82.4 ± 6.2	75.8 ± 6.6	<0.01
12 months	88.7 ± 5.4	83.1 ± 5.9	<0.01

Table 6: Postoperative Complications

Complication	PFN Group (n, %)	DHS Group (n, %)	p value
Superficial infection	3 (5.0)	5 (8.3)	0.47
Deep infection	1 (1.7)	2 (3.3)	0.56
Limb length discrepancy >1 cm	2 (3.3)	7 (11.7)	0.08
Reoperation required	2 (3.3)	6 (10.0)	0.14
Mortality (within 1 year)	2 (3.3)	3 (5.0)	0.65

Discussion

This prospective cohort analysis demonstrated that proximal femoral nail (PFN) fixation was associated with shorter operative duration and lower intraoperative blood loss compared with dynamic hip screw (DHS), alongside earlier mobilization, shorter hospitalization, faster radiological union, and higher Harris Hip Scores across follow-up. These findings align with contemporary comparative evidence suggesting that intramedullary constructs can offer perioperative and early recovery advantages, particularly for fractures with compromised stability. A recent meta-analysis focusing on unstable intertrochanteric fractures reported that PFNA (a cephalomedullary nail conceptually comparable to PFN) was associated with improved postoperative Harris Hip Scores, reduced operative time, decreased intraoperative blood loss, shorter hospital stays, and faster fracture healing compared with DHS, while

also demonstrating lower rates of varus collapse and reoperation in pooled analyses. [8] Although our cohort included both A1 and A2 patterns, the predominance of A2 fractures provides a plausible clinical context for these advantages, given the higher mechanical demands in unstable configurations.

A key trade-off observed in our study was greater fluoroscopy exposure in the PFN group, which is consistent with systematic evidence in stable fracture settings; a recent systematic review of stable intertrochanteric fractures found PFN to be associated with longer fluoroscopy exposure, while DHS may offer advantages in some perioperative parameters depending on the included study designs and endpoints. [9] This reinforces the need for technique refinement, standardized imaging protocols, and radiation-sparing strategies during intramedullary fixation, especially in high-volume units.

The earlier achievement of assisted ambulation and shorter time to functional milestones in the PFN cohort is clinically meaningful in geriatric fracture care, where minimizing bedrest-related complications is a priority. A randomized study comparing postoperative rehabilitation trajectories after DHS versus proximal femoral nail reported faster restoration of walking ability with the nail construct, supporting the concept that intramedullary fixation may facilitate earlier functional recovery in selected patients. [10] Similarly, a study comparing short-term ambulatory function in elderly patients with unstable intertrochanteric fractures reported differences in early walking outcomes between cephalomedullary devices and DHS, emphasizing that functional separation is often most apparent in the early postoperative phase. [13] In our data, the PFN group maintained higher Harris Hip Scores at each assessment point, including at 12 months; however, the absolute gap narrowed over time, suggesting that while PFN may accelerate recovery, longer-term convergence can still occur depending on fracture biology, rehabilitation quality, and comorbidity burden—an observation consistent with broader comparative literature. [9]

The reduced incidence of varus collapse in the PFN group in this cohort is biomechanically plausible. Laboratory and computational work indicate that unstable fracture models generate higher implant and cancellous bone stresses, and that reduction quality and implant positioning strongly influence varus-related mechanical risk; finite element and biomechanical analyses highlight the vulnerability of unstable patterns and the importance of avoiding varus reduction, with cephalomedullary constructs offering favorable stress distribution in certain unstable configurations. [11,12] These mechanistic insights support our clinical signal of fewer varus failures with PFN, particularly relevant when lateral wall integrity is threatened or medial support is compromised. Furthermore, a large retrospective cohort comparing cephalomedullary nails and sliding hip screws across stable and unstable subtypes emphasizes that failure and complication profiles can vary by fracture pattern, reinforcing that stratification by stability is essential when interpreting comparative outcomes. [9]

From a health-system perspective, implant selection must also consider value. A cost-effectiveness analysis modeling fixation options reported that sliding hip screw fixation is generally more cost-effective for stable fractures (A1) and in some A2 scenarios depending on failure rates, while intramedullary nails dominate in reverse obliquity (A3) fractures due to the higher risk—and downstream costs—of failure with sliding constructs in that subgroup. [14] Although our cohort did not include A3 fractures and was not designed for formal economic evaluation, our observed reduction in mechanical collapse with PFN suggests that, in populations enriched for borderline stability, the clinical advantage may translate into resource benefits by reducing late complications and reoperations. Consistent with expert synthesis on unstable trochanteric fractures, durable fixation enabling early mobilization depends on appropriate implant choice, careful reduction, and avoidance of technical pitfalls, regardless of construct type. [15]

This study has limitations. Treatment allocation was not randomized, and implant selection depended on surgeon judgement, which may introduce confounding by indication (e.g., preferential use of PFN in more unstable patterns or in patients expected to mobilize early). The cohort was derived from a single center, which may limit generalizability to different surgical volumes and rehabilitation pathways. While follow-up was structured and functional outcomes were measured with a validated score, longer-term outcomes beyond one year—particularly late implant-related symptoms and health-related quality of life—were not captured. Finally, although the overall complication profile favored PFN in mechanical endpoints, some differences (e.g., implant failure and reoperation) did not reach statistical significance, likely reflecting event rates and sample size rather than equivalence.

Conclusion

In this prospective cohort analysis of elderly patients with intertrochanteric femur fractures, PFN fixation demonstrated clear advantages over DHS fixation in terms of shorter operative time, reduced intraoperative blood loss, earlier mobilization, faster fracture union, and superior functional outcomes during follow-up. Although both implants achieved acceptable union rates, PFN was associated with a

lower incidence of mechanical complications such as varus collapse and implant failure, particularly in unstable fracture patterns. These findings suggest that intramedullary fixation with a proximal femoral nail offers a biomechanically favorable and functionally superior option for managing intertrochanteric fractures in the geriatric population, while acknowledging that implant selection should remain individualized based on fracture configuration, patient factors, and surgical expertise.

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