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Original Research Article

A Comparative Study of Functional Outcome of Dynamic Hip Screw and Proximal Femoral Nailing in Intertrochanteric Fractures

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Abstract

Background: The incidence of intertrochanteric femur fractures has risen markedly in recent decades, due to demographic changes within the Indian population. Conservative management of these fractures, which has been associated with higher mortality and morbidity, has largely been phased out. Rigid internal fixation and early mobilization have become the standard treatment approaches. The current study aimed to evaluate the outcomes of proximal femur nails compared to the dynamic hip screw device, and to assess their impact on the ultimate functional outcome for the patient.

Methods: A total of 30 cases of intertrochanteric fractures of the femur reported to our hospital were included in the study. They were allotted into two groups treated with proximal femoral nail (PFN) and Dynamic Hip Screw (DHS) based on the type of fractures. The operations were done as per standard protocol and the patients were followed up to 1 year postoperatively and functional outcome was recorded in each category.

Results: In our study, the average duration of hospital stay was 19.33 days. Overall, patients who received PFN implants seemed to have slightly better outcomes. *Excellent:* 8 patients (53.33%) in the PFN group achieved excellent results compared to 4 patients (26.66%) in the DHS group. Both groups had similar proportions of patients in the Good (26.66%) and Fair (DHS: 26.66%, PFN: 13.33%) categories. The DHS group had a higher percentage of patients with Poor outcomes (20%) compared to the PFN group (6.66%). The PFN fixation is associated with a higher rate of excellent functional outcomes p-value is (<0.006) in patients with intertrochanteric fractures treated with PFN as compared to patients treated with DHF.

Conclusion: Our findings suggest that PFN fixation offers comparable outcomes to DHS in stable fractures but emerges as the preferred option for managing unstable intertrochanteric fractures due to its superior biomechanical properties and versatility. Further research with larger patient cohorts could solidify these observations.

Keywords: Proximal Femur Nail, Dynamic Hip Screw, Intertrochanteric Femur Fracture, Functional Outcome.

Introduction

As the global elderly population increases, so too does the incidence of hip fractures. It is projected that by 2050, the number of hip fractures worldwide will exceed 6 million [1]. Factors such as weaker bones, reduced balance, the side effects of medications, and difficulties navigating environmental obstacles make the elderly particularly vulnerable to such injuries. Hip fractures significantly raise the risk of both mortality and severe morbidity in this demographic. These risks are notably high in nursing home residents, especially among men, individuals over 90 years old, those with cognitive impairments and other comorbid conditions, patients who receive non-operative treatment, and residents who cannot walk unaided. A comprehensive review in the United States highlighted that femoral neck and intertrochanteric fractures are equally prevalent among patients aged 65 to 99 years [2]. On the other hand, isolated trochanteric fractures tend to occur more frequently in younger, active adults aged 14 to 25 [2]. Internal fixation is now the preferred treatment for intertrochanteric fractures, aiming to get patients back on their feet quickly and minimize complications associated with prolonged bed rest. While various implants have been used with varying degrees of success, Dynamic Hip Screws (DHS) and Proximal Femoral Nails (PFN) are among the most effective for stabilizing these

fractures [3]. These implants offer secure fixation and controlled fracture healing, leading to excellent outcomes for most patients with simple fractures. However, a significant challenge remains for highly unstable intertrochanteric fractures. Current DHS and PFN implants have higher failure rates in these cases, ranging from 8% to 25% for unstable patterns [4] and reaching up to 50% for the most unstable fractures [5]. This study is designed to evaluate and compare the outcomes of using dynamic hip screws (DHS) and proximal femoral nails (PFN) for the fixation of intertrochanteric femur fractures. We will assess radiological union, early mobility, weight-bearing capabilities, and any associated complications. Additionally, the functional outcomes for both groups will be measured using the Modified Harris Hip Score.

Material and Methods

This cross-sectional interventional study was carried out in the Department of Orthopedics, Kakatiya Medical College and Mahatma Gandhi Memorial Hospital, Warangal between December 2020 to December 2022. Successive patients with intertrochanteric fractures of the femur treated with PFN and DHS were included in the study. Institutional Ethical approval was obtained, and written consent was obtained from all the patients included in the study.

Inclusion Criteria

1. All intertrochanteric fractures

2. Patients age more than 18 years

3. Absence of cognitive impairments

Exclusion Criteria

1. All compound fractures

2. All fractures in the pediatric and adolescent age group

3. Pathological fractures

As soon as the patient was admitted, a detailed history was taken & meticulous examination of the patient was done. The required information was recorded in proforma. patient's pelvis with both hips x-ray was taken in an anteroposterior view. The diagnosis was established by clinical and radiological examination. The patient's attendees have explained the nature of the injury its possible complications, the need for surgery, and complications of surgery. Medical evaluation of the patient is done after consulting the physician. A pre-operative parenteral antibiotic is administered one hour before surgery.

Operative Technique for Proximal Femoral Nail (PFN): This surgical approach for trochanteric hip fractures prioritizes minimally invasive techniques. Patients were positioned to optimize fracture reduction under fluoroscopic guidance (real-time X-ray). Prophylactic antibiotics are administered. Percutaneous insertion of guidewires and nails stabilizes the fracture. Open reduction may be necessary for optimal alignment in select cases. Subsequently, screws are inserted to secure the fragments definitively. Layer-by-layer closure and sterile dressing complete the procedure.

Post-operative care: Postoperatively, patients' pulse, blood pressure, respiration, and temperature were monitored. Foot end elevation is given depending on blood pressure. Antibiotics were continued in the postoperative period. Analgesics were given as per the patients' compliance. Blood transfusion was given depending on the requirement. Sutures were removed on the 10th postoperative day. Patients were encouraged to sit in the bed after 24 hours after surgery. Patients were taught quadriceps setting exercises and knee mobilization in the immediate postoperative period. The patient was taught gait training before discharge from the hospital. Only in very unstable fracture patterns weight bearing was not advised. The rest of the patients were encouraged to weight bear partially with axillary crutches or walkers depending on the pain tolerability of the individual patient.

Discharge: Patients were discharged from the hospital when independent walking was possible with or without walking aids.

Follow up: All patients were followed up at an interval of 6 weeks till the fracture union was noted and then after once in 3 months till 1 year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity, and shortening. X-ray of the involved hip with the femur was done to assess fracture union and implant bone interaction.

Operative technique for Dynamic Hip Screw (DHS) Fixation: Patients were positioned on a surgical table for the standard lateral, vastus lateralis splitting approach was used for DHS. The fracture reduction using fluoroscopy (real-time X-ray). Guide pins are inserted into the femoral head under image guidance. The femoral neck is reamed according to bone quality. A lag screw is inserted over the guidewire and secured to a plate positioned on the femur shaft. Cortical screws are then added to further stabilize the fracture. Finally, compression is applied at the fracture site, and the wound is closed. Open reduction may be necessary for optimal alignment in some cases.

Post-operative care: Patients were kept nil orally for 4 to 6 hours post-operatively. Intravenous fluid is given as needed. IV antibiotic is given for 3 days. Oral antibiotic continued for 10 days. Analgesics and tranquilizers were given according to the needs of the patient. The operated lower limb is

immobilized & kept elevated. Check x-rays were taken to study the alignment of the fracture fragment. Reduction in both AP-Internal rotation & lateral view checked & Neck-Shaft angle noted. The wound was inspected on the 2nd & 6th postoperative day. Suture removal was done on the 10th post-operative day depending on the condition of the wound.

Discharge: Patients were discharged from the hospital when independent walking was possible with or without walking aids.

Follow-up: All patients were followed up at intervals of 6 weeks till the fracture union was noted and then once in 3 months till 1 year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity, and shortening. X-ray of the involved hip with the femur was done to assess fracture union and implant bone interaction.

Statistical analysis: all the available data was refined and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 21 in Windows format. All the continuous variables were represented as mean, standard deviation, and percentages. The categorical variables were analyzed by chi-square test to determine differences between two groups and the value of p (<0.05) was considered as significant.

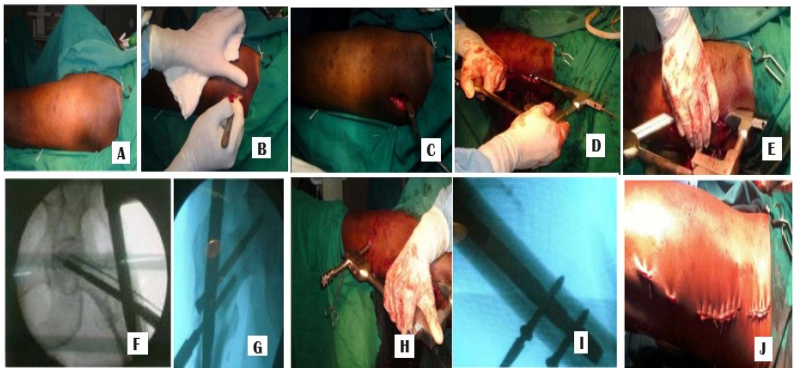

Figure 1: A: Patient position on the operation table for PFN; B: Skin incision for PFN; C: Entry portal with AWL; D: Nail insertion with jig on guide wire; E: Proximal guide wire insertion through the jig and sleeve; F & G: C-arm picture of proximal screw drilling; H & I: Distal locking through the jig; J: Skin closure.

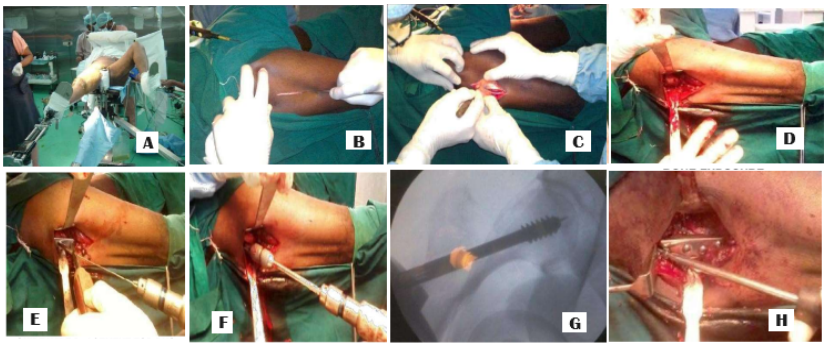

Figure 2: A: Patient Position for DHS; B: Skin Incision; C: vastus lateralis splitting; D: Exposure of Bone; E: Guidewire placement for DHS; F: Insertion of the lag screw and plate; G: Screw position verified under image intensifier H: DHS Plate Insertion

Results

A total of 30 cases of intertrochanteric fracture of the femur were included based on the inclusion and exclusion criteria. Table 1 presents the age and sex distribution of 30 patients included in a study. The majority of cases (53.33%, 16 patients) fell within the 61-80 year age group. A significant portion (30%, 9 patients) were between 41 and 60 years old. Fewer cases were observed in younger age groups (2 patients between 21-40 and none below 20). There were also a few cases (3 patients) in the oldest age group (81-100). *Sex Distribution:* The table shows a slight female predominance, with 16 females (53.33%) compared to 14 males (46.67%). This data suggests that intertrochanteric fractures are more common in older adults, with a peak incidence between 61 and 80 years old. The occurrence of these fractures increases significantly after 40 years of age. While less frequent, younger adults can also experience this type of fracture. There seems to be a slight trend towards a higher prevalence in females, although the difference is not significant.

Table 1: Age and sex-wise distribution of 30 cases of intertrochanteric fractures of the femur included in the study

Age group	Male	Female	Total No of cases	Percentage
0-20	0	0	0	0.00%
21-40	1	1	2	6.66%
41-60	4	5	9	30.0%
61-80	7	9	16	53.33%
81-100	2	1	3	10.0%
Total	14	16	30	100.0

Table 2 provides details about the cause of injury, side affected, and fracture classification in the 30 cases of intertrochanteric fractures studied. *Cause of Injury (Mode of Injury):* Most fractures (63.33%, 19 patients) resulted from trivial falls. Trivial falls appear to be a major contributing factor to intertrochanteric fractures, especially in older adults who might be more susceptible to falls due to balance issues or weaker bones. A significant portion (36.66%, 11 patients) were caused by road traffic accidents (RTA). *Side Affected:* The table shows a nearly even distribution between the right (63.33%, 19 patients) and left leg (36.66%, 11 patients) being affected. The nearly even distribution between right and left leg fractures suggests no significant side-to-side dominance. *Fracture Classification (Evans Classification):* Type 2 fractures were the most frequent (36.66%, 11 patients), followed by Type 1 (30.00%, 9 patients) and Type 3 (23.33%, 7 patients). Type 4 fractures were the least common (10.00%, 3 patients).

Table 2: Mode of Injury and classification of intertrochanteric fractures of the femur

Mode of Injury	Frequency	Percentage
RTA	11	36.66%
Trivial Fall	19	63.33%
Side affected		
Right	19	63.33%
Left	11	36.66%
Type of fracture		
1	9	30.00%
2	11	36.66%
3	7	23.33%
4	3	10.00%

Table 3 compares the functional outcomes in patients who underwent surgery for intertrochanteric fractures using either a Dynamic Hip Screw (DHS) or a Proximal Femoral Nail (PFN). In our study, the average duration of hospital stay was 19.33 days. *DHS vs. PFN Outcomes:* Overall, patients who received PFN implants seemed to have slightly better outcomes. *Excellent:* 8 patients (53.33%) in the PFN group achieved excellent results compared to 4 patients (26.66%) in the DHS group. Both groups had similar proportions of patients in the Good (26.66%) and Fair (DHS: 26.66%, PFN: 13.33%) categories. The DHS group had a higher percentage of patients with Poor outcomes (20%) compared to the PFN group (6.66%). The PFN fixation is associated with a higher rate of excellent functional outcomes p-value is (<0.006) in patients with intertrochanteric fractures treated with PFN as compared to patients treated with DHF.

Table 3: Functional results of patients operated with DHS AND PFN

Functional results	Number of cases of DHS	Percentage	Number of cases of PFN	Percentage
Excellent	4	26.66%	8	53.33%
Good	4	26.66%	4	26.66%
Fair	4	26.66%	2	13.33%
Poor	3	20.00%	1	6.66%
Total	15	100.0%	15	100.0%

Table 4 analyzes the association between fracture type (based on the Boyd and Griffin classification) and functional outcomes in patients who underwent surgery with either DHS or PFN implants. *DHS:* Excellent outcomes were primarily achieved in patients with Type 1 (3 patients) and Type 2 (1

patient) fractures. The majority of patients with poorer outcomes (Fair and Poor) had Type 2 or Type 3 fractures. *PFN:* Similar to DHS, most Excellent outcomes (4 patients) were seen in Type 1 and Type 2 fractures. Unlike DHS, no patients with Type 4 fractures achieved Excellent outcomes with PFN fixation. PFN fixation is associated with a slightly higher rate of Excellent outcomes in patients with more stable fractures (Type 1 and 2) compared to DHS the p values were (<0.005) and hence significant.

Table 4: Function Outcome V/S Type of Fracture with DHS based on Boyd and Griffin classification

	Type 1	Type 2	Type 3	Type 4	Total
Functional outcome of DHF fixation					
Excellent	3	1	0	0	4
Good	2	1	1	0	4
Fair	0	3	1	0	4
Poor	0	2	1	0	3
Total	5	7	3	0	15
Functional outcome of PFN fixation					
Excellent	1	4	2	1	8
Good	2	0	2	0	4
Fair	0	0	0	2	2
Poor	1	0	0	0	1
Total	4	4	4	3	15

Table 5: Comparison of time of fracture union with DHS and PFN

Time of Union Range in weeks	DHS	PFN
12-15	3	10
16-19	7	2
20-23	3	3

All patients enjoyed a good range of hip and knee range of motion. Postoperative mobility was aided in the immediate post-operative period but later all patients were ambulatory independently with or without a walker except in 2 patients who suffered implant failure of DHS. *Follow-Up:* All patients were followed at 6 weeks and 6 months, and some patients up to one year and further if necessary. The time to fracture union is given in Table 5. PFN fixation appears to be associated with a faster time to fracture union compared to DHS in this patient group. All patients in the PFN group achieved union within 19 weeks, while nearly half (46.67%) of the DHS group had a longer healing time (20-23 weeks) In my study mean time for union for PFN is 15.6 weeks. Which is 17.7 for DHS cases the p values is (<0.04) and significant. *Anatomical Results:* Anatomical results were assessed by the presence or absence of deformities, shortening, hip and knee range of motions. In our study one patient had shortening >1cm, and three patients had varus malunion <10 degrees.

Table 6: Delayed Complications

Complication	In cases treated with DHS (out of 15)	Percentage	In cases treated with PFN (out of 15)	Percentage
Hip joint stiffness	0	00.0%	0	0.00%
Knee joint stiffness	0	00.0%	0	0.00%
Delayed union	2	13.33%	1	6.66%
Nonunion	0	00.0%	0	0.00%
Shortening	2	13.33%	1	6.66%
Varus malunion <100	2	13.33%	1	6.66%
Implant failure	2	13.33%	0	0.00%

Table 6 shows the incidence of various delayed complications in patients who underwent surgery for intertrochanteric fractures using either DHS or PFN implants. No patients in either group experienced hip or knee joint stiffness. *Delayed union:* Occurred in a small number of patients (2 in the DHS group, 1 in the PFN group). *Non-union:* No cases of non-union were reported in either group. *Shortening and Varus malunion:* These occurred in a similar proportion of patients in both groups (around 13% for DHS and 6.6% for PFN). *Implant failure:* Two patients in the DHS group experienced implant failure, while none were observed in the PFN group.

Discussion

Despite advancements, achieving optimal outcomes in treating proximal femoral fractures remains an ongoing pursuit. This can be attributed to several factors, including *Balancing biomechanics*: Optimizing implant selection and surgical technique to best distribute forces across the repaired bone. *Realistic expectations for new technologies*: Carefully evaluating the true potential of emerging surgical techniques and implants to ensure they meet anticipated benefits. *Strict adherence to established protocols*: Emphasizing the importance of following well-defined surgical procedures to minimize complications. The complex biomechanics of the proximal femur, coupled with slow healing due to the predominance of cortical bone and reduced blood supply, can lead to high-stress concentrations and post-operative complications. This necessitates a thoughtful approach to implant selection by surgeons, ensuring the chosen device best addresses the specific fracture pattern and patient needs.

Current popular methods of fixation include blade plate systems, sliding hip screw systems, and intramedullary devices. From a mechanical perspective, the use of a combined intramedullary device applied through a minimally invasive technique appears to be advantageous for elderly patients [6]. Preserving the fracture hematoma through closed reduction is crucial for the consolidation process. Intramedullary fixation enables surgeons to limit soft tissue dissection, thereby reducing surgical trauma, blood loss, risk of infection, and wound complications [7]. Among the various intramedullary and extramedullary implants available, the Dynamic Hip Screw (DHS) is the most frequently utilized and continues to be considered the "Gold Standard" for stabilizing intertrochanteric fractures.

According to the study by Saarenpää et al. [8] Sliding Hip Screws, when used for treating unstable trochanteric fractures, exhibit a very high failure rate, with a reoperation rate of 8.2%, which is considered unacceptable in today's medical practice. The Proximal Femoral Nail (PFN) represents a contemporary, advanced intramedullary implant developed from experiences with the gamma nail. The gamma nail also used as an intramedullary device, requires significant expertise due to its steep learning curve and has technical and mechanical failure rates of around 10%. This device is particularly prone to failure at its most vulnerable point, the lag screw-implant interface. This study population included patients between 32 and 86 years old, with an average age of 65.5 years. This is notably younger than the average age reported in Western literature, such as the study by Lunsjö K et al. [9] the average age was around 80 years. However, our findings align more closely with other studies conducted in India. For instance, the average age in the studies by Dhamangaonkar AC et al., were 57.0 and 56.2 years, respectively. Our study observed a difference in fracture union time between Dynamic Hip Screw (DHS) and Proximal Femoral Nail (PFN) fixation. The average time for DHS cases was 17.3 weeks, compared to 15.8 weeks for PFN cases. This difference might be attributed to the inclusion of more unstable fracture types (types 3 and 4) in the DHS group, which generally require longer healing times.

The study by Pajarinen J et al. [11] reported an average union time of 15 weeks for DHS fixation. Our findings (17.3 weeks) suggest a slightly longer duration, potentially due to the inclusion of more complex fracture types. The Functional Outcomes Assessment results of this study showed that excellent results were found in 40% good results in 26.7% fair results in 20% and poor results in 13.33%. The Modified Harris Hip Score (MHHS) was employed to objectively evaluate patients' postoperative functional status. Our study achieved a mean overall MHHS of 81.2, demonstrating functional outcomes comparable to those reported in prior international investigations by Bhatti A Butt et al. [12]. Ten patients in our study presented with unstable fractures (types 3 and 4). Among these patients: PFN Fixation: Seven patients underwent PFN fixation, achieving favorable outcomes with 3 excellent, 2 good, and 2 fair results as measured by the MHHS. DHS Fixation: Three patients received DHS fixation, with outcomes categorized as 1 good, 1 fair, and 1 poor based on MHHS scores. The mean MHHS for the PFN group (85.5) was reasonably higher compared to the DHS group (76.9). These findings corroborate observations from previous studies by Calderón A. et al. [13] and Singh et al. [14] suggesting that PFN fixation might be associated with superior functional outcomes, particularly in patients with unstable intertrochanteric fractures.

Conclusion

This study investigated the clinical efficacy of Dynamic Hip Screw (DHS) and Proximal Femoral Nail (PFN) fixation in treating intertrochanteric fractures. While DHS remains the gold standard for stable fractures due to its controlled collapse mechanism, its effectiveness may be limited in reverse obliquity fractures where the screw orientation can lead to unwanted fragment migration. Conversely, PFN fixation offers biomechanical advantages in both stable and unstable fractures. Its closed technique minimizes surgical invasiveness, and the intramedullary design prevents excessive collapse while maintaining neck length. Additionally, the ability to convert to a dynamic mode for delayed unions enhances treatment flexibility. The crucial entry

point and precise screw placement ensure optimal stability and prevent medial collapse. The implant's design also minimizes bending stresses and facilitates early post-operative mobilization. Our findings suggest that PFN fixation offers comparable outcomes to DHS in stable fractures but emerges as the preferred option for managing unstable intertrochanteric fractures due to its superior biomechanical properties and versatility. Further research with larger patient cohorts could solidify these observations.

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