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ORIGINAL RESEARCH

A prospective comparative study of functional and radiological outcomes of unstable intertrochanteric fractures treated by proximal femoral nail and proximal femoral nail anti-rotation (PFN vs. PFNA2) in Elderly Patients

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ABSTRACT

Background: Intertrochanteric fractures are common in elderly individuals, typically resulting from low-energy trauma. While Dynamic Hip Screws (DHS) were previously considered the gold standard for stable fractures, they have shown limitations in unstable fractures. Proximal Femoral Nail (PFN) and Proximal Femoral Nail Anti-Rotation (PFNA2) are now widely used, but their comparative efficacy remains a subject of debate.**Objective:** To compare the functional, radiological, and complication outcomes of PFN versus PFNA2 in the treatment of unstable intertrochanteric fractures in elderly patients.**Methods:** A prospective randomized comparative study was conducted at Karwar institute of medical sciences, Karwar from April 2023 till November 2024, including 30 patients with unstable intertrochanteric fractures (15 in each group). Patients were followed up at 6 weeks, 3 months, 6 months, and 1 year. Functional outcomes were assessed using the Harris Hip Score (HHS), while radiological outcomes were evaluated based on bone union time. Postoperative complications and surgical parameters were also recorded.**Results:** The mean age of patients in the PFN and PFNA2 groups was 71.47±7.72 and 70.17±8.96 years, respectively ($p>0.05$). The mean Harris Hip Score showed significantly better improvement in the PFNA2 group compared to the PFN group ($p<0.05$). Radiological bony union time showed no significant difference between the two groups ($p=0.84$). However, operation time and fluoroscopic exposure were significantly lower in the PFNA2 group ($p=0.0001$). Postoperative complications were observed in 3 (23.08%) PFN cases and 1 (7.7%) PFNA2 case ($p<0.05$).**Conclusion:** While both implants yield similar radiological outcomes, PFNA2 provides superior functional recovery, reduces operative duration, and minimizes fluoroscopic exposure. Additionally, the PFNA2 group had fewer postoperative complications, making it a preferable choice for managing unstable intertrochanteric fractures.

Key words: Unstable intertrochanteric fractures, Proximal Femoral Nail Anti-Rotation (PFNA2), Functional and Radiological outcomes

INTRODUCTION

Intertrochanteric fractures are a significant concern in the elderly due to osteoporosis and increased fall risk. These fractures result in significant morbidity, prolonged hospital stays, and substantial healthcare costs. Traditionally, DHS was used for fixation, but it has proven inadequate for unstable fractures, often leading to mechanical failure and increased complication rates.

PFN, which incorporates a compression screw with an anti-rotation screw, has become widely accepted as an alternative. However, PFN is associated with complications such as screw backout, Z-effect, reverse Z-effect, and varus collapse. These complications can lead to implant failure and poor functional outcomes. The PFNA2 system, utilizing a single helical blade, aims to enhance stability, reduce implant failure, and improve functional outcomes.

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The helical blade is designed to provide better anchorage in osteoporotic bone and reduce rotational instability. This study compares PFN and PFNA2 in terms of functional recovery, radiological outcomes, and complication rates.

METHODS

A prospective randomized comparative study was conducted at Karwar Institute of Medical sciences, Karwar between April 2023 to November 2024. A total of 30 patients (15 in each group) with similar demographic and fracture characteristics were included in the study. Patients were evaluated at intervals of 6 weeks, 3 months, 6 months, and 1 year post-surgery. The functional outcome was assessed using the Harris Hip Score, while radiological outcomes were measured based on bone union time. A total of 30 patients were included in each group. There were 2 patient loss to follow up in proximal femoral nail group and 2 in Proximal Femoral Nail Anti-rotation. Hence, 26 patients were analyzed in both the group.

INCLUSION CRITERIA

- Age > 60 years.
- Unstable intertrochanteric fractures (AO 31-A2, AO 31-A3).

EXCLUSION CRITERIA

- Pathological fractures.
- Open fractures.
- Multiple fractures in the same extremity.
- Neuromuscular disorders or life-threatening comorbidities.

SURGICAL PROCEDURE: All patients underwent preoperative planning with X-rays and CT scans to assess fracture patterns. All Patients were supine on a fracture table, with affected leg in traction boot. Operated limb was in traction, internally rotated, adducted, and flexed to enter proximal femur, while unaffected limb was flexed and abducted.

Incise the skin around 3 cm in line with the femoral shaft axis and about 5 cm proximal to the tip of the trochanter. The entry point is on the tip of the greater trochanter or slightly medial to it. Insert the guide wire through the tip of the greater trochanter and in line with the middle of the femoral neck, and slightly lateral to a line corresponding to the anatomical axis of the shaft.

Check the position of the guide wire using the image intensifier in AP and lateral view. Insert the protection sleeve with its trocar over the guide wire, pushing it through soft tissues until it abuts against the greater trochanter, then withdraw the trocar and insert a drill bit or reamer.

Mount the nail on the insertion handle, insert it manually, and then remove the guide wire after engaging with the medullary canal. Insert the nail to the femoral head's center, then check the correct insertion depth with a wire parallel to the guide-wire track.

Insert the drill-sleeve assembly through the aiming arm and advance it through soft tissues to the lateral cortex. Deeply advance the guide-wire tip across the head's dense trabecular bone and subchondral bone, stopping 5mm before the joint.

In antero-posterior view the ideal position of the guide wires were parallel to each other and in the distal 1/2 of the neck and in the lateral view it was in a single line in the Centre of the neck. Size of the lag screw was determined and 15 mm less de-rotation screw was also placed and the distal part of the nail 1 or 2 static or dynamic 4.9 mm interlocking bolts were inserted.

Basic difference in PFN and PFN A2 is a single helical blade used in PFNA2 whereas one de-rotation screw (6.4 mm) and one lag screw (8 mm) used in PFN. Hence, incision length for proximal locking was smaller in PFN A2.

PHYSIOTHERAPY

Quadriceps (Strengthening) exercises, stretching exercises of hamstring, hip, knee, and ankle range of motion started from post-operative day 1. Non-weight bearing mobilization for 1 month with walking frame and then partial weight bearing mobilization next 2 weeks, afterwards full weight bearing mobilization according to patient comfort.

RESULTS

The mean Harris Hip Score demonstrated significantly better improvement in the PFNA2 group compared to PFN (p<0.05). The PFNA2 group showed earlier weight-bearing capability and better functional mobility. Radiological union times were comparable (p=0.84), indicating that both implants provided similar healing timelines.

The PFNA2 group had significantly lower operation times (p=0.0001) and required fewer fluoroscopic images (p=0.0001). The mean surgical duration was 42.3±6.5 minutes for PFNA2 compared to 58.9±7.2 minutes for PFN. Postoperative complications occurred in 3 PFN cases (23.08%) versus 1 PFNA2 case (7.7%), a statistically significant difference.

Table 1:Gender Distribution

Gender	PFN(n=13) Mean Age-71.47±4.16	PFN A2(n=13) Mean Age-70.17±8.96
Male	8	6
Female	5	7

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Table 2: Harris Hip Score Comparison

Time Period	PFN A	PFN A2
6 Weeks	26.11±4.90	28.38±5.31
3 Months	46.42±5.50	49.50±8.46
6 Months	69.65±7.57	73.42±8.53
1 Year	88.03±8.46	94.36±11.18

Common complications in the PFN group included lag screw migration, Z-effect, and varus collapse. In contrast, the PFNA2 group had fewer mechanical failures and better implant stability.

TABLE 3:Radiological Outcome Comparison

Time Period	PFN (N=13)	PFN A2 (N=13)
6 Weeks Callus present	13(100%)	13(100%)
3 Months Union in progress	13(100%)	13(100%)
6 Months Union in progress Union present	12(92.30%) 1(7.70%)	11(84.61%) 2(15.39%)
1 Year Union present	13(100%)	13(100%)

TABLE 4:Post-Operative Complication

Complication	PFN(N=13)	PFN A2(N=13)
Screw Backout	1 (7.70%)	1 (7.70%)
Z Effect	2 (15.38%)	0

TABLE 5:Comparison of Post Op Complications

Complication	PFN (N=13)	PFN A2 (N=13)
Present	3 (23.08%)	1 (7.70%)
Absent	10 (76.92%)	12 (92.30%)

CASE ILLUSTRATION 1: Case of right sided unstable it fracture treated with standard PFN with post-operative complication of screw backout-x ray-pre op, 1 month follow up, 3 month follow up respectively.

CASE ILLUSTRATION 2: Case of right sided unstable IT fracture treated with PFN A2-pre op x ray, immediate post op x ray and 6 month follow up x ray respectively.

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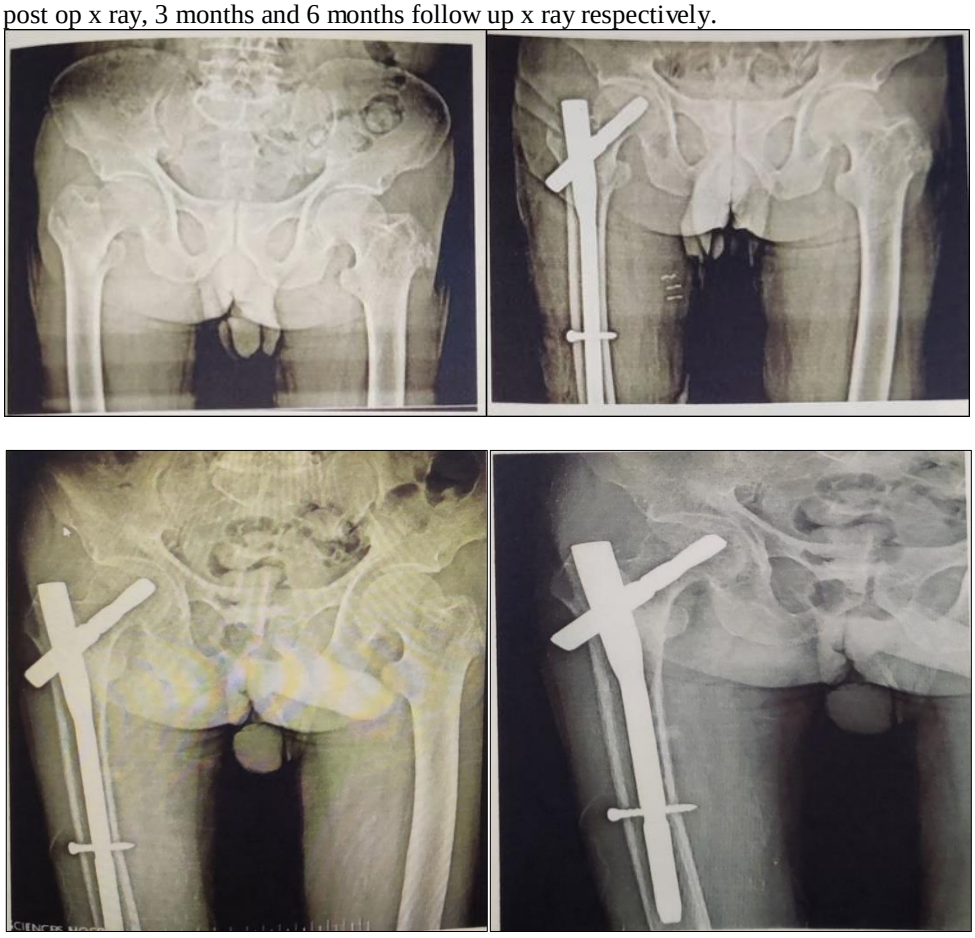
RANGE OF MOTION AT 6 MONTHS (SAME PATIENT AS ABOVE)

CASE ILLUSTRATION 3: Case of right sided unstable it fracture treated with PFN A2-Pre op x ray, immediate post op x ray, 3 months and 6 months follow up x ray respectively.



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RANGE OF MOTION AT 6 MONTHS (SAME PATIENT AS ABOVE)

DISCUSSION

This study suggests that PFNA2 offers superior functional outcomes, shorter surgery times, and lower fluoroscopic exposure than PFN. The helical blade mechanism in PFNA2 provides enhanced rotational stability and improved load distribution, reducing mechanical complications.

While both implants provide similar radiological healing, PFNA2 minimizes implant-related complications. These findings align with previous literature supporting helical blade mechanisms for improved bone-implant interface and stability. Several studies have indicated that PFNA2 allows for better anchorage in osteoporotic bone due to its compaction effect. Additionally, the single helical blade allows for reduced operative steps, thus shortening surgical duration and fluoroscopic exposure.

A significant advantage of PFNA2 is the reduced incidence of Z-effect and reverse Z-effect complications, which are commonly observed in PFN. In osteoporotic patients, these mechanical failures can result in secondary surgeries and prolonged hospital stays. Our findings align with previous studies that demonstrate PFNA2's effectiveness in improving clinical outcomes and minimizing complications.

Future multicenter trials with larger sample sizes are warranted to reinforce these conclusions and evaluate long-term outcomes. Additionally, further research is required to determine whether specific patient demographics influence the choice of implant.

CONCLUSION

This study suggests that there is no difference in radiological outcomes with both the implants; But there is significantly better functional outcome with PFN A2 compared to PFN, however, post-operative complications are very less with PFNA2 as compared to PFN. Duration of operative time and fluoroscopic imaging time also reduces significantly in PFN A2 compared to PFN. But always remember no implant design can compensate for poor reduction or poor implant placement in these fractures and further study is warranted in a larger population size to come to a final result.

CONFLICTS OF INTEREST STATEMENT

None declared.

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