Section: Orthopedics

Original Research Article

A COMPARATIVE & PROSPECTIVE ANALYSIS OF INTERTROCHANTERIC FRACTURES OF FEMUR FIXED WITH PROXIMAL FEMORAL NAILING AND PROXIMAL FEMORAL NAIL A II

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Received *: 20/04/2026*
Received in revised form *: 11/06/2026*
Accepted *: 26/06/2026*

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DOI: 10.70034/ijmedph.2026.3.205

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 1288-1292

ABSTRACT

Background: Intertrochanteric femoral fractures are common in the elderly and are associated with significant morbidity. Intramedullary fixation using Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation II (PFN-A II) are widely used, but their comparative effectiveness remains debated.

Materials and Methods: This prospective comparative study included 60 patients with unstable intertrochanteric fractures, with 30 patients treated using PFN and 30 using PFN-A II. Patients were followed up for 12 months. Outcomes assessed included operative time, intraoperative blood loss, time to fracture union, functional outcome using Harris Hip Score (HHS), and postoperative complications.

Results: Baseline demographic and fracture characteristics were comparable between groups. The PFN-A II group demonstrated significantly shorter operative time (65.5 ± 13.6 vs 91.5 ± 9.7 minutes; p = 0.001) and lower blood loss (238 ± 37.4 vs 300 ± 36.2 mL; p = 0.001). Mean time to union was significantly reduced in the PFN-A II group (12.4 ± 2.8 vs 15.6 ± 3.0 weeks; p = 0.019). Functional outcomes improved progressively in both groups, with higher Harris Hip Scores in the PFN-A II group at all follow-ups, though not statistically significant. Thigh pain was significantly more common in the PFN group (60% vs 10%; p = 0.029), while screw pull-out rates were comparable.

Conclusion: PFN-A II offers advantages over PFN in terms of reduced operative time, lower blood loss, earlier fracture union, and fewer complications, making it a preferred implant for unstable intertrochanteric fractures, especially in osteoporotic patients.

Keywords: Intertrochanteric fracture, Proximal femoral nail (PFN), Proximal femoral nail antirotation II (PFN-A II), Intramedullary fixation, Osteoporotic fractures, Harris Hip Score, Fracture union, Orthopaedic trauma.

INTRODUCTION

Intertrochanteric (peritrochanteric) fractures are extracapsular fractures of the proximal femur, extending from the basilar neck region to the level of the lesser trochanter. These fractures represent one of the most common injuries involving the proximal femur and constitute a significant proportion of hip fractures worldwide.

They are predominantly observed in the elderly population, usually resulting from low-energy trauma such as trivial falls, often in the setting of osteoporosis and compromised bone quality. In contrast, younger individuals typically sustain these fractures following high-energy trauma. Epidemiological data have shown that the lifetime risk of hip fractures at 50 years of age is approximately 5.6% in men and 20% in women, with intertrochanteric fractures accounting for nearly one-third of all hip fractures.[1] With increasing life expectancy and the rising incidence of osteoporosis, the burden of intertrochanteric fractures is expected to grow substantially. These fractures are associated with considerable morbidity

and mortality, leading to prolonged immobilization, loss of independence, and increased socioeconomic burden.[2] Early surgical intervention has therefore become the standard of care, aiming to achieve stable fixation, allow early mobilization, and reduce complications associated with prolonged recumbency.

Despite advances in surgical techniques, the management of unstable intertrochanteric fractures remains challenging. Surgeons frequently encounter issues such as difficulty in achieving and maintaining stable reduction, implant-related complications, and variable functional outcomes.[3] The choice of fixation device plays a crucial role in determining the success of treatment.

Intramedullary devices, particularly Proximal Femoral Nailing (PFN), have gained widespread acceptance as a preferred method of fixation due to their biomechanical advantages, including shorter lever arm, better load-sharing capacity, and minimally invasive insertion techniques.[2,3] More recently, modifications such as the Proximal Femoral Nail Antirotation II (PFN-A II) have been introduced, incorporating design changes aimed at improving rotational stability, especially in osteoporotic bone.[4]

Although both PFN and PFN-A II are commonly used in clinical practice, there remains ongoing debate regarding their relative effectiveness in terms of operative parameters, fracture union, complication rates, and functional outcomes.[5] Given these considerations, a prospective comparative evaluation of these two fixation modalities is essential to determine the optimal implant for managing unstable intertrochanteric femoral fractures.

The objective of this study is to prospectively compare the functional outcomes of unstable intertrochanteric femoral fractures managed with Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation II (PFN-A II), with specific evaluation of intraoperative parameters such as operative time and blood loss, postoperative factors including time to fracture union and hip range of motion, incidence of wound-related and local complications, and overall functional outcome as assessed by the Harris Hip Score at defined follow-up intervals.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Orthopaedics and Traumatology at Mahatma Gandhi Memorial Medical College, Jamshedpur, and included 60 patients with unstable intertrochanteric femoral fractures. Patients were recruited consecutively and allocated into two groups: 30 patients treated with Proximal Femoral Nail (PFN) and 30 with Proximal Femoral Nail Antirotation II (PFN-A II).

Inclusion Criteria

Where age >50 years, both sexes, unstable intertrochanteric fractures (Boyd and Griffin types II–IV), closed fractures, and osteoporotic bone (Singh index ≤3).

Exclusion Criteria

Included compound fractures, stable fracture patterns (Boyd and Griffin type I/Evans stable), associated ipsilateral lower limb injuries affecting weight-bearing, severe knee osteoarthritis, neurological comorbidities, and non-ambulatory patients.

Data Collection: The study involved a comprehensive data collection process for patients admitted with hip fractures. Initial evaluations included clinical assessments and radiological imaging, specifically anteroposterior pelvic radiographs and computed tomography when necessary. Fractures were classified using the Boyd and Griffin and Evans systems. Initial management focused on fluid resuscitation, analgesia, blood transfusions, and immobilization via upper tibial traction.

Preoperative assessments included routine hematological and biochemical tests, along with anesthetic fitness evaluations. Written informed consent was obtained, and prophylactic antibiotics were administered prior to surgery. Surgical procedures were performed under fluoroscopic guidance on a traction table, utilizing a minimally invasive approach through the greater trochanter. Different entry points were used for various implants, with fixation achieved through either proximal screws or a helicalblade. Postoperative care emphasized early mobilization, quadriceps strengthening, and range-of-motion exercises, with partial weight-bearing initiated based on fixation stability. Follow-up occurred at two-week intervals until fracture union, then monthly for six months, with assessments of operative time, blood loss, fracture union time, hip range of motion, complications, and functional outcomes measured by the Harris Hip Score.

Statistical Analysis

Data analysis utilized open EPI software, focusing on continuous variables like age and operative time, expressed as mean ± SD, and categorical variables as frequencies and percentages. Comparisons between PFN and PFN-A II groups for continuous variables employed independent samples Student's t-test, while categorical variables used Chi-square or Fisher's exact tests. Functional outcomes were assessed via repeated measures ANOVA, and time to fracture union was analyzed using Kaplan–Meier survival analysis with log-rank tests. Effect sizes were calculated, with significance set at $p < 0.05$.

RESULTS

A total of 60 patients with unstable intertrochanteric femoral fractures were included in this prospective

comparative study, with 30 patients each treated using Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation II (PFN-A II). All patients completed follow-up up to 12 months.

Baseline Characteristics

The mean age was 60 ± 6.7 years in the PFN-A II group and 58.2 ± 5.3 years in the PFN group. Females constituted the majority of cases (55%), consistent with osteoporotic fracture patterns. Right-sided injuries were more common (≈65%).

Most injuries were due to low-energy falls (60%), while 40% resulted from road traffic accidents. Boyd and Griffin type II fractures were the most common (75%), followed by type IV (15%) and type III (10%). Baseline demographic and fracture characteristics were comparable between the two groups, with no statistically significant differences ($p > 0.05$).

Intraoperative Parameters

Intraoperative parameters show that the PFN-A II group had significantly better outcomes compared to the PFN group, with an operative time of 65.5 ± 13.6 minutes versus 91.5 ± 9.7 minutes ($p = 0.001$) and intraoperative blood loss of 238 ± 37.4 mL compared to 300 ± 36.2 mL ($p = 0.001$). [Figure 1 and Figure 2]

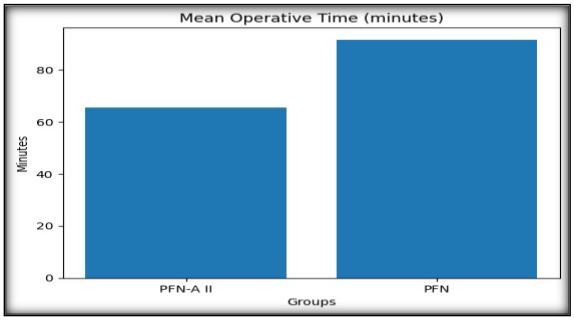

Figure 1: Comparison of mean operative time between PFN-A II and PFN groups

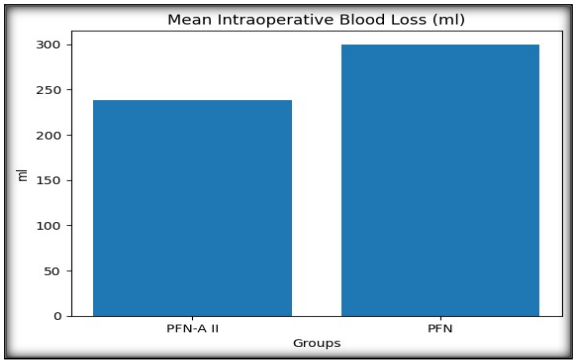

Figure 2: Comparison of mean intraoperative blood loss between PFN-A II and PFN groups

Radiological union was achieved earlier in the PFN-A II group, with an average union time of 12.4 ± 2.8 weeks, compared to 15.6 ± 3.0 weeks in the PFN group. This difference was statistically significant ($p = 0.019$). The PFN-A II group saw the earliest union at 10 weeks, whereas the PFN group experienced union durations extending up to 20 weeks. [Figure 3 and Figure 4]

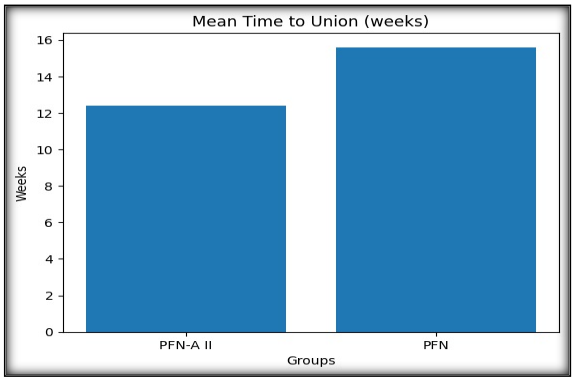

Figure 3: Comparison of mean time to fracture union between PFN-A II and PFN groups

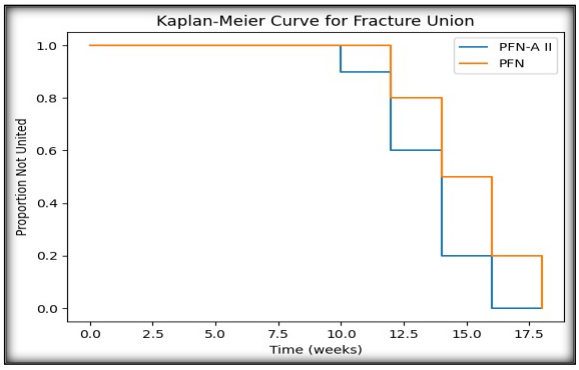

Figure 4: Kaplan–Meier curve depicting time to fracture union

Functional outcomes measured by the Harris Hip Score (HHS) showed progressive improvement in both groups over time, with the PFN-A II group achieving consistently higher mean scores at all follow-up intervals. At 6 weeks, early recovery was better in the PFN-A II group, although this was not statistically significant. By 3 months, the superiority of PFN-A II continued, and at 6 and 12 months, there was a higher proportion of good-to-excellent outcomes in this group, with no statistically significant differences observed ($p > 0.05$). [Figure 5]

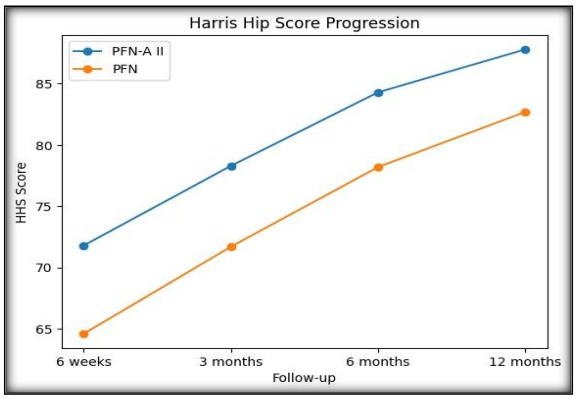

Figure 5: Line graph showing progression of Harris Hip Score over follow-up intervals

Postoperative Complications

Postoperative complications were evaluated, highlighting two main issues: screw pull-out and anterior/lateral thigh pain. Thigh pain was significantly more prevalent in the PFN group at 60%, compared to only 10% in the PFN-A II group ($p = 0.029$). In terms of screw pull-out incidents, PFN-A II had a rate of 10%, whereas the PFN group experienced a rate of 20%, which was not statistically significant. Notably, no cases of wound infection were reported. [Figure 6]

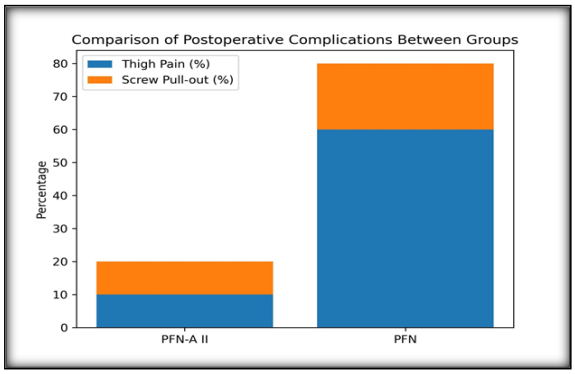

Figure 6: Comparison of postoperative complications between groups.

DISCUSSION

Intertrochanteric fractures of the femur remain a significant cause of morbidity in the elderly population, largely due to osteoporosis and increased life expectancy. The primary goal of management is to achieve stable fixation that permits early mobilization, thereby reducing complications associated with prolonged immobilization. Intramedullary devices such as Proximal Femoral Nail (PFN) and its modification, Proximal Femoral Nail Antirotation II (PFN-A II), have been widely used for this purpose due to their biomechanical advantages.

In the present study, baseline demographic characteristics, including age, sex distribution, fracture type, and mechanism of injury, were comparable between the two groups, ensuring homogeneity and minimizing selection bias. Similar demographic patterns have been reported in previous studies, where intertrochanteric fractures predominantly affect elderly females due to osteoporotic bone changes.[6,7]

The current study demonstrated significantly reduced operative time and intraoperative blood loss in the PFN-A II group compared to the PFN group. This can be attributed to the use of a single helical blade in PFN-A II, which simplifies the surgical technique and reduces operative steps. Comparable findings have been reported by Bhardwaj et al,[8] who observed shorter operative duration and reduced blood loss with PFN-A II. Similarly, Cho et al,[9] highlighted that PFN-A II allows more efficient fixation with less surgical trauma.

A statistically significant reduction in time to fracture union was observed in the PFN-A II group. The helical blade design of PFN-A II compacts cancellous bone, providing better anchorage and rotational stability, particularly in osteoporotic bone. This biomechanical advantage facilitates earlier fracture healing. Liao et al,[10] in a systematic review, also reported improved stability and comparable or earlier union rates with PFN-A type implants compared to conventional intramedullary devices.

Functional outcomes assessed using the Harris Hip Score (HHS) showed progressive improvement in both groups, with consistently higher scores in the PFN-A II group at all follow-up intervals. Although the differences were not statistically significant, the trend suggests better early and mid-term functional recovery with PFN-A II. Similar observations have been reported in previous comparative studies, where PFN-A II demonstrated superior functional outcomes, particularly in osteoporotic fractures.[8,11]

The absence of statistically significant differences in long-term functional outcomes may be due to the relatively small sample size and the fact that both implants provide stable fixation, allowing satisfactory rehabilitation.

The incidence of anterior and lateral thigh pain was significantly higher in the PFN group compared to the PFN-A II group. This may be related to the use of dual screw constructs in PFN, which can cause soft tissue irritation. In contrast, the helical blade design of PFN-A II reduces stress concentration and minimizes soft tissue impingement. Similar findings have been reported by Hegde et al.[11]

Screw pull-out rates were lower in the PFN-A II group, although the difference was not statistically significant. The improved purchase of the helical blade in osteoporotic bone likely contributes to reduced implant failure. Previous literature supports that PFN-A II provides better resistance to cut-out and rotational instability.[5]

No cases of postoperative infection were observed in either group, which may be attributed to adherence to aseptic surgical techniques and perioperative antibiotic protocols.

Clinical Implications

The findings of the present study suggest that PFN-A II offers certain advantages over PFN, particularly in terms of reduced operative time, decreased blood loss, earlier fracture union, and lower incidence of thigh pain. These benefits are especially relevant in elderly patients with osteoporotic bone, where surgical efficiency and implant stability are critical.

CONCLUSION

Proximal Femoral Nail Antirotation II (PFN-A II) demonstrates clear perioperative and biomechanical advantages over conventional Proximal Femoral Nail (PFN) in the management of unstable intertrochanteric femoral fractures. It is associated

with significantly reduced operative time and blood loss, earlier fracture union, and a lower incidence of postoperative thigh pain. Although long-term functional outcomes were comparable between the two groups, PFN-A II showed a consistent trend toward better recovery.

Overall, PFN-A II can be considered a more effective and reliable implant, particularly in osteoporotic bone, facilitating stable fixation and early mobilization.

Limitations

This study has certain limitations. The sample size was relatively small, which may limit the generalizability of the findings. Additionally, the follow-up period was limited to 12 months, which may not capture long-term complications or implant-related failures. The absence of advanced statistical modeling and patient-level survival analysis (Kaplan–Meier) is another limitation.

Future Directions

Further multicentric studies with larger sample sizes and longer follow-up durations are required to validate these findings. Incorporation of functional outcome measures, quality of life assessments, and cost-effectiveness analysis would provide a more comprehensive evaluation of these implants.

Acknowledgement

The authors express their sincere gratitude to the Department of Orthopaedics and Traumatology, Mahatma Gandhi Memorial Medical College and Hospital, Jamshedpur, for providing the clinical facilities, infrastructure, and institutional support necessary for conducting this study. We are deeply thankful to our teachers, mentors, and guides for their invaluable guidance, encouragement, and expert supervision throughout the research process. Their insights and constructive suggestions greatly contributed to the successful completion of this work.

We also acknowledge the significant support provided by the Multidisciplinary Research Unit (MRU), Mahatma Gandhi Memorial Medical College and Hospital, Jamshedpur, for facilitating scientific and research-related activities associated with this study. The research infrastructure, academic environment, and technical support made available through the MRU were instrumental in ensuring the quality and smooth execution of the project.

We extend our appreciation to all faculty members, resident doctors, nursing staff, operation theatre personnel, and hospital staff for their cooperation and assistance during patient care, follow-up, and data collection. We are especially grateful to all the patients who willingly participated in this study. Finally, we thank our family members and friends for their continuous encouragement, understanding, and support throughout the conduct of this research.

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