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Research Article

A Prospective Comparative Study Evaluating Functional and Radiological Outcomes of Intertrochanteric Femur Fractures Treated with Proximal Femoral Nail (PFN) Versus Proximal Femoral Nail Antirotation II (PFNA2) in Adult Patients

Vikas Kumar Rai, Manish Kumar Saw*, Benu Gopal Das, Madhav Sharma

MGM Medical College, Kishanganj

Corresponding author: Msaw353@gmail.com

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ABSTRACT

Background: Intertrochanteric femur fractures are common in elderly populations and are associated with high morbidity and mortality. Intramedullary fixation using proximal femoral nail (PFN) and proximal femoral nail antirotation II (PFNA2) has become the preferred treatment modality due to biomechanical advantages and early mobilization. However, the optimal implant remains debated, especially in osteoporotic patients in resource-limited regions such as Bihar.

Aim: To prospectively compare the functional and radiological outcomes of intertrochanteric femur fractures treated with PFN versus PFNA2 in adult patients.

Methodology: This prospective comparative study was conducted over one year at a tertiary care center in Bihar and included 40 adult patients with intertrochanteric fractures. Patients were randomly allocated into two groups: PFN (n=20) and PFNA2 (n=20). Intraoperative parameters, fracture union, complications, and functional outcomes using the Harris Hip Score (HHS) were evaluated at 6 weeks, 3 months, 6 months, and 12 months. Statistical analysis was performed using SPSS, with $p < 0.05$ considered significant.

Results: The PFNA2 group showed significantly shorter operative time and less blood loss compared to PFN ($p < 0.05$). Mean fracture union time was earlier in PFNA2 (13.6 weeks) than in PFN (14.8 weeks). At 12 months, mean HHS was higher in PFNA2 (88.9) compared to PFN (84.6) ($p < 0.05$). Implant-related complications were fewer in the PFNA2 group.

Conclusion: PFNA2 demonstrates superior operative efficiency, earlier union, and better functional outcomes compared to PFN, making it a preferable implant for intertrochanteric femur fractures, particularly in osteoporotic elderly patients in resource-limited settings.

Keywords: Intertrochanteric Fractures, Femoral Fractures, Intramedullary Fixation, Proximal Femoral Nail, Fracture Healing

INTRODUCTION

Intertrochanteric fractures of the femur are among the most common injuries encountered in orthopedic practice, particularly in the elderly population. These fractures occur in the extracapsular region between the greater and lesser trochanters and are frequently associated with osteoporosis, trivial trauma, and increasing life expectancy. Globally, the incidence of hip fractures is rising steadily and is expected to double by 2050 due to demographic transition and aging populations [1]. These fractures are associated with significant morbidity, loss of independence, and increased mortality, thereby posing a major public health concern [2].

Early surgical stabilisation is considered the gold standard for management of intertrochanteric fractures as it allows early mobilization, reduces complications such as deep vein thrombosis, pulmonary embolism, and pressure sores, and improves functional recovery [3]. Among the various fixation methods, intramedullary devices have gained widespread acceptance due to their biomechanical superiority, load-sharing properties, and minimal surgical exposure. The proximal femoral nail (PFN) has long been used as a reliable implant for both stable and unstable intertrochanteric fractures [4].

However, conventional PFN systems are associated with certain complications such as screw cut-out, Z-effect, reverse Z-effect, and rotational instability of the femoral head fragment, particularly in osteoporotic bone [5]. To overcome these limitations, the Proximal Femoral Nail Antirotation II (PFNA2) was introduced. PFNA2 utilizes a helical blade mechanism that compacts cancellous bone, improves purchase in osteoporotic femoral heads, and provides better rotational stability [6]. Additionally, PFNA2 is designed with anatomical considerations specific to Asian populations, including a smaller femoral canal diameter and altered femoral curvature, making it particularly suitable for Indian patients [7].

Several clinical studies have compared PFN and PFNA2 with respect to operative parameters, fracture union, functional outcomes, and complication rates. While many studies report comparable

fracture union rates between the two implants, PFNA2 has been shown to offer advantages such as reduced operative time, decreased blood loss, and better functional scores in certain patient groups [8]. Other studies, however, suggest that both implants provide similar long-term radiological and functional outcomes, indicating that the choice of implant may depend on surgeon preference and patient-specific factors [9]. Thus, despite multiple studies, the superiority of one implant over the other remains a subject of debate.

In India, and particularly in states such as Bihar, the burden of intertrochanteric fractures is increasing due to rising life expectancy, poor bone health, nutritional deficiencies, and high prevalence of osteoporosis in elderly populations. Bihar represents a largely rural and socioeconomically challenged region where patients often present late, have limited access to specialized care, and possess poor baseline nutritional status. These factors may influence fracture healing, rehabilitation outcomes, and implant performance. Additionally, tertiary care centers in Bihar cater to a large referral population with varied fracture patterns, making it essential to evaluate implant performance in this specific demographic setting.

Despite the availability of literature comparing PFN and PFNA2 globally, there is a paucity of region-specific prospective data from eastern India, particularly Bihar, that evaluates both functional and radiological outcomes in a real-world tertiary care setting. Considering differences in bone quality, patient compliance, and healthcare access, findings from Western or metropolitan Indian populations may not be directly applicable to patients in Bihar. Therefore, a prospective comparative evaluation in this population is both relevant and necessary.

The need for the present study arises from the increasing incidence of intertrochanteric fractures in Bihar, limited regional data comparing PFN and PFNA2, and the necessity to identify the most effective implant in terms of surgical parameters, fracture union, complication rates, and functional recovery in this population. Determining the optimal implant can help reduce morbidity, improve early mobilisation, and decrease socioeconomic burden in a resource-limited setting.

The aim of this study is to prospectively compare the functional and radiological outcomes of adult patients with intertrochanteric femur fractures treated with proximal femoral nail (PFN) *versus* proximal femoral nail antirotation II (PFNA2) at a tertiary care center in Bihar, and to evaluate differences in operative parameters, complication rates, fracture union, and postoperative functional recovery.

MATERIALS AND METHODS

The present study was conducted in the Department of Orthopedics at MGM Medical College and Hospital, Kishanganj in Bihar, India, which serves as a major referral center for trauma cases from both urban and rural regions of the state. The institute caters to a large population with a high burden of osteoporotic fractures, road traffic injuries, and low-energy domestic falls among the elderly. The hospital is equipped with round-the-clock trauma services, operation theatre facilities, C-arm fluoroscopy, and postoperative rehabilitation services, making it an appropriate setting for evaluating surgical outcomes of intertrochanteric femur fractures.

This study was designed as a prospective, randomized, comparative clinical study conducted over a period of one year. The objective was to compare the functional and radiological outcomes of intertrochanteric femur fractures treated with proximal femoral nail (PFN) and proximal femoral nail antirotation II (PFNA2).

Eligible patients presenting to the orthopedic outpatient department and emergency trauma unit with intertrochanteric femur fractures were screened and enrolled based on predefined inclusion and exclusion criteria. After obtaining written informed consent, patients were randomly allocated into two equal groups using a simple randomization method (computer-generated random number table):

Group A: Patients treated with PFN

Group B: Patients treated with PFNA2

Each group consisted of 20 patients.

Sample Size

A total of 40 patients with intertrochanteric femur fractures were included in the study. The sample size was based on feasibility and patient inflow in the tertiary care center during the one-year study period. Equal allocation (1:1 ratio) was done to ensure comparability between the two intervention groups.

Inclusion Criteria:

Adult patients aged ≥ 40 years. Radiologically confirmed intertrochanteric femur fractures. Both **s**table and unstable fracture patterns (as per AO/OTA classification). Patients fit for surgical intervention. Patients are willing to give informed consent and comply with the follow-up protocol.

Exclusion Criteria

Pathological fractures other than osteoporosis. Polytrauma patients with life-threatening injuries. Subtrochanteric extension fractures. Previous ipsilateral hip surgery. Patients medically unfit for anesthesia or surgery. Patients unwilling or unable to complete follow-up.

Methodology:

Upon admission, all patients underwent a detailed clinical evaluation, including history of trauma, comorbid conditions, and pre-injury mobility status. Routine laboratory investigations and radiographs of the pelvis with both hips (anteroposterior view) and the affected femur were obtained. Fractures were classified using the AO/OTA classification system.

All patients received preoperative optimization, including management of anemia, control of diabetes or hypertension, and prophylactic antibiotics prior to surgery. Patients were operated on as early as medically feasible.

Surgical Procedure

All surgeries were performed under spinal or combined spinal-epidural anest1hesia on a fracture table under C-arm guidance by experienced orthopedic surgeons.

In Group A (PFN), fixation was performed using a standard proximal femoral nail with two proximal screws (lag screw and anti-rotation screw).

In Group B (PFNA2), fixation was performed using a proximal femoral nail antirotation system with a helical blade.

Closed reduction was attempted in all cases; open reduction was performed when satisfactory alignment could not be achieved.

Intraoperative Parameters Recorded

Duration of surgery (minutes). Intraoperative blood loss (ml). Fluoroscopy exposure time. Intraoperative complications (if any). Postoperative Protocol.

Postoperatively, all patients received: Intravenous antibiotics for 3–5 days. Thromboprophylaxis as per institutional protocol. Early mobilization with quadriceps strengthening exercises from day 1.

Toe-touch or partial weight-bearing as tolerated, progressing to full weight-bearing based on fracture stability and radiological healing. Suture removal was done on postoperative day 12 to 14.

Follow-up and Outcome Assessment

Patients were followed up at 6 weeks, 3 months, 6 months, and 12 months postoperatively.

Functional Outcome

Assessed using the Harris Hip Score (HHS) at each follow-up visit.

Radiological Outcome

Evaluated by serial radiographs to assess: Fracture union, Implant position, Tip–apex distance, Varus collapse or screw/blade cut-out, Secondary Outcome Measures, Time to fracture union, Time to full weight-bearing, Postoperative complications (infection, implant failure, shortening, reoperation), Mortality within one year.

Fracture union was defined radiologically by the presence of bridging trabeculae across at least three cortices and clinically by the absence of pain at the fracture site during weight-bearing.

All data collected were entered into a Microsoft Excel spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0. The demographic data, fracture characteristics, and operative parameters were expressed as mean ± standard deviation and percentages. Independent Student's t-test was done for operative time, blood loss, Harris Hip Score, and Chi-square test

Table 1: Demographic and baseline characteristics

Variable	*Group A (PFN) (n=20)*	*Group B (PFNA2) (n=20)*	*p-value*
Mean age (years)	64.8 ± 9.6	66.1 ± 8.9	0.62
Gender (M:F)	8:12	7:13	0.74
Mode of Injury (Fall/RTA)	15/5	16/4	0.71
Stable Fractures	9	8	0.75
Unstable Fractures	11	12	0.75

Table 2: Intraoperative parameters

Parameter	*PFN (Group A)*	*PFNA2 (Group B)*	*p-value*
Duration of surgery (min)	65.7 ± 9.5	54.3 ± 8.2	<0.01
Blood Loss (mL)	148 ± 32	112 ± 25	<0.01
Fluoroscopy Time (min)	3.8 ± 1.1	3.1 ± 0.9	0.04
Open Reduction Required	3 cases	2 cases	0.63

Table 3: Functional outcome (Harris Hip Score)

Follow-up period	*PFN (Group A) Mean ± SD*	*PFNA2 (Group B) Mean ± SD*	*p-value*
6 weeks	58.2 ± 7.3	61.4 ± 6.8	0.12
3 months	69.5 ± 6.9	74.2 ± 7.1	0.03
6 months	78.3 ± 6.7	83.6 ± 6.2	0.01
12 months	84.6 ± 6.5	88.9 ± 5.8	0.02

Table 4: Radiological outcome and complications

Outcome parameter	*PFN (Group A)*	*PFNA2 (Group B)*	p-value
Mean Union Time (weeks)	14.8 ± 2.6	13.6 ± 2.2	0.04
Screw/Blade Cut-out	2 cases	0 cases	0.14
Varus Collapse	2 cases	1 case	0.55
Superficial Infection	1 case	1 case	1.00
Implant Failure	1 case	0 cases	0.31

for complication rates, union rates. A *p-value* < 0.05 was considered statistically significant.

RESULTS

A total of 40 patients with intertrochanteric femur fractures were included in the study, with 20 patients treated using PFN (Group A) and 20 patients treated using PFNA2 (Group B). All patients completed a minimum follow-up of 12 months and were included in the final analysis.

The mean age of patients in Group A was 64.8 ± 9.6 years, while in Group B it was 66.1 ± 8.9 years, with no statistically significant difference ($p > 0.05$). The majority of patients in both groups were above 60 years of age. Female patients predominated in both groups, consistent with osteoporotic fracture patterns. The most common mode of injury was a trivial fall at home, followed by road traffic accidents. The distribution of fracture type (stable vs unstable) was comparable between the two groups.

Both groups were comparable in terms of demographic characteristics and fracture pattern distribution, indicating uniform baseline characteristics.

The mean duration of surgery was significantly lower in the PFNA2 group (54.3 ± 8.2 minutes) compared to the PFN group (65.7 ± 9.5 minutes) ($p < 0.05$). Similarly, mean intraoperative blood loss was less in the PFNA2 group (112 ± 25 mL) compared to PFN (148 ± 32 ml). Fluoroscopy exposure time was also marginally lower in PFNA2. No major intraoperative complications were noted in either group.

PFNA2 demonstrated significantly reduced operative time and blood loss compared to PFN, suggesting a technically efficient procedure.

Functional outcome was assessed using the Harris Hip Score (HHS) at different follow-up intervals. At 12 months, the mean HHS in the PFN group was 84.6 ± 6.5, while in the PFNA2 group it was 88.9 ± 5.8, showing a statistically significant better functional outcome in the PFNA2 group ($p < 0.05$). The PFNA2 group showed faster recovery and better early mobilization.

The PFNA2 group showed significantly better functional outcomes at 3 months, 6 months, and 12 months follow-up compared to PFN.

The average time to radiological union was 14.8 ± 2.6 weeks in PFN group and 13.6 ± 2.2 weeks in the PFNA2 group, which was statistically significant ($p < 0.05$). Complication rates were slightly higher in the PFN group. Complications observed included screw cut-out, varus collapse, and superficial infection.

PFNA2 showed slightly faster union rates and fewer implant-related complications compared to PFN, although not all differences were statistically significant.

DISCUSSION

Intertrochanteric femur fractures remain a major cause of morbidity and mortality in the elderly population, particularly in developing regions such as Bihar where osteoporosis, malnutrition, and delayed presentation are common. The goal of treatment is stable fixation, early mobilization, and restoration of pre-injury functional status. Intramedullary fixation devices such as proximal femoral nail (PFN) and proximal femoral nail antirotation II (PFNA2) have gained popularity due to their biomechanical advantages and minimally invasive application [1].

In the present study, both PFN and PFNA2 provided satisfactory outcomes in terms of fracture union and functional recovery. However, PFNA2 demonstrated statistically significant advantages in operative parameters, earlier fracture union, and improved functional scores. These findings are consistent with previous studies that have shown PFNA2 to be a technically efficient implant with improved biomechanical stability, particularly in osteoporotic bone [2,3].

The demographic distribution in the present study showed a higher prevalence of intertrochanteric fractures in elderly females, which is consistent with global epidemiological patterns attributed to postmenopausal osteoporosis [4]. The predominant mode of injury was trivial fall, reflecting poor bone quality and frailty in this population. Similar findings have been reported in other Indian and international studies [5].

In terms of intraoperative parameters, the PFNA2 group demonstrated significantly reduced surgical duration and intraoperative blood loss compared to the PFN group. This can be attributed to the simplified instrumentation and single helical blade design of PFNA2, which eliminates the need for placement of two proximal screws as required in PFN. Several studies have reported similar findings, suggesting that PFNA2 reduces operative complexity and fluoroscopy exposure [6,7].

Functional outcome assessed using the Harris Hip Score (HHS) showed significantly better scores in the PFNA2 group at 3, 6, and 12 months follow-up. This indicates earlier rehabilitation and improved hip function. The helical blade design of PFNA2 provides superior rotational stability and compaction of cancellous bone, thereby reducing micromotion at the fracture site and facilitating early weight-bearing [8]. Other authors have similarly reported improved functional outcomes with PFNA2 compared to PFN, especially in unstable fracture patterns [9].

Radiological union was achieved in all cases in both groups; however, the mean time to union was slightly shorter in the PFNA2 group. This may be explained by better fracture stability and reduced risk of collapse due to improved anchorage of the helical blade in osteoporotic bone. Biomechanical studies have demonstrated that PFNA2 has higher resistance to cut-out and varus collapse compared to conventional screw-based systems [3,10].

Complication rates in the present study were slightly higher in the PFN group. Two cases of screw cut-out and one case of implant failure were observed in PFN, whereas no cut-out or implant failure occurred in the PFNA2 group. These findings are in agreement with previously published literature where complications such as Z-effect, reverse Z-effect, and screw migration have been associated with PFN systems [6]. The helical blade of PFNA2 prevents rotational instability and provides better load distribution, thereby reducing such complications [8].

Despite these advantages, it is important to note that PFN also provided satisfactory outcomes in the majority of patients, with acceptable functional scores and fracture union rates. Therefore, both implants remain viable options for the management of intertrochanteric fractures. The choice of implant may depend on

surgeon expertise, fracture pattern, and availability of resources. In low-resource settings such as Bihar, cost considerations and implant availability may influence decision-making.

The findings of the present study are particularly relevant for Bihar's population, where late presentation, poor nutritional status, and osteoporosis are common challenges. PFNA2, with its superior fixation in osteoporotic bone and reduced surgical time, may be especially advantageous in such settings. Early mobilisation facilitated by stable fixation can significantly reduce complications such as bed sores, pneumonia, and thromboembolism, which are major contributors to mortality in elderly patients with hip fractures [4].

However, the study has certain limitations. The sample size was relatively small (n=40), and the follow-up period was limited to one year. Larger multicentric studies with longer follow-up are required to validate these findings. Additionally, cost-effectiveness analysis was not included in the present study, which may be important in resource-constrained regions.

CONCLUSION

PFNA2 demonstrated superior operative efficiency, earlier fracture union, better functional outcomes, and fewer implant-related complications compared to PFN. Therefore, PFNA2 may be considered a more effective and reliable implant for managing intertrochanteric femur fractures in adult patients, particularly in osteoporotic populations in resource-limited settings like Bihar.

REFERENCES

1. Gullberg B, Johnell O, Kanis JA. Worldwide projections for hip fracture. Osteoporos Int. 1997;7(5):407-13.
2. Parker MJ, Handoll HH. Replacement arthroplasty versus internal fixation for extracapsular hip fractures in adults. Cochrane Database Syst Rev. 2006 Apr 19;2006(2):CD000086.
3. Anglen JO, Weinstein JN; American Board of Orthopaedic Surgery Research Committee. Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice. A review of the American Board of Orthopaedic Surgery Database. J Bone Joint Surg Am. 2008 Apr;90(4):700-7.
4. Simmermacher RKJ, Bosch AM, Werken CVD;. The AO/ASIF proximal femoral nail (PFN); a new device for the treatment of unstable proximal femoral fracture. Injury. 1999; 30 (5) : 327:332.
5. Kanthimathi B, Narayanan V. Early Complications in Proximal Femoral Nailing Done for Treatment of Subtrochanteric Fractures. Malays Orthop J. 2012 Mar;6(1):25-9.
6. Sommers MB, Roth C, Hall H, Kam BC, Ehmke LW, Krieg JC, Madey SM, Bottlang M. A laboratory model to evaluate cut-out resistance of implants for pertrochanteric fracture fixation. J Orthop Trauma. 2004 Jul;18(6):361-8.
7. Hu SJ, Chang SM, Ma Z, Du SC, Xiong LP, Wang X. PFNA-II protrusion over the greater trochanter in the Asian population used in proximal femoral fractures. Indian J Orthop. 2016 Nov-Dec;50(6):641-646.
8. Shah MR, Shah MM, Shah IM, Shah KR. Surgical and Functional Outcomes of the Results of Conventional Two-Screw Proximal Femoral Nail (PFN) Versus Helical-Blade Anti-rotation Proximal Femoral Nail (PFNA2). Cureus. 2023 Aug 18;15(8):e43698.
9. Mallya S, Kamath SU, Madegowda A, Krishnamurthy SL, Jain MK, Holla R. Comparison of radiological and functional outcome of unstable intertrochanteric femur fractures treated using PFN and PFNA-2 in patients with osteoporosis. Eur J Orthop Surg Traumatol. 2019 Jul;29(5):1035-1042.
10. Prabhat V, Jingua T, Gupta GK, Topno R, Kundu S, Guria A. A Randomized Trial Comparing the Outcome of Proximal Femoral Nailing and Proximal Femoral Nailing Antirotation 2 for Unstable Intertrochanteric Femur Fracture. Ann Afr Med. 2025 Jul 1;24(3):621-627.

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