International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

To Compare the Result of Proximal Femoral Nailing (PFN) and Proximal Femoral Nailing Antirotation-Asian (PFNA2) in Unstable Trochanteric Fracture

Dr. Gaurav Kaushal[1], Prof. Dr Ashwani Sadana[2], Dr. Shubham Khandelwal[3], Dr. Lalit Pathak[4], Dr. Tarun Gupta[5]

[1]Junior Resident, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India
[2]Professor and Head of Department, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India
[3]Senior Resident, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India
[4]Associate Professor, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India
[5]Assistant Professor, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India

Corresponding Author:

Dr. Gaurav Kaushal
Junior Resident, Department of Orthopaedics, F.H. Medical College and Hospital, Agra, Uttar Pradesh, India

Received: 04-06-2026
Accepted: 25-06-2026
Available online: 10-07-2026

ABSTRACT

Background: Unstable trochanteric fractures are common in elderly patients and are associated with significant morbidity and functional impairment. Intramedullary fixation devices such as Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation-Asian (PFNA2) are widely used for their management. However, the superiority of one implant over the other remains controversial.
Aim: To compare the clinical, radiological, and functional outcomes of PFN and PFNA2 in the treatment of unstable trochanteric fractures.
Materials and Methods: This prospective interventional study was conducted in the Department of Orthopaedics at FH Medical College and Hospital from January 2024 to December 2025. A total of 48 patients with unstable trochanteric fractures were included and divided into two groups: PFN (n=24) and PFNA2 (n=24). Patients were assessed for operative time, intraoperative blood loss, radiological union time, and functional outcome using the Modified Harris Hip Score (HHS). Statistical analysis was performed using SPSS version 16.0, and a P-value <0.05 was considered statistically significant.
Results; The mean intraoperative blood loss was significantly lower in the PFNA2 group (145.08 ± 20.23 ml) compared to the PFN group (170.29 ± 37.42 ml) (P = 0.005). The mean operative duration was also shorter in the PFNA2 group (70.32 ± 14.20 minutes) than in the PFN group (79.53 ± 13.64 minutes) (P = 0.02). Radiological union occurred earlier in the PFNA2 group (11.3 ± 2.6 weeks) compared to the PFN group (13.5 ± 2.8 weeks) (P = 0.008). Functional outcomes assessed by Modified HHS showed comparatively better recovery in the PFNA2 group during follow-up.
Conclusion: Both PFN and PFNA2 were effective in the treatment of unstable trochanteric fractures. However, PFNA2 demonstrated advantages such as shorter operative time, reduced blood loss, earlier fracture union, and better functional outcomes. Therefore, PFNA2 may be considered a preferable implant for unstable trochanteric fractures, especially in elderly patients with osteoporotic bone.

Keywords*: Unstable trochanteric fracture, Proximal Femoral Nail, PFN, PFNA2, Harris Hip Score, intramedullary fixation.*

INTRODUCTION

Trochanteric fractures of the femur are among the most common injuries encountered in orthopaedic practice, particularly in the elderly population. These fractures are associated with significant morbidity, mortality, prolonged hospitalisation, and socioeconomic burden due to increasing life expectancy and the rising prevalence of osteoporosis.[1] Intertrochanteric fractures account for approximately 45–50% of all hip fractures and commonly occur following low-

energy trauma such as domestic falls in elderly individuals, whereas high-energy trauma is more frequently observed in younger patients.[2]

The management of unstable trochanteric fractures remains challenging because of comminution, poor bone quality, and the strong deforming muscular forces acting around the proximal femur.[3] Conservative treatment has largely been abandoned because prolonged immobilisation may lead to complications such as deep vein thrombosis, pulmonary embolism, pressure sores, pneumonia, urinary tract infection, malunion, and non-union.[4] Therefore, early surgical stabilisation and mobilisation have become the standard approach in modern orthopaedic practice.

Various implants have been developed for the fixation of unstable trochanteric fractures, including the dynamic hip screw (DHS), gamma nail, proximal femoral nail (PFN), and proximal femoral nail antirotation (PFNA/PFNA2).[5] Among these, intramedullary fixation devices have gained widespread acceptance because they offer biomechanical advantages such as a shorter lever arm, reduced bending stress, minimal soft tissue dissection, less blood loss, and earlier weight bearing.[6]

The Proximal Femoral Nail (PFN), introduced by the AO/ASIF group in 1997, has become a widely accepted implant for unstable trochanteric fractures due to its minimally invasive insertion technique and biomechanical stability.[7] However, complications associated with PFN, including screw cut-out, Z-effect, reverse Z-effect, implant failure, and prolonged operative time, have been reported in several studies.[8]

To overcome these shortcomings, the Proximal Femoral Nail Antirotation-Asian (PFNA2) system was developed specifically for the Asian population. PFNA2 incorporates modifications in nail geometry, mediolateral angle, and proximal dimensions to better match Asian femoral anatomy.[9] The helical blade design of PFNA2 compacts cancellous bone during insertion, thereby improving rotational stability and implant anchorage, especially in osteoporotic bone.[10] Several comparative studies have evaluated PFN and PFNA2 regarding operative duration, intraoperative blood loss, fracture union, functional outcome, and postoperative complications.[11,12] However, controversy still exists regarding the superiority of one implant over the other in unstable trochanteric fractures. Therefore, the present study was conducted to compare the clinical, radiological, and functional outcomes of PFN and PFNA2 in the treatment of unstable trochanteric fractures.

MATERIALS AND METHODS

Study Design

This study was designed as a prospective interventional study conducted to evaluate and compare the clinical and functional outcomes of Proximal Femoral Nail Antirotation 2 (PFNA2) and Proximal Femoral Nail (PFN) in the management of unstable trochanteric fractures.

Study Centre

The study was conducted in the Department of Orthopaedics at FH Medical College and Hospital.

Duration of Study

The study was carried out over a period of two years from January 2024 to December 2025.

Study Population

The study population included all patients presenting to the Outpatient Department (OPD) of the Department of Orthopaedics and the Emergency Department of FH Medical College and Hospital with trochanteric fractures during the study period and fulfilling the predefined inclusion criteria.

Sample Size

A total of 48 patients were enrolled in the study.

Inclusion Criteria

The following patients were included in the study:

- Men and women aged between 51 and 75 years
- Patients with unstable trochanteric fractures
- Patients willing to provide informed consent for participation and surgery

Exclusion Criteria

Patients fulfilling any of the following criteria were excluded from the study:

- Pathological fractures
- Severe life-threatening diseases or patients unfit for surgery
- Open fractures

- Polytrauma patients
- Presence of active infection
- Patients with inflammatory arthritis
- Tumour metastasis involving bone
- Patients unwilling to provide consent

Surgical Technique: Proximal Femoral Nailing

Determination of Entry Point

Most intramedullary nails designed for trochanteric fractures were inserted through the greater trochanter rather than the trochanteric fossa. The exact entry point depended upon the design of the selected nail system. The surgeon ensured familiarity with the implant design before surgery. Fracture deformities, such as flexion and abduction, occasionally made identification of the ideal entry point difficult. In such cases, realignment of the proximal femur was achieved using a percutaneously inserted Schanz screw and/or a ball-spiked pusher to facilitate proper positioning.

For long nails, special attention was given to placing the incision and entry point slightly posteriorly in line with the anatomical axis of the femur.

Planning of Skin Incision

The skin incision was planned along the curved axis of the femoral canal, which lies slightly posterior to the expected line. Proper alignment of the incision with the intended path of instrumentation and nail insertion helped minimise eccentric reaming and prevent posterior cortical perforation.

Skin Incision

The tip of the greater trochanter and the femoral shaft axis were identified and marked on the skin under image-intensifier guidance as needed. A 3–5 cm skin incision was made several centimetres proximal to the tip of the greater trochanter along the proximal extension of the bowed femoral shaft axis. The exact incision site varied depending on the patient's soft-tissue thickness and the implant insertion system used.

Deep Incision and Exposure

Superficial Dissection

A longitudinal incision measuring approximately 3–8 cm was made through the fascia of the gluteus muscle centred over the skin marking.

Deep Dissection

The fibres of the gluteal muscles were split bluntly to expose the tip of the greater trochanter, which was palpated using a finger or surgical instrument.

Implant Systems

Both PFNA2 and PFN implant systems were utilised in the study according to fracture configuration and surgeon preference. Intraoperative fluoroscopic guidance was used during all procedures to confirm reduction, implant positioning, and fixation.

Method of Assessment

Patients were followed up clinically and radiologically at:

- 6 weeks
- 3 months
- 6 months
- 9 months postoperatively

The following parameters were assessed and compared between the PFNA2 and PFN groups:

- Operative time
- Intraoperative blood loss
- Blood transfusion requirement
- Total fluoroscopy time
- Postoperative drainage
- Duration of hospitalisation
- Postoperative complications
- Ease of nail handling and implant insertion

Statistical Analysis

Statistical analysis was performed using SPSS software version 16.0 (SPSS Inc., Chicago, IL, USA). Quantitative variables were analysed using Student's t-test, whereas categorical variables were evaluated using the Chi-square test or Fisher's exact test, wherever appropriate. A two-tailed P-value of less than 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

Table 1: Demographic Distribution of Patients in PFN and PFNA2 Groups

Variable	Category	PFN (n=24) No. of Cases	PFN Percentage	PFNA2 (n=24) No. of Cases	PFNA2 Percentage	P-value
Age Group	< 50 years	2	8.33%	3	12.50%	—
	51–60 years	9	37.50%	10	41.67%	—
	61–70 years	7	29.17%	8	33.33%	—
	> 70 years	6	25.00%	3	12.50%	—
	Total	24	100.00%	24	100.00%	—
	Mean ± SD	62.42 ± 9.45	—	59.96 ± 8.83	—	—
Gender	Male	16	66.67%	14	58.33%	0.55
	Female	8	33.33%	10	41.67%	
	Total	24	100.00%	24	100.00%	

Table 2: Distribution of Fracture Side and Mode of Injury in PFN and PFNA2 Groups

Variable	Category	PFN (n=24) No. of Cases	PFN Percentage	PFNA2 (n=24) No. of Cases	PFNA2 Percentage	P-value
Side of Fracture	Left	13	54.17%	14	58.33%	0.77
	Right	11	45.83%	10	41.67%	
	Total	24	100.00%	24	100.00%	
Mode of Injury	Domestic Fall	14	58.33%	16	66.67%	0.55
	Road Traffic Accident	10	41.67%	8	33.33%	
	Total	24	100.00%	24	100.00%	

Table 3: Distribution of Fracture Types and Comparison of Intraoperative Parameters between PFN and PFNA2 Groups

Variable	Category	PFN (n=24)	PFNA2 (n=24)	Test Value	P-value
Type of Fracture	Type I	6 (25.00%)	3 (12.50%)	—	0.74
	Type II	6 (25.00%)	7 (29.17%)	—	
	Type III	8 (33.33%)	9 (37.50%)	—	
	Type IV	4 (16.67%)	5 (20.83%)	—	
	Total	24 (100.00%)	24 (100.00%)		
Intraoperative Blood Loss (ml)	Mean ± SD	170.29 ± 37.42	145.08 ± 20.23	t = -2.90	0.005
Surgical Duration (min)	Mean ± SD	79.53 ± 13.64	70.32 ± 14.20	t = -2.29	0.02

Table 4: Comparison of Radiological Union Time and Modified Harris Hip Score (HHS) between PFN and PFNA2 Groups

Variable	Category	PFN (n=24)	PFNA2 (n=24)	Test Value	P-value
Radiological Union Time (weeks)	Mean ± SD	13.5 ± 2.8	11.3 ± 2.6	t = -2.76	0.008
Modified HHS at 6 Weeks	Poor (<70)	15 (62.50%)	10 (41.67%)	χ^2 = 2.13	0.34
	Fair (70–79)	8 (33.33%)	12 (50.00%)		
	Good (80–89)	1 (4.17%)	2 (8.33%)		
	Excellent (90–100)	0 (0.00%)	0 (0.00%)		
	Total	24 (100.00%)	24 (100.00%)		
Modified HHS at 3 Months	Poor (<70)	9 (37.50%)	4 (16.67%)	χ^2 = 3.11	0.21
	Fair (70–79)	10 (41.67%)	11 (45.83%)		
	Good (80–89)	5 (20.83%)	9 (37.50%)		
	Excellent (90–100)	0 (0.00%)	0 (0.00%)		
	Total	24 (100.00%)	24 (100.00%)		

Table 4: Comparison of Radiological Union Time and Modified Harris Hip Score (HHS) at 6 Weeks and 3 Months between PFN and PFNA2 Groups

Variable	Category	PFN (n=24)	PFNA2 (n=24)	Test Value	P-value
Radiological Union Time (weeks)	Mean ± SD	13.5 ± 2.8	11.3 ± 2.6	t = -2.76	0.008
Modified HHS	Poor (<70)	24 (50.00%)	14 (29.17%)	—	—
	Fair (70–79)	18 (37.50%)	23 (47.92%)	—	—
	Good (80–89)	6 (12.50%)	11 (22.92%)	—	—
	Excellent (90–100)	0 (0.00%)	0 (0.00%)	—	—
	Total Assessments	48	48		

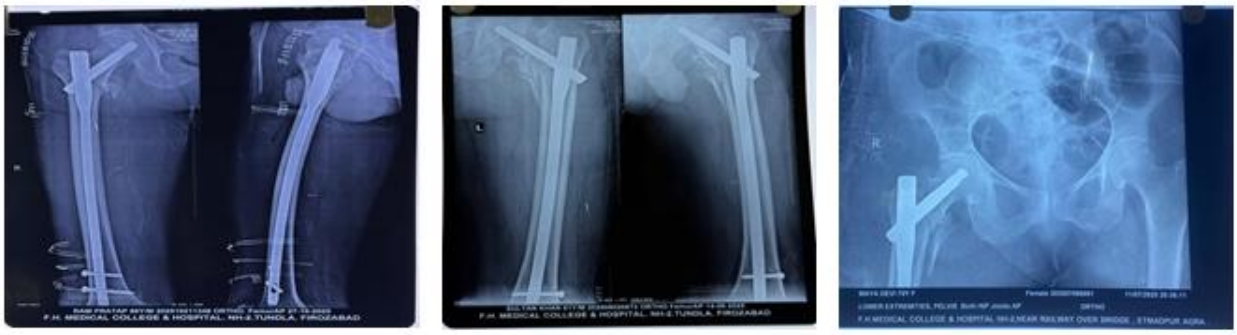


Image 1: lower extremities, pelvis, pfna2

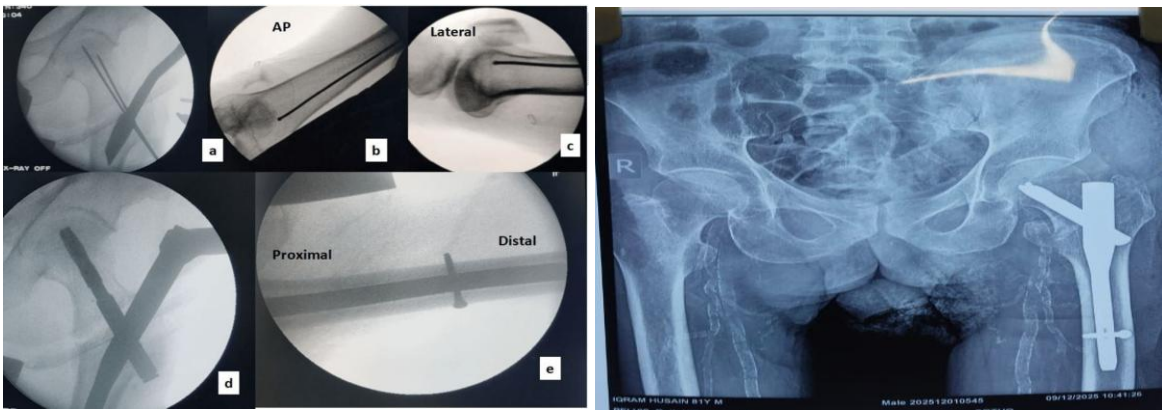
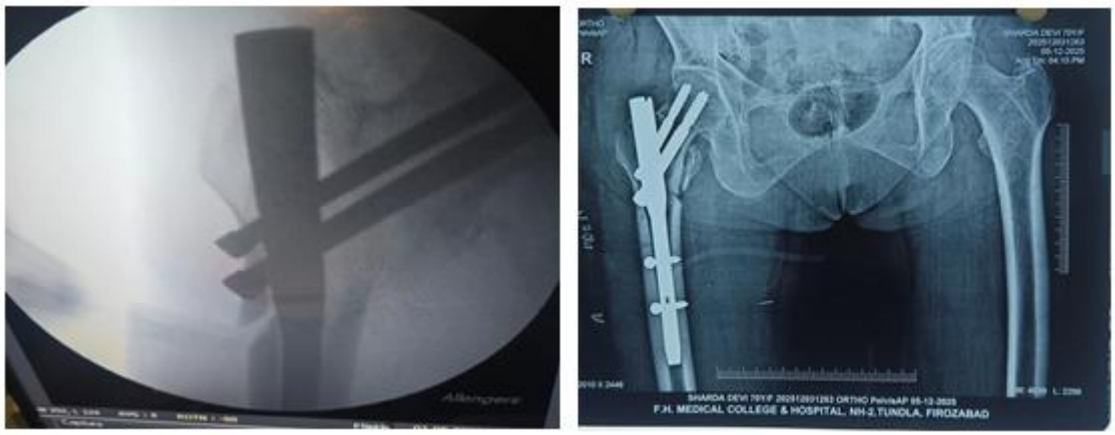
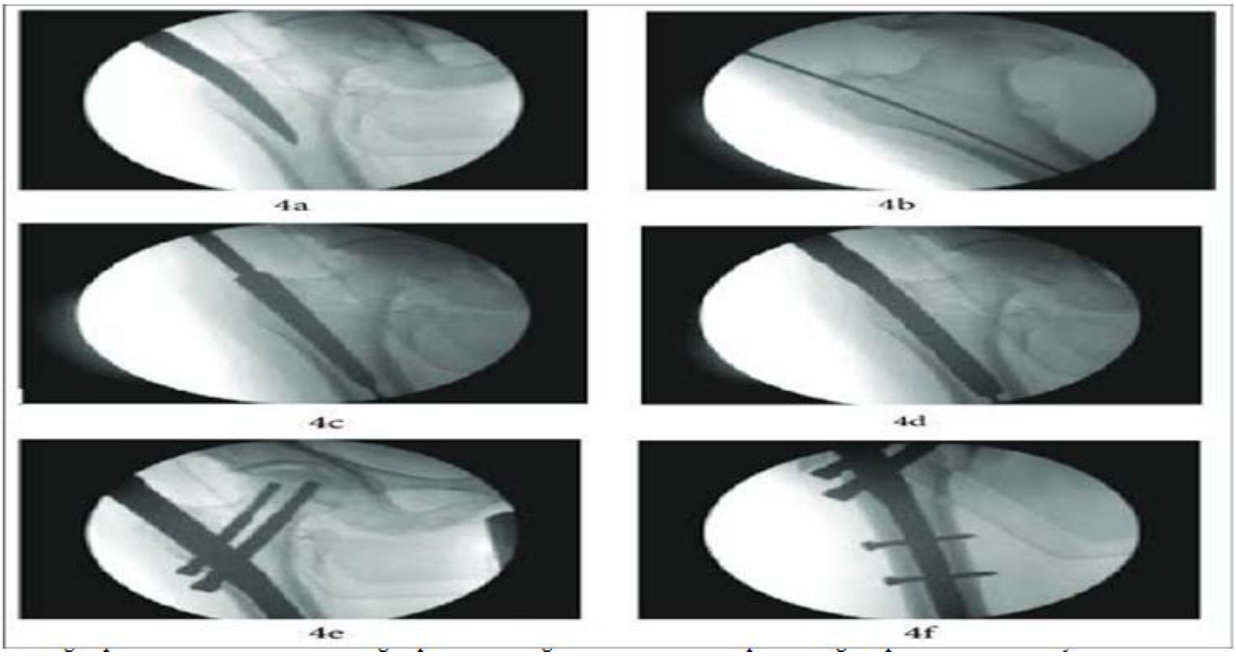


Image 2: intra operative X-RAY of PFN





DISCUSSION

The management of unstable trochanteric fractures continues to be a major challenge in orthopaedic surgery, particularly in elderly patients with osteoporotic bone. The ideal implant should provide stable fixation, permit early mobilisation, minimise complications, and ensure satisfactory functional recovery. In the present prospective interventional study, the outcomes of PFN and PFNA2 were compared in patients with unstable trochanteric fractures.

In the present study, the majority of patients belonged to the age group of 51–70 years, with mean ages of 62.42 ± 9.45 years in the PFN group and 59.96 ± 8.83 years in the PFNA2 group. These findings are comparable with those reported by Boldin et al.[8] and Pu et al.[9], who observed that unstable trochanteric fractures are predominantly seen in elderly individuals because of osteoporosis and increased risk of falls. Male predominance was observed in both groups, which was similar to the observations of Garg et al.[12]

Domestic fall was the most common mechanism of injury in both groups, accounting for 58.33% of cases in the PFN group and 66.67% in the PFNA2 group. This finding correlates with the epidemiological pattern described by Court-Brown and Caesar,[2] who reported that low-energy trauma is the leading cause of proximal femoral fractures in the elderly population.

The distribution of fracture types was comparable between the two groups, with Type III fractures being the most common pattern observed. This ensured homogeneity between the study groups and allowed reliable comparison of treatment outcomes.

A significant finding of the present study was the lower intraoperative blood loss observed in the PFNA2 group (145.08 ± 20.23 ml) compared with the PFN group (170.29 ± 37.42 ml), which was statistically significant (P = 0.005). Similar findings were reported by Zhang et al.[11], who demonstrated that PFNA2 required less operative exposure and surgical manipulation, thereby reducing blood loss.

The mean operative duration was also significantly shorter in the PFNA2 group (70.32 ± 14.20 minutes) than in the PFN group (79.53 ± 13.64 minutes) (P = 0.02). This reduction in surgical duration may be attributed to the simpler instrumentation and single helical blade insertion used in PFNA2 compared with the dual screw mechanism of PFN. Comparable observations were made by Garg et al.[12] and Simmermacher et al.[7]

Radiological union occurred earlier in the PFNA2 group, with a mean union time of 11.3 ± 2.6 weeks compared with 13.5 ± 2.8 weeks in the PFN group (P = 0.008). The earlier union associated with PFNA2 may be due to improved rotational stability and enhanced cancellous bone compaction achieved by the helical blade design. Sommers et al.[10] demonstrated that the helical blade mechanism provides greater resistance to cut-out and rotational instability in osteoporotic bone.

Functional outcome assessment using the Modified Harris Hip Score (HHS) revealed progressive improvement in both groups during follow-up. At 6 weeks, most patients had poor to fair outcomes, reflecting the early postoperative recovery

period. However, by 3 months, the PFNA2 group demonstrated comparatively better functional recovery, with a greater proportion of patients achieving good HHS scores. Although the difference was not statistically significant, the trend favoured PFNA2. Similar findings have been reported in previous comparative studies.[11,12]

The better clinical and radiological outcomes associated with PFNA2 may be attributed to several biomechanical advantages, including improved rotational stability, better fixation in osteoporotic bone, reduced risk of implant failure, and minimally invasive insertion technique.[9,10] Furthermore, PFNA2 was specifically designed for the Asian population with modifications that better accommodate proximal femoral anatomy.[9]

Despite these advantages, the present study had certain limitations. The sample size was relatively small, and the follow-up period was limited to 9 months. Long-term complications, implant survival, and quality-of-life outcomes could not be assessed comprehensively. In addition, the study was conducted at a single tertiary care centre, which may limit the generalisability of the findings.

Overall, the findings of the present study suggest that PFNA2 provides shorter operative duration, reduced intraoperative blood loss, earlier radiological union, and comparatively better functional outcomes than PFN in the treatment of unstable trochanteric fractures. Therefore, PFNA2 may be considered a preferable implant option, particularly in elderly patients with osteoporotic bone.

CONCLUSION

Both PFN and PFNA2 were effective in the treatment of unstable trochanteric fractures. However, PFNA2 showed better outcomes in terms of shorter operative time, reduced intraoperative blood loss, earlier radiological union, and improved functional recovery. The helical blade design of PFNA2 provided better rotational stability and fixation, especially in osteoporotic bone. Therefore, PFNA2 may be considered a preferable implant for the management of unstable trochanteric fractures, particularly in elderly patients.

REFERENCES

1. Rockwood CA Jr, Green DP, Bucholz RW. Rockwood and Green's Fractures in Adults. 8th ed. Philadelphia: Wolters Kluwer Health; 2015.
2. Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. Injury. 2006;37(8):691–697.
3. Kaufer H. Mechanics of the treatment of hip injuries. Clin Orthop Relat Res. 1980;(146):53–61.
4. Kyle RF, Gustilo RB, Premer RF. Analysis of six hundred and twenty-two intertrochanteric hip fractures. J Bone Joint Surg Am. 1979;61(2):216–221.
5. Hardy DC, Descamps PY, Krallis P, et al. Use of an intramedullary hip-screw compared with a compression hip-screw with a plate for intertrochanteric femoral fractures. J Bone Joint Surg Am. 1998;80(5):618–630.
6. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. J Bone Joint Surg Am. 1995;77(7):1058–1064.
7. Simmermacher RKJ, Bosch AM, Van der Werken C. The AO/ASIF-Proximal Femoral Nail (PFN): A new device for the treatment of unstable proximal femoral fractures. Injury. 1999;30(5):327–332.
8. Boldin C, Seibert FJ, Fankhauser F, et al. The proximal femoral nail (PFN): A minimally invasive treatment of unstable proximal femoral fractures. Acta Orthop Scand. 2003;74(1):53–58.
9. Pu JS, Liu L, Wang GL, Fang Y, Yang TF. Results of the proximal femoral nail anti-rotation (PFNA) in elderly Chinese patients. Int Orthop. 2009;33(5):1441–1444.
10. Sommers MB, Roth C, Hall H, et al. A laboratory model to evaluate cutout resistance of implants for pertrochanteric fracture fixation. J Orthop Trauma. 2004;18(6):361–368.
11. Zhang S, Zhang K, Jia Y, et al. InterTan nail versus proximal femoral nail antirotation-Asia in the treatment of unstable trochanteric fractures. Orthopedics. 2013;36(3):e288–e294.
12. Garg B, Marimuthu K, Kumar V, et al. Outcome of short proximal femoral nail antirotation and proximal femoral nail in unstable trochanteric fractures. Hip Int. 2011;21(5):531–536.