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Original Article

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PFN A3 in Intertrochanteric Fractures: A Game Changer in Proximal Femoral Fixation

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Abstract

Background: Intertrochanteric fractures, unstable particularly (AO/OTA 31-A3), is difficult to treat. Proximal femoral nailing (PFN) has emerged as a convenient means of its treatment owing to biomechanical superiority to achieve optimal stability and minimizing complications, particularly comminuted or osteoporotic fractures. This article explores the effectiveness of a PFN A3 design in the treatment of intertrochanteric fractures. To assess the clinical and radiologic results of the use of the PFN A3 for fixation of intertrochanteric fractures, particularly in the stability of fixation, fracture union, and complication reduction. ***Material & Methods:*** In this retrospective analysis, 158 patients (48 men, 110 women; age range, 47-95 years) who had surgical fixation with the PFN A3 for intertrochanteric fractures from September 2022 to April 2025 were studied. Seventy-five fractures were on the right side and 83 on the left side. Fracture classification, operative time, blood loss, union rate, time to weight-bearing, and complications were recorded and compared. ***Results:*** The mean age of the study population was 78.3 years, with a slight female predominance (69.62%). The distribution of Modified Harris Hip Score (MHHS) among study participants revealed significant variations with age, while differences based on sex and AO/OTA classification were not statistically significant, with 26% of patients categorized as having good outcomes and 36% classified as excellent. Younger patients demonstrated significantly better functional outcomes. The mean neck–shaft angle was 137°, with no significant variation across demographic groups. The mean TAD was 21.09 mm. Post-operative complications were minimal, with screw cut-out occurred in no cases and superficial wound healing delays in 0.17%, sepsis in 1.26%. ***Conclusion:*** For intertrochanteric fractures PFN A3 implant plays a significant role as far as femoral fixation especially in older individuals due to the osteoporotic nature of the bone in elderly patients.

Keywords: ***Intertrochanteric fracture, PFN A3, Proximal femoral nail.***

Introduction

Intertrochanteric fractures, fractures of the upper third of the femur, are a major global health burden. Exclusively occurring in elderly patients in the form of low-energy trauma due to osteoporosis, their prevalence is escalating with increased aging [1]. Proper treatment is important as delayed mobilization from these fractures is associated with serious complications such as DVT, pulmonary embolism, and pressure sores. The anatomically distinct location and weakened bone quality require strong and stable fixation surgery. Conservative treatment in the past of these fractures was associated with high mortality and morbidity. Development of surgery ushered in internal fixation, first with extra medullary devices such as the Dynamic Hip Screw (DHS). Though DHS serves well in stable fractures, it has drawbacks for unstable or comminuted types because of its long lever arm, which produces high bending moments and makes lag screw cutout risk higher in osteoporotic bone [2]. This has led the way to intramedullary nailing. The 1997 creation of the PFN was a breakthrough, followed by variations such as PFNA and PFNA2, always building on designs. Advances in the form of the helical blade of contemporary PFNA2 improve rotation stability and diminish head element cut-out through cancellous bone compaction. All these advances aside, treatment of highly unstable intertrochanteric fractures, particularly AO/OTA 31-A3 types, still poses problems [3]. These fractures, with their extensive comminution or compromise of the lateral femoral wall, result in intrinsic instability and increased risk for implant failure, shortening, or rotational deformity. The ongoing quest for an implant yielding consistent strong fixation and predictable healing in these difficult situations persists. This is a retrospective study examining the PFN A3 system, a certain development within the proximal femoral nailing family. Speculated to provide the advanced features specifically for difficult intertrochanteric fractures, specifically unstable AO/OTA 31-A3 types, the PFN A3 seeks to improve on the old generations. Through potentially delivering better biomechanical characteristics and improved design aspects, it hopes to provide a better solution for stable fixation, early fracture union, and reduced postoperative complications. We propose to intensively

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test its performance in real-world settings, assessing its effect on fracture healing, patient mobility, and overall clinical outcomes in a heterogeneous patient population. This study aims to identify whether the PFN A3 is indeed a game changer for proximal femoral fixation, possibly creating a new gold standard of care for these common and disabling injuries.

Methodology

This retrospective study was done on 158 patients who had intertrochanteric fracture and operated between May 2021 and October 2023 at the Department of Orthopaedics, Karuna Medical College and Hospital, Kerala.

Inclusion criteria

1. Patients above 18 years of age with unstable intertrochanteric fractures
2. AO/OTA Classification System-A type of fracture.
3. Patients who are medically fit and willing for surgery.

Exclusion criteria

1. AO/OTA Classification System B and C (neck of femur and head of femur fracture)
2. Fractures extending into diaphysis compound fractures
3. Patients with pathological fractures.

This is a retrospective study that includes 158 patients with Intertrochanteric fracture. All the surgeries were done in a single center by the same team of surgeons. All patients in this study were admitted from the emergency room, with complaints of pain in the affected hip and other affected body part after trauma, either due to a fall or due to RTA. All the patients were evaluated completely and a routine investigation was done. Diagnosis was made based on clinical findings and radiological examination. X-ray pelvis with both hip anteroposterior view and lateral view of the affected hip was sufficient for diagnosis. (Fig. 1,2). Patients with suspected intertrochanteric fractures satisfying inclusion criteria were included. All the patients underwent pre-anesthetic checkups, once they were fit, they were operated on as early as possible, with PFNA. Assessment of the reduction quality was done by a comparison of the neck-shaft angle of the operated side and the normal side on AP view of immediate post-operative radiographs. A variation of <5° from the normal side was considered a "good" reduction The post-operative radiological outcome was assessed and compared using parameters such as tip-apex distance, neck-shaft angle. Fracture union rates were compared at 6 weeks and 6 months. (Fig. 3,4). At each follow-up, radiological assessment with neck shaft angle and tip apex distance, clinical assessment was done by Modified Harris Hip Score. Evaluation for intraoperative blood loss and surgery time (skin to skin) was done. All the patient's post-operative follow-ups were done at 6 weeks 3 and 6 months. Functional assessment was done on every follow-up at 6 weeks and 3 months, and the final assessment at 6 months was done using the Modified Harris Hip Score, WOMAC score and VAS score.

Results

A total of 158 patients were included in this study. (**Table 1**) shows the distribution of pre-operative patients' characteristics. The mean age of the patients in this study was 78.3. A majority of patients were in the 76-95-year age group, with more female predominance. Left sided fracture seems to be more common than right side. In terms of fracture severity, AO/OTA A2.3 fractures were the most frequent, followed by A3.1. (**Table 1**) summarizes the details of the study. The mean operation time was 30 minute. The mean blood loss was 22.025ml (**Table 2**). The distribution of Modified HHS (MHHS) (**Table 3**) among study participants revealed significant variations with age, while differences based on sex and AO/OTA classification were not statistically significant. Participants aged 50-60 years had the highest mean score 85.45 followed by those aged 61–75 years 67.42 and 76-95 years 54.6. Males had a slightly higher mean score (71.72) compared to females (69.33). The distribution in neck–shaft angle among study participants had no statistically significant differences across age, sex, or AO/OTA classification groups (**Table 4**). Participants aged 76-95 years had the highest mean angle (148.25°), followed closely by those aged 61-75 years (132.38°) and 50-60 years (129.77°). Males and females had identical mean neck–shaft angles (132°), with standard deviations of 4.92° and 3.08°, respectively. Among AO/OTA classification types, Types A2.3 and A2.2 had the highest mean angles (134.48° and 133.83°, respectively), while Types A3.2 had slightly lower means (128.68°). The overall mean neck–shaft angle was 130.6° ± 2.1°. The analysis of tip–apex distance (TAD) among study participants did not show statistically significant differences by age, sex, or AO/OTA classification (**Table 5**). The overall mean TAD in this study was 21.79 mm, with no participants having a TAD >25 mm. Participants aged 76-95 years had the highest mean TAD (21.87mm), followed by those aged 61-76 years (20.6mm) and 50-60 years (18.71 mm), though the differences were not statistically significant. Females had a slightly lower mean TAD (21.20 mm) compared to males (21.75mm). Among AO/OTA classifications, Type A2.3 and Type A3.1 fractures showed higher mean TAD values (22.35mm and 21.75 mm, respectively). The final outcome of the patients was assessed by Harris Hip Score (**Fig 1**) In this study, post-operative complications were minimal. Negative cortical support, positive medial cortical support, and delayed superficial wound healing were each observed in 2% of cases (1 patient each), no patient had screw cut out. This showed the patients who did not return for follow up (**Fig 2**). The final results measured by WOMAC Score (**Fig 3**) and VAS score preoperative and post-operative shown (**Fig 4**).

Table 1: Patients Demographics

S. No	Variable	Frequency	Percentage
1	**Age**		
	50-60	14	8.86%
	61-75	43	27.22%
	76-95	101	63.92%
2	**Sex**		
	Male	48	30.38%
	Female	110	69.62%
3	**Fracture Side**		
	Left	83	52.53%
	Right	75	47.47%

4	**AO**		
	A1.1	0	0.00%
	A1.2	1	0.63%
	A1.3	2	1.27%
	A2.1	4	2.53%
	A2.2	16	10.13%
	A2.3	82	51.90%
	A3.1	46	29.11%
	A3.2	7	4.43%
	A3.3	0	0.00%
	Total	**158**	**100.00%**

Table 2: Intra Operative Details of Patients

S. No	*Variable*	*Minimum*	*Maxmium*	*Mean*	*SD*
1	Operation Time (Minutes)	20	50	21.52	6.60
2	Blood Loss (ML)	20	60	22.025	8.80

SD: Standard Deviation

Table 3: Modified Harris Hip Score for the Patients (Post-Operative)

S. No	Variable	Harris Hip Score			
		Minimum	Maximum	Mean	SD
		Age			
1	50-60	80	90	85.45	3.84
	61-75	65	70	67.42	2.04
	76-95	50	60	54.6	4.53
2	**Sex**				
	Male	60	90	71.72	9.52
	Female	55	90	69.33	11.5
3	**AO**				
	A1.1	0	0	0.0	0.0
	A1.2	72	72	72.0	0.0
	A1.3	70	81	74.93	4.18
	A2.1	60	76	68.59	7.21
	A2.2	65	86	75.01	7.8
	A2.3	56	90	69.7	14.01
	A3.1	72	90	80.3	5.94
	A3.2	82	88	86.44	2.13
	A3.3	0	0	0.00	0.0

Table 4: The Neck-Shaft Angle in The Patients (Post - operative)

S. No	Variable	The Neck-Shaft Angle in The Patients			
		Minimum	Maximum	Mean	SD
		Age			
1	50-60	127	135	129.77	2.78
	61-75	128	136	132.38	3.13
	76-95	128	170	148.25	17.07
2	**Sex**				
	Male	127	140	132.32	4.92
	Female	127	135	132.26	3.08
3	**AO**				
	A1.1	0	0	0.0	0.0
	A1.2	127	135	130.67	3.18
	A1.3	128	136	132.16	3.25
	A2.1	127	135	131.15	3.41
	A2.2	128	137	133.83	3.16
	A2.3	128	140	134.48	4.99
	A3.1	128	135	131.88	2.22
	A3.2	127	130	128.68	0.92
	A3.3	0	0	0.0	0.00

Table 5: Tip Apex Distance Study Post Op in Patient

S. No	Variable	Apex Distance Study Post Op in Patients			
		Minimum	Maximum	Mean	SD
		Age			
1	50 Yrs - 60yrs 61 Yrs - 75yrs 76 Yrs - 95yrs	17.82 19 20.34	20.22 22.2 23.4	18.71mm 20.6mm 21.87	0.87mm 0.92mm 0.88mm
2	**Sex**				
	Male Female	21.3 19	22.2 23.4	21.75 21.20	0.26 1.27
3	**AO**				
	A1.1 A1.2 A1.3	0 21.3 20.34	0 21.3 22.2	0 21.3 21.27	0 0 0.54
	A2.1 A2.2 A2.3	19 17.32 21.3	21.02 20.1 23.4	20.01 18.96 22.35	0.58 0.66 0.61
	A3.1 A3.2 A3.3	21.3 20.34 0	22.2 21.3 0	21.75 20.82 0	0.26 0.28 0

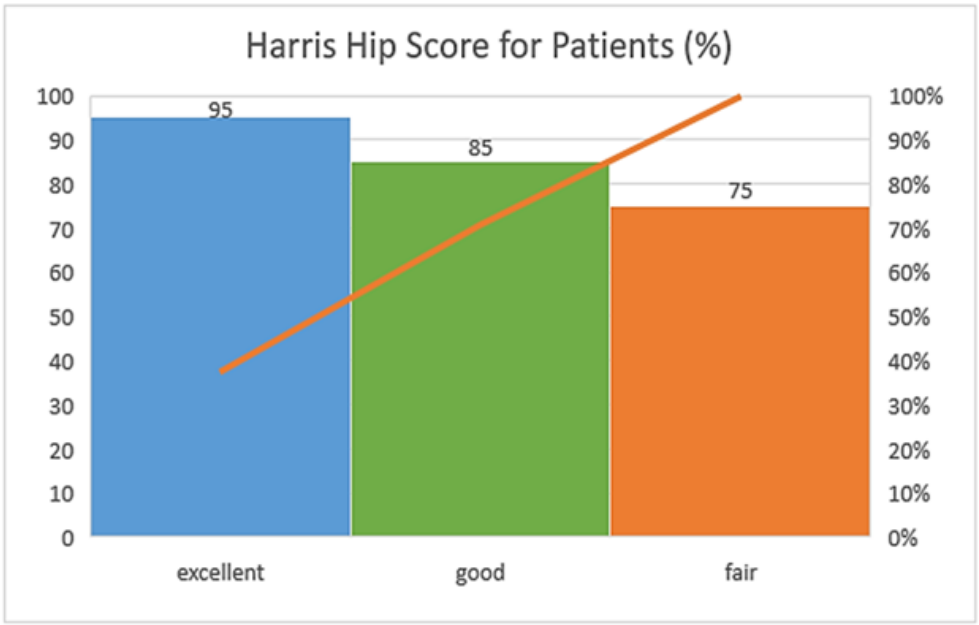

Figure 1: Harris Hip Score for Patients (%)

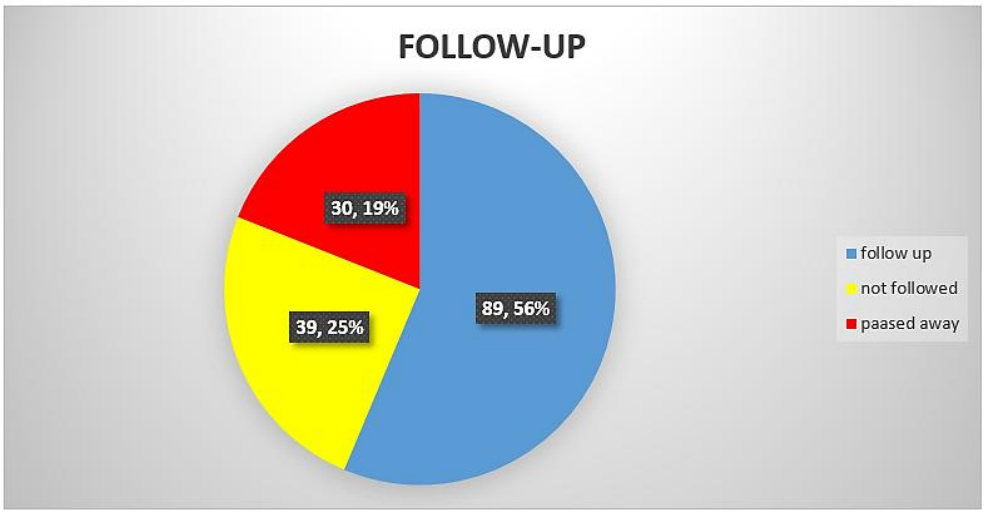

Fig 2: Final Follow-Up Patients

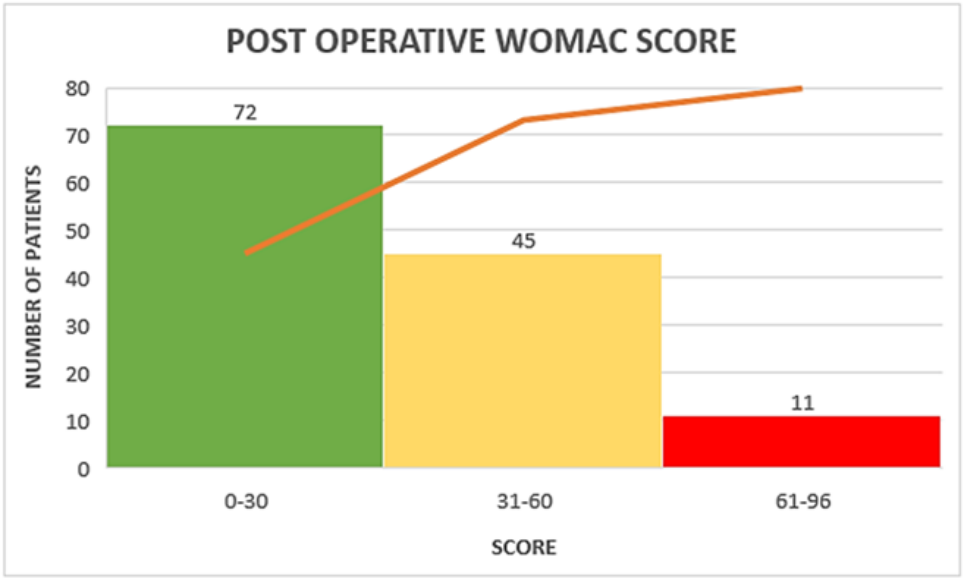

Fig 3: Post Operative Womac Score

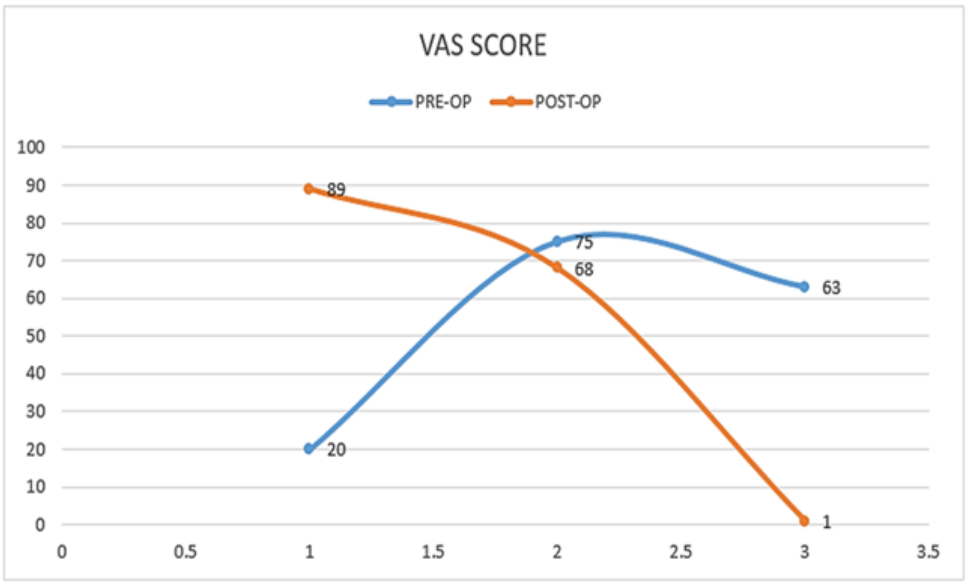

Fig 4: VAS Score

Discussion

Intertrochanteric fractures are often noted in older individuals due to trivial fall as a result of osteoporosis [4]. The benefits of PFN include a shorter lever arm, fracture site compression, and enhanced rotational stability, which contribute to a lower chance of mechanical failure. Additionally, patients treated with PFN typically experience shorter hospital stays, earlier mobilization, less blood loss, shorter surgery times, faster rehabilitation, and quicker bone healing, making PFN a highly effective treatment option for certain fractures. The average operating time for (30 minutes) intramedullary nail fixation. The PFN A3 has arrived as a game changer in the management of intertrochanteric fractures specially in unstable fractures. It gives a biomechanical stability and functional outcome with minimal invasiveness.

In our study, the mean age in patients was 78.3, majority falling within the 76-95year age, the youngest patient was 47 years old and the oldest patient was 95. Ageing factors leading to osteoporosis, diminished muscle strength, and impaired balance lead to these fractures. Moreover, advancing age often complicates postoperative recovery due to comorbidities that may delay fracture healing and impact functional outcomes. The predominance of female patients in our study aligns with existing literature on intertrochanteric fractures, which consistently highlights a higher incidence among women, this increased vulnerability in females is largely attributed to postmenopausal osteoporosis, where decreased estrogen levels lead to accelerated bone loss and reduced bone mineral density. Additionally, women tend to have longer lifespans than men. Studies have also indicated that certain anatomical and biomechanical factors, such as wider pelvic structure and lower muscle mass in females, may further contribute to this predisposition [5].

The AO/OTA classification system provides a structured framework for categorizing intertrochanteric fractures based on fracture patterns, which can influence surgical planning and outcomes [6]. In our study, Type A2.3 fractures were the most prevalent (51.90%) followed by Type A3.1 (29.11%). The predominance of this type of fractures aligns with existing data that suggest this type often results from low-energy trauma in osteoporotic bone, which is common in elderly population [7]. Type A2/A3 fractures are more common are relatively stable and easier to manage surgically, whereas Type A3.3 fractures are unstable, pose greater challenges in achieving optimal reduction and fixate on. Specially (OTS) 31A3 fracture is best dealt with PFN when compared with dynamic condylar screw [8]. The study by an author in a case of unstable IT fracture while using PFN with additional

screw or cerclage wire increases the stability of construct [9]. However, a study showed PFNA better over PFN because of reduced operative time, blood loss, and need for fluoroscopic imaging [10]. However, no statistically observable benefits were noted in postoperative functional outcomes or complications between the two implants. PFNA has better rotation stability with single screws and better functional outcomes in treating unstable intertrochanteric fractures when compared to PFN [11].

The mean post-operative neck-shaft angle of 130.6° ± 2.1° observed in this study is consistent with the desired anatomical restoration showed in our study. Maintaining an optimal neck-shaft angle is crucial as it directly impacts the biomechanics of the hip joint, ensuring appropriate load distribution and functional recovery. Deviations from the normal range (approximately 125°-135°) may result in complications [12] The MHHS (Modified Harris Hip Score) is a reliable tool for evaluating post-operative outcomes in patients undergoing surgical management of hip fractures, particularly intertrochanteric fractures [13]. It assesses pain and functional capacity, daily activity performance, providing a fantastic measure of recovery. In this study, the total mean MHHS was 83.55 (26% good and 36% excellent) indicating favorable post-operative outcomes with effective surgical management and rehabilitation. This score aligns with good functional recovery, reduced pain, and restored mobility [14]. Mean MHHS was 83.55, with 26% of patients categorized as having "good" outcomes and 36% classified as "excellent." The high mean score in the current study suggests that PFNA-3 may provide marginally better functional outcomes [15], potentially due to enhanced biomechanical stability or reduced post-operative complications.

The MHHS in this study demonstrated significant variability among the patients. Participants under 50-60 years achieved the highest mean score 85.45 indicating better recovery due to better bone quality, muscle strength, and lesser comorbidities. The 61–75-year age group scored moderately well 67.42, while those 76-95 years had the lowest mean score 54.6, indicative of challenges such as osteoporosis. This finding are similar to existing literature [16], which consistently identifies age as a major predictor of outcomes in hip fracture management, especially in unstable fracture [17]. There was variation in TAD between different age groups, sex, and AO/OTA classification system, but they were not statistically significant. The overall mean TAD was 21.09mm. None of the participants had a TAD >25 mm. Especially >25 mm TAD is associated with increased implant failure rates [18]. The duration of surgery minimum took 20 minutes and maximum was 50 minutes [**Table 2**].

The Hospital stay for most of the patients it was 4 days. Most of the patients started walking within 2-4 weeks and 2 patients started walking after 28 weeks. In this study, no implant failure, no reoperation and post-operative complications were minimal. Screw cut-out was nil, while delayed superficial wound healing were each observed in 1 patient of cases, and no patient had periprosthetic fractures, which is a major concern in the treatment of proximal femoral fractures, particularly with devices such as PFNA-2. Improper placement of the helical blade, compromised bone quality, and suboptimal surgical techniques, potentially leading to serious outcomes such as joint damage, persistent pain, or the need for revision surgery, hence these challenges emphasize surgical planning, careful implant selection, and a good postoperative care. Complications related to PFNA II are varus collapse, cut out of the helical blade, and lateral migration of screws have been reported in high incidence. This study shows PFNA3 is really a game changer in the management of intertrochanteric fracture [19]. So continuous research is crucial to advance implant designs, enhance surgical techniques, and identify at risk patients, ultimately minimizing complications and enhance good quality of life [20,21].

Strengths and Limitations

The major strength of the study is that it is a prospective observational study done in a tertiary care hospital. The study seemed to have limitations, including a single center study, follow-up period was short and missing long-term complications or functional changes. Additionally, being a single-center study, the findings may not reflect variations across different settings or patient demographics. Selection bias could also have influenced the results, as certain groups, such as those with severe comorbidities, may have been excluded.

Conclusion

The study showed PFN A3 provides fantastic fixation and excellent functional outcome in intertrochanteric fractures especially in elder patients. It is a reliable implant for mobility, stability and also the risk of failure of the implant is almost nil. However, further studies in future are essential for the long follow-up.

Declarations

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Author Contributions

Data collection and analysis by P.R and M.N.V.N; Design by V. K, M.I; Formal analysis by S.A.; DIBIN & Visualization and writing – original draft by V.K, S.A & DIBIN.; Writing – review and editing by V.K, S.A, M.I and J.H. Statistics and Data, Overall supervising and corresponding M.I, P.R. All authors have read and agreed to the final version of the manuscript.

Ethical Approval

Informed written consent was taken from the patients and ethical approval from our institution was granted.

Conflicts of Interest

There was no conflict of interest.

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