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Assessment of Functional Outcome of Intertrochanteric Fractures Treated by PFN A2 in Elderly Patients in a Tertiary Care Hospital

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Abstract

Background: The Proximal Femoral Nail Antirotation (PFNA2) surgical implant has been developed as an efficient internal fixation device for treating intertrochanteric fractures. This study aims to evaluate the functional outcomes of geriatric patients with intertrochanteric fractures treated with the PFNA2, focusing on pain alleviation and hip function recovery.
Materials and Methods: This was a single-center, observational, prospective study conducted at a tertiary care hospital. A total of 100 patients with intertrochanteric fractures were included. Patients treated with PFNA2 were followed up for 6 months. The functional outcomes were measured using the Visual Analogue Scale (VAS) for pain and the Harris Hip Score (HHS) for hip function.
Results: The average age of the 100 patients was 66.47 ± 6.66 years. The majority of patients in this study had A2-type fractures, as classified by the AO/OTA system. Both the VAS for pain and the HHS for hip function showed significant improvement between the pre-operative and 6-month post-operative assessments.
Conclusion: The Proximal Femoral Nail A2 is an excellent treatment option for elderly patients with intertrochanteric fractures, providing significant improvements in pain relief and functional outcomes.

Keywords: *Osteoporosis, Intertrochanteric fractures, Elderly, Anti-rotation, Hip score.*

Introduction

Intertrochanteric (IT) breaks in the femur are some of the most common types of fractures encountered by orthopedic doctors, especially in older adults. These fractures are linked to significant rates of death, illness, and a detrimental effect on the patients' overall quality of life.[1,2,3] It accounts for nearly 50% of all hip fractures. Elderly individuals, particularly those with age-related bone density loss, associated comorbidities are more prone to such injury and are associated with poor prognosis. Given the importance of early mobilisation, functional recovery, and quality of life, the type of surgical treatment and its outcome play a very important role.[4]

Internal fixation is an excellent approach for managing stable trochanteric fractures, with reliable outcomes. However, the most effective way to treat unstable intertrochanteric fractures, particularly in osteoporotic individuals, is still debated. Although open reduction and rigid fixation are considered the standard treatments for unstable intertrochanteric femoral fractures, complications associated with internal fixation have prompted researchers to investigate other treatment options.[5,6]

There are various types of implants avaiable for fixation like Dynamic Hip Scew (DHS),Proximal femoral nail antirotation screw (PFNA) and Proximal femoral nail antirotation with helical blade (PFNA 2). DHS is an extramedullary fixation device whereas PFNA is intramedullary device. Both screw PFN and helical PFNA are similarly effective devices for stabilizing unstable trochanteric fractures, showing no notable variation in their

short-term complication rates. However, the helical PFN shows a slightly reduced rate of complications, along with decreased surgical time, less blood loss, and fewer imaging requirements.[7]

The Asian-specific Proximal Femoral Nail Antirotation (PFNA2) surgical implant has emerged as an effective intramedullary internal fixation technique for the treatment of IT fractures. Its unique shape and design enable better femoral shaft fracture fixation while maintaining robust stability. This becomes especially important in elderly people and aids in early recovery and mobilisation.[8,9] In terms of implant failure (cutout rate) following fixation the study by HW Jones et al did not show any statistical significance with PFNA and DHS device.10 This implant is ideal for stopping femoral head penetrations when addressing unstable trochanteric fractures, and it also has a lower chance of failure.[11,12]

Although PFN A2 is increasingly being utilised to treat hip fractures, there is still a paucity of knowledge about its functional effects in the elderly. Functional outcomes, such as pain relief, mobility, and the ability to do daily duties, are important indicators of effectiveness in this group. Improving care for the elderly will be achievable by developing more precise surgical techniques and rehabilitation regimens based on a better understanding of the impact of PFN A2 on these factors.[8,9]

This research intends to evaluate the effectiveness of PFN A2 fixation in older individuals with intertrochanteric fractures. By concentrating on this age group, we intend to offer insights that can assist surgeons in enhancing surgical techniques and post-operative management for these at-risk individuals

Methods

Study Design

This was an upcoming observational research project carried out in the Orthopaedics Department at Kannur Medical College, located in Anjarakandy, Kerala, India, which is a specialized medical facility, from 2022 to 2024. The centre serves a diverse population, including urban, semi-urban, and rural areas.

Study Population and Data Collection

The research involved individuals who were 60 years old or more and had been diagnosed with verified closed intertrochanteric fractures, which fall into the AO classification categories 31-A1, 31-A2, or 31-A3. Patients with a history of prior hip fractures or previous surgery on the affected hip, pathological fractures (e.g., due to cancer or osteomyelitis), severe cognitive impairment or dementia, inability to walk or bear weight on the affected leg before the fracture, or active infection/sepsis were excluded from the study.

All patients underwent PFNA 2 fixation surgery under spinal anaesthesia after medical evaluation and optimization of medical illnesses if any. The results related to the functionality of patients who suffered intertrochanteric fractures were assessed by gauging pain levels through the Visual Analogue Scale (VAS) and the Harris Hip Score (HHS) at the beginning, on the second day post-surgery, on the twelfth day post-surgery, and six months following the operation.

During operation patient lying in supine position over fracture table,closed reduction of the fracture done under image intensifier guidance.Lateral approach is used and entry point made in tip of the greater trochanter of the femur.Guide wire inserted into the femoral canal and reaming of the proximal femur done.As femoral canal is wide in elderly we avoided femur canal reaming.PFNA2 nail inserted into the femoral canal using jig.Guide pin inserted into the femoral head and appropriate sized helical blade fixed to the femoral head after reaming.One distal locking screw of suitable size fixed.All the steps carried out using image intensifier in less than one hour.

Statistical Analysis

Data gathering was conducted with Microsoft Excel version 2024. Continuous variables were presented as mean ± SD and median, while the categorical variables were shown as counts and percentages. The Kolmogorov-Smirnov test was applied to check for data normality. When normality was not confirmed, non-parametric tests were utilized. Preoperative and postoperative functional scores were analyzed by employing statistical methods

like paired t-tests and analysis of variance (ANOVA). A p-value of less than 0.05 was considered statistically significant. All statistical analyses were conducted using GraphPad InStat 3.0.

Ethical Considerations

This research was granted ethical clearance by the Institutional Ethics Committee at Kannur Medical College and Hospital with approval number 057/KMC/EC, 11/2022, and all individuals involved provided informed consent.

Results

Baseline Characteristics

The baseline characteristics of patients in our study showed an average age of 66.47 ± 6.66 years, with 83% of the patients being over 60 years old. The study revealed a relatively balanced gender distribution between men and women, with a slight dominance of left-sided fractures. Of the patients, 89% had comorbidities related to cardiometabolic diseases. Most of the patients in our study had A2-type fractures, as classified by the AO/OTA fracture classification system (Table 1).

Table 1. Baseline characteristics of patients

Variabel	n,%
Age (years)	
61-70	69 (61)
71-80	28 (20)
>80	3 (3)
Gender	
Male	52 (52)
Female	48 (48)
Side	
Right	43 (43)
Left	57 (57)
Associated comorbidity	
Hypertension	48 (48)
T2DM	41 (41)
CAD/CVA	12 (12)
CKD	7 (7)
AO/OTAFracture classification	
A1.1	2 (2)
A1.2	15 (15)
A1.3	13 (13)
A2.1	16 (16)
A2.2	20 (20)
A2.3	8 (8)
A3.1	11 (11)

A3.2	11 (11)
A3.3	4 (4)

Outcome Assessment

The functional outcome analysis demonstrated a statistically significant improvement in both pain levels and the Harris Hip Score (HHS) throughout the study period. The mean Visual Analog Scale (VAS) score for pain significantly decreased from 8.1 ± 0.9 preoperatively to 5.9 ± 1.1 on the 2nd postoperative day (POD), further dropping to 3.7 ± 0.8 by the 12th POD, and reaching 1.5 ± 0.6 at the 6-month follow-up ($p < 0.001$). Likewise, the HHS initially showed a slight decline from a baseline of 52.4 ± 6.8 to 48.1 ± 7.2 on the 2nd POD, but thereafter demonstrated substantial recovery, improving to 68.7 ± 6.4 by the 12th POD and 86.2 ± 5.7 at the 6-month follow-up ($p < 0.001$) (Table 2). These results indicate significant and sustained postoperative pain relief and functional recovery.

Table 2. Functional outcome (VAS and Harris Hip Score) across study period.

Parameter	Baseline (Pre-op) Mean ± SD	2nd POD Mean ± SD	12th POD Mean ± SD	6th Month Mean ± SD	p-value (ANOVA / Paired t-test)
VAS Pain Score	8.1 ± 0.9	5.9 ± 1.1	3.7 ± 0.8	1.5 ± 0.6	<0.001*
Harris Hip Score	52.4 ± 6.8	48.1 ± 7.2	68.7 ± 6.4	86.2 ± 5.7	<0.001*

*Significant at $p < 0.05$.

Throughout the study period, the VAS for pain decreased significantly. By the 2nd postoperative day (POD), the pain score had reduced by 27%, by the 12th POD it had dropped by 54%, and by the end of the 6th month, the reduction was nearly 81% (Figure 1). Similarly, the Harris Hip Score (HHS) showed substantial improvements by the end of the study period. Although there was a slight decline on the 2nd POD, the score rose significantly by the 12th POD and continued to improve by the end of the 6th month, when compared to baseline (Figure 2).

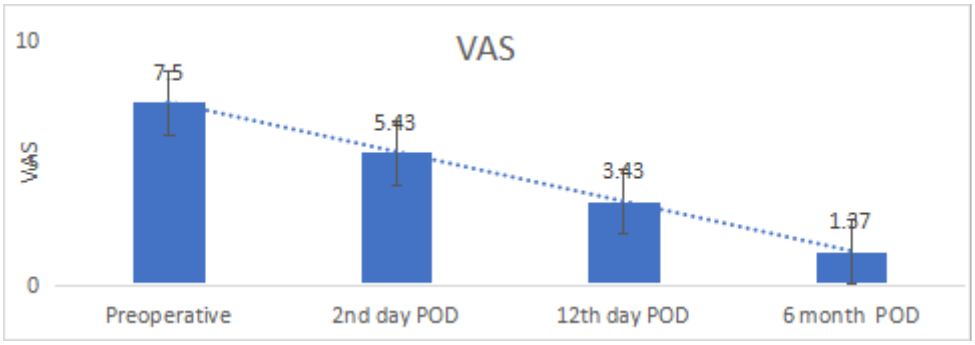

Figure 1. VAS score among study participants

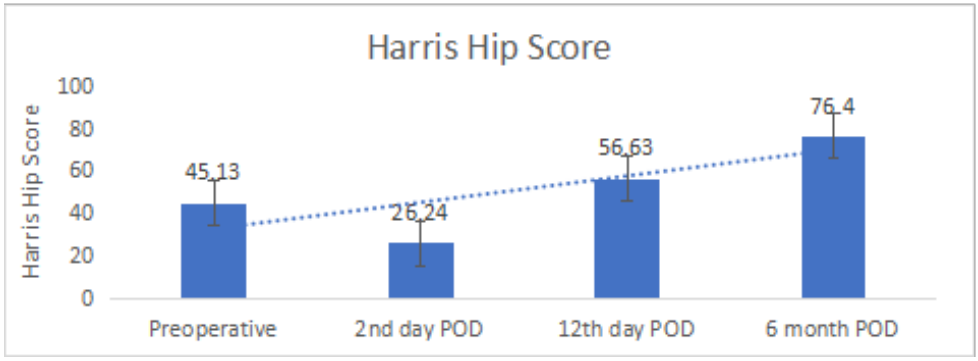

Figure 2. HARRIS HIP score among study participants

Radiological evaluation of the intertrochanteric fracture was performed preoperatively (Figure 1) in all patients. An anteroposterior radiograph was obtained to assess the type of fracture. Immediately after surgery (Figure 2), another radiograph was taken to evaluate the implant fixation and stability. During the follow-up period (Figure 3), radiographs were taken to monitor fracture union and the status of the implant.

Figure 3. Preoperative anteroposterior radiograph of the pelvis showing a comminuted, displaced intertrochanteric fracture on the right side. The greater trochanter is migrated superiorly, resulting in a varus femoral neck-shaft angle.

Figure 4. Immediate postoperative anteroposterior radiograph of the right hip showing fracture fixation with the PFN A2 implant. The helical blade is placed into the femoral head, and the distal locking screw is visible. The fracture is reduced, maintaining the femoral neck-shaft angle.

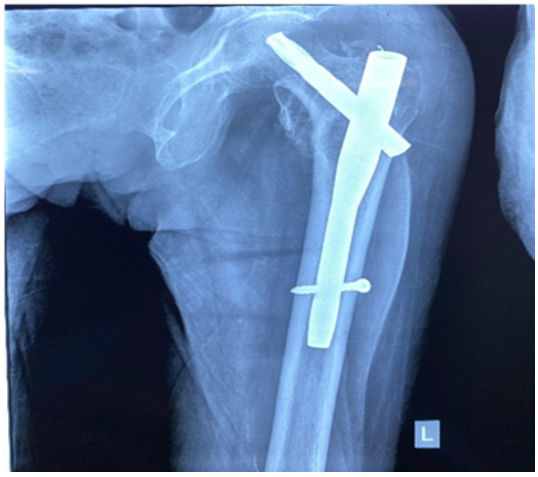

Figure 5. Follow-up radiograph showing the united intertrochanteric fracture. The PFNA 2 implant is in proper position without migration, resulting in the union of the fracture.

Discussions

In this study, we aimed to evaluate the functional outcomes of intertrochanteric fractures in older patients treated with the Proximal Femoral Nail Antirotation (PFNA2). We found that PFNA2 significantly improved pain relief and mobility after surgery, suggesting that it is a viable treatment option for this population. Perioperative optimization of comorbidities, pain management, and proper postoperative rehabilitation play a major role in functional outcomes.

Age is one of the most important factors impacting the outcome of patients treated for intertrochanteric femoral fractures. According to a study, patients over the age of 80 had poor prognoses, resulting in delayed recovery and increased comorbidities.[13] Similarly, another study observed that patients over 80 experienced delayed recovery, lower functional outcomes, and complications such as nonunion and malunion.[14] Reduced bone density, lower muscle mass, fragility, and associated comorbidities all contribute to delayed healing and complications in the elderly population. Despite this, our study found that patients over the age of 80 who were treated with PFNA2 experienced significant improvements in hip function and mobility.

Many studies report gender differences in the prevalence of intertrochanteric fractures and hip fractures in general, with females being at a higher risk of such fractures due to low mineral density, menopause-related hormonal changes, and associated osteoporosis, which is more common in females in the postmenopausal phase. This is also responsible for delayed healing in females.[13,14] However, we found no such variation in functional outcomes between males and females in our study, indicating that PFN2 is an effective and stable treatment choice regardless of gender.

Associated comorbidities have been linked to poor healing, delayed recovery, and an increased risk of complications. Comorbidities, particularly diabetes, hypertension, and other cardiometabolic conditions, are not only common in the elderly but have also been shown to slow the recovery of patients with IT fractures. Previous studies have reported similar findings, emphasising that comorbid conditions, particularly diabetes and hypertension, are related to poor healing and recovery. Despite these challenges, and with the majority of patients having cardio-metabolic comorbidities, the use of PFN2 in our study resulted in smooth recovery and early mobility, ensuring better stability, fixation, and weight-bearing potential in patients, and preventing complications associated with immobilisation due to delayed healing.[15,16]

Pain is a critical element of recovery, and adequate pain management is essential for early mobilisation and rehabilitation. In our study, the average VAS score decreased significantly from 7.5 on the day of surgery to 3.2 at 6 weeks post-operatively, which correlates with early stabilisation, minimising mobility at the fracture site, and improving healing with PFN2. A similar decrease in the VAS score was observed in previous studies, with an average of 2.5 at 6 weeks and 1.8 at 3 months post-operatively.[17] In a comparative assessment, previous studies

found that patients treated with PFN2 had a significantly higher VAS score improvement than those treated with an extramedullary device such as DHS.[14] These findings imply that the stable fixation offered by PFN2 is likely related to reduced pain in elderly patients, allowing for early weight-bearing movement.

We also assessed functional recovery through a more comprehensive approach, evaluating pain, mobility, and deformity by calculating the Harris Hip Score (HHS). The average preoperative HHS was 47, indicating poor hip function, but it improved to 79 at 6 months post-surgery, demonstrating significant functional improvement. This suggests that PFN2 is a viable therapeutic modality for early mobility in the elderly. This finding is consistent with the study by Sadic et al. who reported a mean HHS improvement from 42 preoperatively to 75 at 6 months, with the majority achieving excellent to good functional recovery.[17] Similarly, Jonnes et al. found an average HHS score of 80 at six months post-operatively.[16] The authors further emphasized that early stabilization provided by PFN2 leads to early ambulation and functional recovery, resulting in a higher HHS score compared to extramedullary fixation, such as DHS. Other studies have also observed a decreased HHS score when using DHS to repair intertrochanteric fractures in older individuals, compared to PFNA2.[15,18,19] Our study showed similar results in terms of HHS, even though the duration of follow-up was shorter than in other studies.[18] In research conducted by K. L. Maa and colleagues, the writers determined that PFNA is an important option for addressing intertrochanteric fractures, as it results in fewer fixation failures, reduced blood loss, and a shorter hospitalization period.[20] These factors appear to play a major role in early recovery following surgery.

Thus, our study, along with similar studies, found that PFNA2 is an excellent and effective treatment method for managing intertrochanteric fractures in elderly patients, showing significant improvements in VAS and HHS scores, prompt functional recovery, pain reduction, and early mobilization. This study also demonstrates that stable PFNA2 fixation, with less surgical duration and reduced blood loss, leads to better postoperative outcomes in elderly patients with intertrochanteric femur fractures.

Our study does not have a control group; however, the results are compared with studies already existing in the literature.[14,16] Despite other limitations, such as the single-center nature, small sample size, shorter follow-up, lack of randomization, and heterogeneity in fracture patterns, our study sheds light on the efficacy of PFNA2 in elderly patients with intertrochanteric fractures.

Conclusions

The current research discovered that older patients with intertrochanteric fractures treated using Proximal Femoral Nail Antirotation (PFNA2) experienced improved functional results, indicating that PFNA2 is a successful treatment approach for alleviating pain and enhancing the Harris Hip Score. It facilitates early mobilization and functional recovery, potentially leading to an improved quality of life. However, it is important to ensure adequate management of medical conditions and postoperative rehabilitation, including gait training and physiotherapy, following any hip fracture surgery in the geriatric population to achieve optimal results.

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Declarations of competing interest

No potential competing interest was reported by the authors.

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