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## Management of intertrochanteric femur fractures in the elderly: Exploring the role of proximal femoral nail antirotation: A two year prospective study

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### Abstract

**Background:** The high incidence of intertrochanteric femur fractures among the elderly population necessitates an efficient and effective surgical intervention. Amidst ongoing debate and research regarding the optimal implant selection, this study aims to elucidate the role of Proximal Femoral Nail Antirotation (PFNA) as a potentially ideal choice.

**Methods:** This two-year prospective study was conducted at a multi-specialty hospital in Kasaragod, Kerala, encompassing 50 patients who met the requisite inclusion criteria. Functional and radiological outcomes were assessed at regular intervals up to two years post-surgery. Demographic parameters, fracture details, surgical specifics, and complications were meticulously documented.

**Results:** The study cohort comprised a higher proportion of male patients (56%) with right-sided injuries (58%) predominating. The mean age of patients was  $79 \pm 6.67$  years. The majority of patients sustained fractures due to falls (82%), with type 31A2 (64%) being the predominant fracture classification. The surgical procedures had a mean duration of  $39 \pm 11.6$  minutes with a mean blood loss of  $139 \pm 27.3$  ml. MHHS revealed excellent results in 25(50%), good results in 22(44%), fair and poor results in two(4%) and one(2%) patient

**Conclusion:** Proximal Femoral Nail Antirotation (PFNA) demonstrated high efficacy as an implant choice in this study by minimizing surgery time, blood loss, and complications. It facilitated favorable functional and radiological outcomes at the final follow-up in the majority of elderly patients. However, a larger multi-centric study is warranted to further investigate the efficacy and potential complications associated with this implant.

**Keywords:** Elderly, hip fractures, intertrochanteric femur fractures, proximal femoral nail Antirotation

### Introduction

Intertrochanteric femur fractures, a prevalent orthopaedic injury affecting the proximal femur, poses significant challenges in clinical practice. These fractures occur in the region between the greater and lesser trochanters, a complex anatomical area subject to substantial biomechanical stress<sup>[1]</sup>. As highlighted in recent literature, the incidence of intertrochanteric fractures is particularly high among the elderly population, a demographic often characterised by underlying osteoporosis and compromised bone quality<sup>[2]</sup>. This predisposition to fragility fractures contributes to the complexity of managing these injuries, often leading to prolonged hospital stays, increased healthcare costs, and a higher risk of morbidity and mortality<sup>[3, 4]</sup>.

Surgical intervention, primarily internal fixation, has emerged as the cornerstone of treatment for intertrochanteric fractures. This approach aims to provide stable fixation of the fracture fragments, enabling early mobilisation and potentially reducing the risk of complications<sup>[5]</sup>. Various internal fixation devices, including intramedullary nailing systems like the Proximal Femoral Nail Antirotation, have demonstrated efficacy in stabilising these fractures and facilitating positive patient outcomes<sup>[1]</sup>. However, the optimal choice of implant and surgical technique remains a subject of ongoing research and debate, with factors such as fracture pattern, bone quality, and surgeon experience influencing decision-making<sup>[3]</sup>.

Among the various internal fixation devices available, the PFNA has gained considerable traction in the management of intertrochanteric fractures. The PFNA is an intramedullary nailing system designed to provide stable fixation and promote fracture healing.

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Its key features include a helical blade that enhances fixation in osteoporotic bone and an anti-rotational screw that mitigates the risk of implant cutout [3]. These design elements contribute to the PFNA's purported advantages in achieving stable fixation, facilitating early mobilisation, and potentially reducing complication rates.

The PFNA represents an evolution of earlier intramedullary devices, such as the Proximal Femoral Nail. While the PFN offered advantages like avoiding femoral canal reaming and providing rotational stability, it faced limitations, including complications like proximal screw cutout and difficulties with distal locking screw placement [3]. The PFNA addressed these limitations with design modifications, notably the helical blade, which improves bone impaction and anti-rotational stability, particularly in osteoporotic bone. Studies have shown that PFNA can lead to improved hip joint recovery and quality of life in patients with specific types of intertrochanteric fractures [5].

This study delves into the complexities of intertrochanteric fractures, examining the challenges they present and exploring the evolution of treatment modalities, with a specific focus on the PFNA. By prospectively analysing the outcomes of patients with unstable intertrochanteric fractures treated with the PFNA, this research aims to contribute to the growing body of evidence on the efficacy and safety of this surgical approach.

### Methodology

This prospective study was conducted at Carewell Hospital and Research Centre, Kasaragod, a tertiary hospital between January 2022 to July 2024, after obtaining written informed consent from the participants and ethical committee clearance. The objective was to evaluate the functional and radiological outcomes in patients with intertrochanteric femur fractures treated with the PFNA.

### Study Population

This study includes 50 patients, aged 60 and older who meet the following inclusion criteria:

- Diagnosed with intertrochanteric fractures
- Treated surgically with PFNA as the primary fixation method
- Available for follow-up assessments for a minimum of 2 years post-operatively

### Patients were excluded from the study if they met any of the following criteria

- Pathological fractures (e.g., due to metastatic disease)
- Previous ipsilateral hip or femur surgery
- Significant cognitive impairment hindering informed consent or follow-up assessments
- Polytrauma patients

### Data Collection

Data was collected prospectively at the time of surgery and during follow-up visits at regular intervals (e.g., 6 weeks, 3 months, 6 months, 1 year, and 2 years). The following data points were recorded:

- **Patient Demographics:** Age, sex, co-morbidities (e.g., osteoporosis, diabetes, hypertension, etc.)
- **Fracture Characteristics:** Fracture type (AO/OTA classification), mechanism of injury, time from injury to surgery
- **Surgical Details:** Type of anaesthesia, operative time, blood loss, intra-operative complications
- **Functional Outcomes:** Assessed using validated patient-reported outcome measures such as:
  - Modified Harris Hip Score (mHHS) for hip function and pain. Outcome was categorised as excellent (90-100), good (80-90), fair (70-80), and poor (<70).
  - Visual Analog Scale for pain assessment
- **Radiological Outcomes:** Assessed using standard X-rays at regular intervals to evaluate fracture union, implant position, and any complications.

### Surgical Method

Following the administration of spinal anaesthesia, patients were positioned on the traction table, and fracture reduction was achieved under image intensifier guidance. Femoral entry was made at a point immediately medial to the greater trochanter's tip using a cannulated bone awl. A guide wire was utilised to introduce an appropriately sized PFNA with a standard 240mm length. Guide pin placement was conducted under image intensifier guidance. Subsequently, measurements for the helical blade were obtained using a direct measure, and the lateral cortex was penetrated with a lateral cortex drill. Additional drilling was performed, and a suitable helical blade was inserted. The nail was statically locked distally through the zig using a distal locking bolt in all patients. Post-operative antibiotic prophylaxis was administered to all patients in accordance with hospital protocol. Post-operative rehabilitation encompassed early mobilisation of hip and knee joints, and weight-bearing was initiated using an adjustable walker, contingent upon the patient's general condition and intra-operative reduction as evaluated on post-operative radiographs. Fracture union was determined by the presence of significant callus formation evident in post-operative radiographs.

### Results

There were a total of 50 patients in our study. 28(56%) were male and 22(44%) were female. The mean age in our study was found to be  $79 \pm 6.67$  years. Mean duration from injury to surgery was found to be  $4 \pm 2.2$  days. The surgical procedures had a mean duration of  $39 \pm 11.6$  minutes with a mean blood loss of  $139 \pm 27.3$  ml. Post operative blood transfusion was necessary in 7 patients. Modified Harris Hip score had an average of  $71 \pm 6.23$  at 6 weeks,  $76 \pm 7.38$  at 3 months,  $81 \pm 10.24$  at 6 months,  $83 \pm 8.12$  at 1 year and  $85 \pm 6.89$  at the end of 2 years.

Impingement at the anterior cortex during nail insertion was a concern during the surgery which was seen in 4(8%) of our cases. 2(4%) of our patients had a helical blade cutout and 2(4%) cases had an iatrogenic fracture. Three (6%) out of the four above mentioned patients had varus collapse leading to gait changes at the end of final follow up. None of the patients underwent a second surgery.

**Table 1:** Distribution of patients based on Demographic Details

	Number of Cases	Percentage
<b>Gender</b>		
Male	28	56%
Female	22	44%
<b>Age of the Patient (in years)</b>		
60-70	9	18%
70-80	21	42%
80-90	17	34%
>90	3	6%
<b>Side of injury</b>		
Right	29	58%
Left	21	42%
<b>Mode of Injury</b>		
Fall	41	82%
Road traffic Accident	9	18%
<b>Co-morbidities</b>		
Diabetes	24	48%
Hypertension	27	54%
Chronic kidney disease	7	14%
Other chronic ailments	3	6%

**Table 2:** Distribution of patients based on fracture and surgical details

Type of Fracture	Number of Cases	Percentage
31A1	12	24%
31A2	32	64%
31A3	6	12%

Time from injury to surgery	Number of cases	Percentage
1-2 days	17	34%
3-5 days	22	44%
6-10 days	8	16%
>10 days	3	6%

Duration of surgery (in minutes)	Number of cases	Percentage
15-30	9	18%
31-45	23	46%
45-60	11	22%
60-90	5	10%
>90	2	4%

Intra-operative blood loss (in ml)	Number of Patients	Percentage
<100	3	6%
100-250	39	78%
250-500	8	16%
>500	0	0%

**Table 3:** Distribution based on functional outcomes and complications

Modified Harris Hip Score	6 weeks	3 months	6 months	1 year	2 years
Excellent (90-100)	0 (0%)	3 (6%)	17 (34%)	22 (44%)	25 (50%)
good (80-90)	6 (12%)	16 (32%)	19 (38%)	21 (42%)	22 (44%)
fair (70-80)	23 (46%)	20 (40%)	12(24%)	5 (10%)	2 (4%)
poor (<70)	21 (42%)	11 (22%)	2 (4%)	2 (4%)	1 (2%)

VAS score	6 weeks	3 months	6 months	1 year	2 years
No pain	3 (6%)	17 (34%)	25 (50%)	30 (60%)	39 (78%)
Mild	24 (48%)	20 (40%)	19 (38%)	18 (36%)	9 (18%)
Moderate	17 (34%)	11 (22%)	4 (8%)	1 (4%)	1 (4%)
Severe	6 (12%)	3 (6%)	2 (4%)	1 (4%)	1 (4%)

Time	Number of patients	Percentage
10-12 weeks	18	36%
12-18 weeks	27	54%
18-24 weeks	4	8%
>24 weeks	1	2%

Complications	Number of Patients	Percentage
Anterior cortex Impingement	4	8%
Iatrogenic Fracture	2	4%
Non-union	0	0%
Malunion	3	6%
Implant failure (screw cut out)	2	4%
Surgical site infection	2	4%
Delayed infection	0	0%
Gait changes	3	6%



**Fig 4:** Image showing helical blade back-out at 3 months follow up

**Discussion**

Worldwide, hip fractures are of great interest. Globally, as the population ages, geriatric hip fractures are becoming a more common issue. A new comprehensive study predicts that by 2050, over half of all hip fractures worldwide would happen in Asia, mostly as a result of the region's rapidly aging population and greater life expectancy.

It is difficult for an average orthopedic surgeon to treat unstable intertrochanteric fractures. Osteosynthesis using dynamic hip screws, cephalomedullary nails, and, in certain situations, arthroplasty are among the available treatment options. Implant selection for unstable intertrochanteric fractures is still up for debate, though. Nowadays, a growing number of surgeons favor using cephalomedullary devices to treat unstable intertrochanteric and pertrochanteric fractures. PFNA II is currently preferred in the west, and numerous studies from that area attest to this [6, 7].

Due to a tendency toward increased use of intramedullary



**Fig 3:** Image showing post operative virus collapse at 6 months follow up

fixation of intertrochanteric fractures and a decrease in implant failures and high union rates, there are very few research on this topic from the Indian population.

### Age & sex distribution

The mean age of the patients in our study was determined to be  $79 \pm 6.67$  years, which aligns with the findings reported by Loo et al. [8]. In contrast, research conducted by Swaroop et al. [3] indicated a mean age of 73.39 years, while a similar study by Kumar et al. [8] reported a mean age of 61 years. This discrepancy may be attributed to the inclusion of patients across a broader age range in those studies, unlike our study, which exclusively included patients aged 60 years and above. In our study, a higher incidence of intertrochanteric fractures was observed among males compared to females. These findings are consistent with the studies conducted by Ramavel V et al., and Radaideh AM et al. [9, 10].

### Distribution of side and mode of injury

Our study also noted a predominance of right-sided fractures, which contrasts with the findings of Singh et al., Loo et al., and Sahin et al. [8, 11, 12].

The majority of fractures in our patients resulted from falls rather than road traffic accidents, aligning with the studies by Singh et al., Mereddy et al., and Mu and Zhou et al. [5, 13, 15].

The mean duration of our surgical procedures was  $39 \pm 11.6$  minutes, comparable to the studies by Swaroop et al. and Singh et al. [3, 11]. This duration was shorter compared to other intramedullary implants and dynamic hip screw devices [3]. We recorded a mean blood loss of  $139 \pm 27.3$  ml, which was slightly higher than reported in the studies by Swaroop, Singh, and Zhou et al. [3, 5, 11].

### Functional outcome

The Modified Harris Hip Score indicated excellent outcomes in 29 (58%) cases, good outcomes in 18 (36%) cases, fair outcomes in 2 (4%) cases, and poor outcomes in 1 (2%) case at the final follow-up. These results are comparable to those in the studies by Ramavel V et al. and Swaroop et al., [3, 9].

### Complications

Anterior femoral cortex impingement was encountered in 4 (8%) cases during the insertion of a 240mm nail, similar to the findings of Kiran Kumar et al. [9], which may be attributed to the short length and excessive bowing in Indian femurs. It is advisable to use a longer nail, as preferred by Jin et al., or a relatively shorter nail to prevent this complication in such patients.

Two (4%) patients experienced an iatrogenic lateral wall fracture, one of which subsequently developed a varus collapse leading to malalignment and Trendelenburg gait. This finding is consistent with the study by Kiran Kumar et al. and may be attributed to a lateral entry as suggested by Mallya et al. [2, 8].

Our study reported 2 (4%) patients with superficial surgical site infections, which aligns with the findings of Singh et al., who reported 5%, 4.7% in Sadic et al., and 4.7% globally [11, 14].

Several studies have reported a helical blade cut-out range of 2-25%, attributing this to the design of the helical blade and medial perforation of subchondral bone. We observed helical blade cut-out in 2 (4%) of our patients, both of whom experienced a varus collapse after 3 months, despite the helical blade being optimally placed in the center/center position as suggested by Baumgaertner et al. Neither case had

a TAD (tip-apex distance)  $>25$ mm, which distinguishes our study from those conducted by Geller et al. and Mallya et al., where a TAD  $>25$ mm was associated with screw back-out [2, 15, 16].

### Conclusion

The management of intertrochanteric fractures in elderly patients presents a significant challenge to orthopaedic surgeons. The utilisation of the Proximal Femoral Nail Antirotation (PFNA) technique is a highly effective option, as it requires less operative time and yields favourable functional and radiological outcomes with minimal postoperative complications. Employing either a shorter or longer nail may prevent anterior femoral cortex impingement, while a slightly medial entry point could mitigate the risk of lateral wall fractures.

We recognise the necessity for a larger multi-centric study to identify solutions to the complications encountered in our study.

### Conflict of Interest

Not available

### Financial Support

Not available

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