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Original Research Article

To Study the Outcome of PFNA-2 in Intertrochanteric Fracture Femur in Elderly Patients

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Abstract:

Background: Intertrochanteric fractures are increasingly common due to aging populations. Treating these fractures in elderly patients poses challenges due to osteoporosis and other risk factors. Choosing the right implant is crucial for success, and PFNA-2 is an excellent choice. These fractures occur between the greater and lesser trochanters due to direct or indirect stresses. Direct forces target the greater trochanter or femur axis, while indirect stresses involve abductor or iliopsoas muscle actions.

Aim and Objectives: Objective of this study was to assess the outcome of PFNA-2 in Intertrochanteric Femur Fracture in Elderly Patients.

Materials and Methods: This study was a prospective study with a sample of 20 patients with Intertrochanteric fractures of the femur. These 20 patients were treated with Proximal Femoral Nail Anti-rotation II (PFNA-II) at the Department of Orthopaedics and Traumatology, Gandhi Medical College, Bhopal. Patients were selected from among the admissions to the Orthopaedic ward and recruited into the study prospectively based on the inclusion and exclusion criteria.

Results: The mean age of the patients was 69.50±11.71 years. Minimum age was 41 years and the oldest participant was 90 years old, each had right side and left side injury respectively. Majority 12(60.0%) injured from self- fall, 8(40.0%) were injured from road traffic accident. The mean operating time was 50.0 minutes. Most of the patients (55%) were operated on in 50 minutes or less. 9(45.0%) patient's time of radiological union was 16-17 weeks. The average time taken for fracture union was 15.60±2.79 weeks. In the evaluation of the VAS scores, a significant reduction was observed at the 6 weeks, 3 months, and 6 month postoperative follow-up. The average VAS score at 1 month was 79.40±6.69, at 3 months it was 74.50±7.77 and at 6 months it was 67.70±9.48. Postoperative assessment of the patients was done using the Harris Hip Score. Good to excellent results at final follow-up in Harris Hip Score was seen in 70% of the patients, while 30% of the patients showed fair results.

Conclusion: The PFNA-2 nail is a quick and straightforward implant for proximal reconstruction. Its helical blade aids in bone compaction and rotation prevention in osteoporotic trochanteric fractures, offering added advantages. With careful implantation and optimal fracture reduction, this design could lower complication rates compared to other options. For elderly osteoporotic patients, the PFNA-2 stands out as the superior choice for intertrochanteric fractures.

Keyword: intertrochanteric fractures, PFNA-2, extra capsular, proximal femur fractures.

Introduction

The incidence of intertrochanteric fractures is on the rise alongside the aging population [1]. Managing these fractures in elderly patients poses a formidable challenge due to osteoporosis and associated surgical and anesthesia risks [1]. Hence, selecting the most appropriate fixation method and implant is paramount to achieve positive therapeutic outcomes [1], and in this context, PFNA-2 emerges as an exceptional choice for intertrochanteric femur fractures. Intertrochanteric fractures involve extra capsular fractures between the greater and lesser trochanters [2]. Such fractures result from falls, involving both direct and indirect forces [2]. Direct forces focus on the femur's axis or the greater trochanter [3], while indirect forces result from the pull of muscles like the iliopsoas or abductors [4]. The greater trochanter serves as an insertion site for muscles like the gluteus medius, while the lesser trochanter is significant for muscles like the iliacus and psoas major [5].

The calcar femorale, a dense vertical bone wall extending from the posterior femur shaft to the neck, plays a crucial role in determining fracture stability [6]. The metaphyseal region, rich in blood supply, contributes to better union rates and less osteonecrosis compared to femoral neck fractures [6]. Intertrochanteric fractures, though occurring across different age groups, are more prevalent in the elderly with osteoporosis due to lower-energy mechanisms [7]. This type of fracture, accounting for nearly half of all hip fractures, is associated with significant morbidity and mortality [6].

Unstable fractures demand appropriate surgical management to achieve stability and enable early weight-bearing [10]. Among various options, cephalomedullary nails, particularly PFNA-2, are favored for treating unstable proximal femoral fractures [11]. The classification of intertrochanteric fractures has evolved over time, with AO/OTA and Boyd-Griffin classifications providing valuable insights [12]. The AO/OTA classification is especially helpful in evaluating treatment outcomes and comparing reports in the literature [12].

In cases where surgery is not feasible, non-operative treatment is rare but may be considered for non-ambulatory patients with adequate pain control [13]. For most intertrochanteric fractures, internal fixation is the preferred approach based on fracture stability [14]. Among the available options, PFNA-2 stands out as a reliable choice with advantages such as reduced intraoperative complications, lower blood requirements, and improved union rates [14]. The unique design of PFNA-2, featuring a helical blade, confers two distinct benefits [14]: It compacts weak cancellous bone in the femoral head and it offers a larger contact surface area with femoral cancellous bone compared to conventional implants. Present study was performed to assess the outcome of PFNA-2 in Intertrochanteric Femur Fracture in Elderly Patients.

Materials and Methods

This study was a prospective study with a sample of 20 patients with Intertrochanteric fractures of the femur. These 20 patients were treated with Proximal Femoral Nail Anti-rotation II (PFNA-II) at the Department of Orthopaedics and Traumatology, Gandhi Medical College, Bhopal. Patients were selected from among the admissions to the Orthopaedic ward and recruited into the study prospectively based on the inclusion and exclusion criteria. All patients are followed up for December 2020–September 2022. Informed and written consent were obtained from all the patients. Based on preoperative hemoglobin levels and also amount of blood loss during surgery, Blood Transfusion was planned for all patients. Test dose of antibiotics and xylocaine sensitivity were done. Lower limb was prepared from hip to knee level. Bowel & bladder preparations were done. Patients were posted for PFNA2 under spinal anaesthesia.

The study's inclusion criteria encompass individuals aged over 50 years of both genders, specifically targeting cases of intertrochanteric fractures with durations less than three weeks. Exclusion criteria involve patients with delayed presentation, pathological fractures, bone metabolism disorders unrelated to osteoporosis, prior hip surgery or fracture, proximal femur deformities, active infections, lack of consent, and medical unfitness for surgery.

On admission, a proper history from the patients was taken regarding the Mode of injury and severity of trauma. A thorough clinical examination was done. All the findings were recorded in the patient's proforma. All the patients were carefully inspected for un-displaced or impacted & displaced fractures, for the deformity (shortened and externally rotated extremity), swelling and ecchymosis, clinical tenderness (on the area of the greater trochanter), bony irregularity. Distal vascularity was assessed by palpating the Dorsalis pedis artery and posterior tibial artery. Splint & Mobilisation: Limb rested on Thomas splint of appropriate size with below-knee skin traction to immobilize and maintain the length & alignment of the fractures and mobilization of the patient.

Radiographic and Other Imaging Studies: Standard radiographic examination includes AP view of the Pelvis, AP and lateral view of the proximal femur and distal thigh was done. AP view X-Ray of Pelvis with both Hips was taken and the fracture configuration was noted.

Fractures were classified according to Boyd & Griffin Classification (1949). [15]

Pac Work-Up: All routine basic investigations including complete hemogram, Blood Grouping and Viral markers were done. As the patients are aged more than 50 years both cardiologist and chest physician opinion obtained to know cardiac and pulmonary reserve of the patient to withstand the surgical procedure.

Figure 1: g, h – PFN A-II nail, i,j– jig & cannula, k -driver for helical blade, l- measuring gauge, m-helical blade

Figure 2: Showing incision

Figure 3:

Patient Positioning

Position the patient supine on an extension table or a radiolucent operating table. Abduct the unaffected leg as far as possible and place it on a leg support, so that it allows free fluoroscopic examinations. This should be tested preoperatively. For unimpeded access to the medullary cavity, abduct the upper body by about 10 –15° to the unaffected side (or adduct the affected leg by 10 –15°).

Reduce fracture

Perform closed reduction of the fracture under image intensifier control. If the result is not satisfactory, perform open reduction.

Note: Exact anatomical reduction and securing fixation of the patient to the operating table are essential for easy handling and a good surgical result.

Approach

Palpate the greater trochanter. Make a 5 cm incision proximal from the tip of the greater trochanter. Make a parallel incision in the fasciae of the gluteus medius and split the gluteus medius in line with the fibers.

Determine entry point

Entry Point**:** The superior and medial aspect of greater trochanter is palpated using a finger. In PFNA-II, the entry was made over the medial border

of the greater trochanter. Entry was made using an entry owl under C-Arm guidance in both AP & Lateral view.

Insert guide wire

Guide Wire Insertion: In PFNA-II, initially a guide wire was inserted through the entry point onto the proximal end of the femur, and adjusted using x-ray control in both anterior-posterior and lateral planes until the wire was at the correct entry point into the bone. The wire was lined up within the intramedullary canal on both anterior-posterior and lateral planes.

Reaming: In PFNA-II, the entry and the medullary canal were reamed using a 15mm entry point reamer and distal reaming of the canal was done with graded cannulated reamers, whenever necessary.

Nail Insertion: In PFNA-II, the nail was inserted with the help of the jig over the guide wire with help of the C-arm in both AP & Lateral view. Fluoroscopic images were taken when the nail was being introduced to check for any peri-operative femoral fractures. The nail along with the jig was inserted by hand by gentle twisting movements.

Proximal Locking: Once the nail was positioned appropriately the guide wire was removed and the drill sleeves were attached to the jig and through a stab incision over the lateral thigh, the drill sleeves were pushed up to the lateral cortex one for compression screw and one for de-rotation screw. The guide pin was then passed into the head & neck in the center-center position using the guide pin sleeve under C-arm in both AP & Lateral view. The guide pins were advanced upto 5mm short of the articular surface of the femoral head in both AP & Lateral view. Proximal locking with the compression screw along the inferior part of the neck was done first followed by the superior de-rotation screw of appropriate length as measured preoperatively &intra-operatively.

Distal Locking**:** In PFNA-II, distal locking was done with the aid of a jig and two distal locking screws under the C-arm in both AP & Lateral view. For long PFN & PFNA-II distal locking was done with the freehand technique.

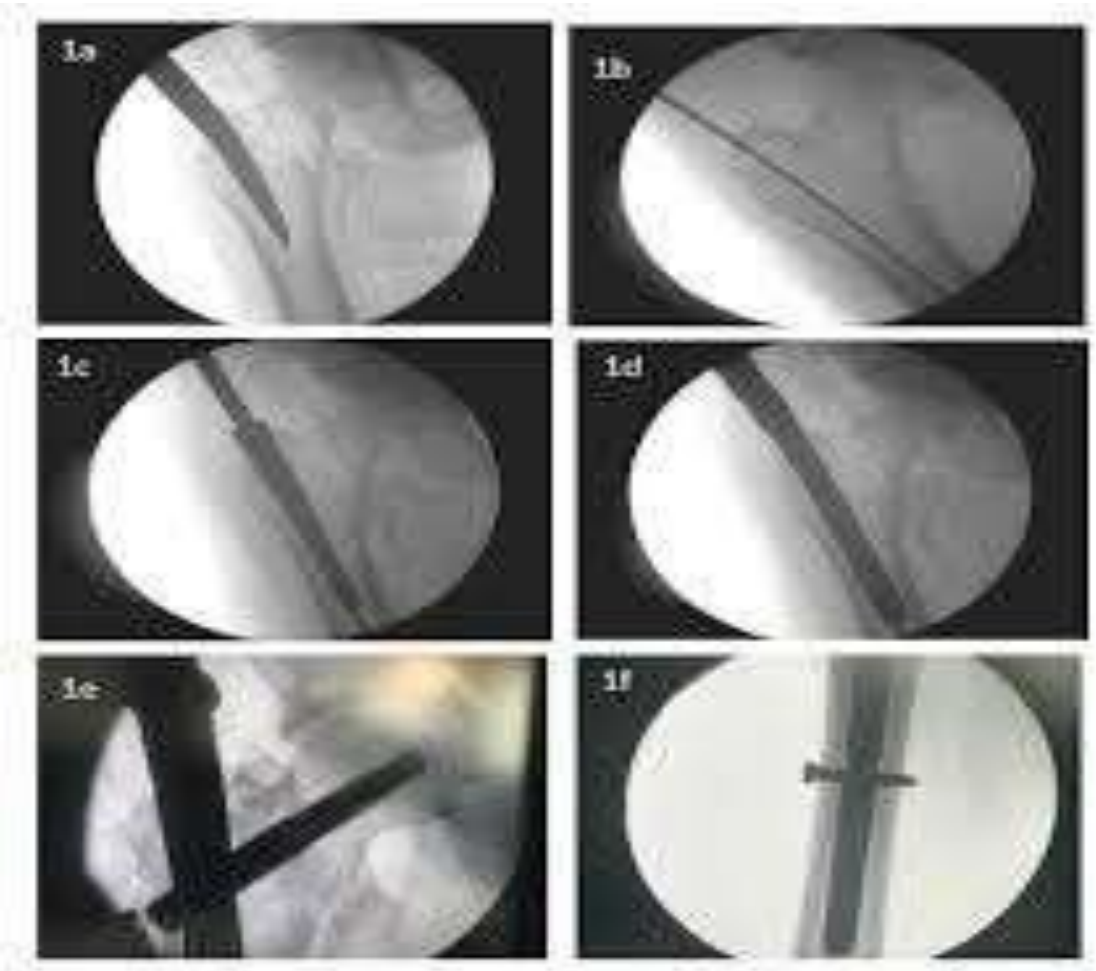

Figure 3: showing surgical technique of PFNA-II insertion-1(a) Nail entry point, 1(b) Insertion of guide pin, 1(c) reaming, 1(d) Insertion of nail, 1(e) placement of Helical blade, 1(f) placement of 4.9mm distal cortical screws

Post-Operative Protocol:

Post-operative rehabilitation plays a major role in recovery of range of movement and improving the functions of Hip and knee joints. If fracture fixation was stable, early rehabilitation was started. Increased and useful range of motion was achieved, within the first week of the postoperative period. Weight-bearing was started on 2nd Postoperative day.

Early Phase (1stweek): The primary goal was full range of motion, Knee and Hip mobilization started on the 1stpostoperative day.

Early weight: bearing started on the 2nd day if fixation was stable. Static & Dynamic Quadriceps strengthening and Hamstring stretching, Hip, knee, and ankle range of motion exercises were started.

1. Improves early range of motion of Hip and Knee.
2. Decreases incidence of deep vein thrombosis and pulmonary embolism.
3. Pain relief and early discharge.
4. Sutures were removed between the 12th - 15th postoperative days.

Follow Up: All the patients were advised to review for regular follow up at regular interval. Patients were advised to review at 1 month, at 3 months, 6 months and final follow up.

In each visit their functional outcome was analysed by ROM at injured Hip, VAS score, Harris Hip Score, and also digital x-ray of the operated Hip was taken to assess the union of fractures.

Time for fracture healing was evaluated according to radiographic and clinical criteria. Clinically Union was assessed by the absence of tenderness (or) pain with full weight-bearing.

Radiological union of the fracture was assessed by the Standard Digital Antero-posterior & Lateral Radiograph of the Pelvis with the operated hip.

Results

Table 1: Demographic distribution

	No. of Cases	Percentage
Age Group (years)		
51-60 years	2	10.0%
61-70 years	10	50.0%
71-80 years	6	30.0%
81-90 years	2	10.0%
Sex		
Male	15	75.0
Female	5	25.0
Mode of injury		
Road Traffic Accident	8	40.0
Self-fall	12	60.0
Side of injury		
Left	10	50.0
Right	10	50.0
Type of Fracture		
Type II	12	60.0
Type III	6	30.0
Type IV	2	10.0

Table 2: Distribution of patients according to type of fracture (Boyd and Griffin classification)

Duration	No. of Cases	Percentage
3 – 5 days	4	20.0
6 – 8 days	9	45.0
9 – 11 days	5	25.0
> 12 days	2	10.0
Total	20	100.0

Table 3: Distribution of patients according to Associated Morbidities

Associated Morbidities	No. of Cases	Percentage
Hypertension	4	20.0
None	16	80.0
Total	20	100.0

Table 4: Distribution of patients according to reduction

Reduction	No. of Cases	Percentage
Closed reduction	17	85.0
Open reduction	3	15.0
Total	20	100.0%

Table 5: Distribution of patients according to operative time (minutes)

Operative Time (minutes)	No. of Cases	Percentage
30 – 40 minutes	5	25.0
41 – 50 minutes	6	30.0
51 – 60 minutes	8	40.0
61 – 70 minutes	1	5.0
Total	20	100.0%

Table 6: Distribution of patients according to blood loss (ml)

Blood Loss (ml)	No. of Cases	Percentage
< 100	1	5.0
100-200	16	80.0
200-300	3	15.0
Total	20	100.0%

Table 7: Distribution of patients according to hospital stay (days)

Hospital stay (days)	No. of Cases	Percentage
10-12 days	10	50.0
13-15 days	7	35.0
16-19 days	1	5.0
>20 days	2	10.0
Total	20	100.0

Table 8: Distribution of patients according to Post-operative Hospital stay (days)

Post-operative Hospital stay (days)	No. of Cases	Percentage
3 days	3	15.0
4 days	6	30.0
5 days	5	25.0
6 days	5	25.0
7 days	1	5.0
Total	20	100.0

Table 9: Distribution of patients according to Weight Bearing at 6 months

Weight Bearing	No. of Cases	Percentage
Full weight-bearing	17	85.0%
Partial weight-bearing	3	15.0%
Total	20	100.0%

Table 10: Distribution of patients according to Time of radiological union (weeks)

Time of radiological union (weeks)	No. of Cases	Percentage
12-13 weeks	6	30.0%
14-15 weeks	0	0.0%
16-17 weeks	9	45.0%
18-20 weeks	5	25.0%
Total	20	100.0%

Table 11: VAS score

VAS Score	Follow-up					
	1 month		3 months		6 months	
	No.	%	No.	%	No.	%
Mild	0	0.0%	0	0.0%	0	0.0%
Moderate	6	30.0%	9	45.0%	12	60.0%
Severe	14	70.0%	11	55.0%	8	40.0%
No Pain	0	0.0%	0	0.0%	0	0.0%

Table 12: Distribution according to Harris Hip Scoring and outcome of surgery at one month and three months

Score	Harris hip score							
	1 month		3 month		6 month		Final follow-up	
	No	%	No	%	No	%	No	%
< 70 (Poor)	11	55.0%	6	30.0	1	5.0%	0	0.0%
70-80 (Fair)	8	40.0%	8	40.0	6	30.0%	6	30.0
80-90 (Good)	1	5.0%	0	0.0%	12	60.0%	7	35.0
90-100 (Excellent)	0	0.0%	0	0.0%	1	5.0%	7	35.0

Table 13: Functional Outcome

Outcome	No. of Cases	Percentage
Excellent	7	35.0
Fair	6	30.0
Good	7	35.0
Total	20	100.0%

Discussion

Treatment of intertrochanteric fractures in elderly patients is a challenge for many trauma surgeons, mainly because of many such patients have severe osteoporosis and many disorders that increase the risks associated with surgery and anesthesia[1]. Literature suggests that intramedullary nailing is the best choices for surgical fixation for intertrochanteric and has better clinical outcomes in many osteoporotic patients in the present study Proximal femoral nail antirotation-2 (PFNA-2) is the newer design and has been widely used for treatment of this fracture.[16] In this study use of the PFNA-II to treat intertrochanteric fractures in elderly patients has the following advantages: simple operation and, few complications, with good clinical efficacy. The time of PFNA-II was relatively short, and the long-term complications are less. The helical blade in PFNA2 has two advantages. 1.) It compacts the already weak cancellous bone from the femoral head. 2.) It also has more contact surface area with the femoral cancellous bone, than other conventional implants. A single helical blade PFNA2 is technically better for small size femur in Asian population with osteoporotic bone.

Sample size: In our study 20 patients were selected with intertrochanteric facture femur was comparable to Dr. Ravindran et al.(2022)[17] they have studied 32 patients and Bijendra Kumar et al.(2021)[18] in which sample size was 25.

Demographic parameters: In our study mean age group of patients were 69.50±11.71 years (50 to 90 years) comparable to Dr. Ravindran et al.(2022)[17] ,their age group of patients were between 50 to 91 and Bijendra Kumar et al.(2021)[18] in which age group were between 30 to 80 years and Harisankar M, et al.(2022) [19] in which age group was between 20to 100 years.

In our study out of 20 cases 15(75%) were male and 5(25%) were female showing male predominance, comparable to Dr. Ravindran et al.(2022)[17] in which 15 (46.8%) male and 17(53.12%) female showing female predominance and Harisankar M, et al.(2022)[19] in which 23(54.7%) were female and 19 (54.23%)were male showing female predominance. In our study out of 20 patients 50% patients had right side injury and 50% left side injury, compare to Harisankar M, et al.(2022)[19] in which 51.3% had right side and 48.75 had left side involved.

Mode of trauma: In our study, we conclude that mode of trauma for intertrochanteric fracture were mainly due to self-fall in 60% and RTA in 40%, comparable to Harisankar M, et al.(2022)[19] in which trauma due to RTA 13.7% and self-fall 83.3%, this was accordance to our study.

Operative time: In our study mean operative time were 50.00±9.45 (30 to 70 min) comparable Dr. Ravindran et al.(2022)[17] in which average time of surgery was 93.2 minutes and Bijendra Kumar et

al.(2021) [18] in which mean duration of surgery was 65.24+6.57 min.

Blood loss during surgery: In our study, mean blood loss was 145.50±49.14 ml comparable to Dr. Ravindran et al.(2022)[17] in which mean blood loss was 100 ml, and Bijendra Kumar et al.(2021)[18] in which mean blood loss was 153.8±10.92 and Harisankar M, et al.(2022)[19] in which mean blood loss was 91.8 ml.

Post-operative assessment using Harris hip score: In our study ,out of 20 patients functional outcome of 7(35.0%) patient was excellent, 6(30.0%) patients had fair functional outcome and 7(35.0%) patients had good functional outcome comparable to Dr. Ravindran et al.(2022)[17] in which out of 32 patients Harris hip score in 75% patients had excellent outcome,16.6% patients had good outcome and 9.31 had poor outcome, and Harisankar M, et al.(2022)[19] in which out of 42 patients Harris hip score in 1% had excellent outcome,75% had good outcome, 5% had fair outcome, 1% had poor outcome and 3% had failed.

The current study has several limitations that warrant consideration. Firstly, the sample size is relatively small, and the follow-up period is relatively short, which could potentially impact the generalizability and comprehensive understanding of the findings.

Moreover, the involvement of different surgeons in performing surgeries introduces the potential for surgical bias, which may influence the consistency of results. It is also worth noting that this particular implant option carries a higher cost compared to alternative choices, which could have implications for its feasibility and accessibility in certain settings.

Conclusion

The PFN-A2 device is a proximal reconstruction nail whose implantation is simple and fast. The helical blade may confer additional benefits in patients with osteoporotic trochanteric fractures, both by preventing rotation and by ensuring cancellous bone compaction. This design may diminish the rate of complications associated with the other Available implant, provided the implantation procedure is scrupulously followed and fracture reduction is optimal. PFNA2 is best implant in intertrochanteric fracture in elderly osteoporotic patients compare to other available implant.

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