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Original Research Article

Functional outcome of treatment of fracture intertrochanteric femur by using proximal femoral nail antirotation II

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ABSTRACT

Background: The elderly are most frequently affected by intertrochanteric fractures, which have a major effect on the medical community and society at large. In 2003, AO introduced the proximal femoral nail anti-rotation device, which was further improved and named proximal femoral nail antirotation II (PFNA II) in 2009.
Methods: This study was conducted from December 2020 to August 2022. The 60 cases of proximal femoral nail anti-rotation II-managed intertrochanteric femur fractures were assessed.
Results: In the present study, 24 patients (40%) had type IV (Evan's) fractures. Right hip was involved in 30 patients (50%). Meantime for clinic-radiological union was 20 weeks. There was complication rate of 2.08% as helical blade protrusion and non-union, 2.08% as helical blade protrusion, 2.08% as blade backout, 4.17% as superficial infection and 4.17% as lateral wall fracture. Seven patients expired postoperatively within 3 months while 5 patients lost during follow Up. After a 6-month follow-up, the Harris hip grade was used to evaluate 48 instances. Of these, 8 cases (16.67%) had an excellent score, 29 cases (60.42%) had a good score, 7 cases (14.58%) had a fair score, and 4 cases (8.33%) had a poor score. Thirty-seven of the 48 cases had reached the one-year follow-up mark. Thus, of the 37 patients assessed, 11 cases (29.73%) had excellent Harris hip grades, 19 cases (51.35%) had good scores, 4 cases (10.81%) had fair scores, and 3 cases (8.11%) had poor scores at the end of a one-year follow-up.
Conclusions: Even in rural populations, PFN A-II is a better, safer implant with a low rate of complications for treating stable and unstable intertrochanteric femur fractures.

Keywords: Cleveland's index, Harris hip score, Intertrochanteric fractures, Proximal femoral nail antirotation II, Tip apex distance

INTRODUCTION

The elderly are most frequently affected by trochanteric fractures, which have a major effect on the medical community and society at large.[1] Approximately 50% of fractures around the hip are caused by these fractures. They still have a significant role in many disabilities that lower quality of life and even cause death. In the elderly, simple falls can cause osteoporotic bone fractures in the intertrochanteric region of the femur; in younger people, high-energy injuries such car crashes or falls from heights are the cause.[2]

As a result of falling, both direct and indirect stresses can cause intertrochanteric fractures. A fall that directly strikes the trochanter and lateral limb rotation due to osteoporotic and weakening bone, which results in early and recurrent fractures, are the two proposed mechanisms of injury. A direct correlation exists between the degree of osteoporosis and the severity of the fracture.

A third mechanism that has been proposed recently is cyclical loading, which generally results in micro and macro-fractures in osteoporotic bone.[3] The distinction between intracapsular (femoral neck) and extracapsular (intertrochanteric) fractures initially made by Cooper.[4]

Intertrochanteric fractures were categorized by Evan as either stable or unstable. Key traits of unstable variation include reverse obliquity, basicervical patterning, and posteromedial fragmentation and comminuted greater trochanteric (lateral wall comminution).[5]

Operative techniques should be used to treat intertrochanteric fractures. These days, conservative techniques are limited to older patients who have a high risk of complications from surgery and anesthesia.[6]

Internal fixation and open or closed reduction can be used to accomplish early mobilization, which is the main objective of the treatment to prevent secondary problems.[7]

The cephalomedullary device has numerous potential benefits, including improved head rotational stability, resistance to varus collapse, and more effective load transfer. Because the intramedullary position limits the amount of sliding, there is a reduced risk of shortening and deformity during the procedure, as well as less soft tissue dissection and blood loss.[8]

Numerous clinical and biomechanical investigations have examined the outcomes of various implants, including the Gamma nail (GN), the proximal femoral nail (PFN), and the dynamic hip screw (DHS). Most of the literature recommends use of intramedullary device and especially in an unstable fracture due to improved biomechanics of an intramedullary construct.[9] Numerous problems, including cut outs, screw back outs, implant breakage, femoral shaft fractures, and consequent loss of reduction, have been reported with those devices.[10] In 2003, AO introduced the proximal femoral nail anti-rotation device, which was further improved and named PFNA II in 2009.[11]

Helical blade has a significantly higher cut out resistance than commonly used screw systems.[12] The benefits of the spiral blade in the proximal femoral nail antirotating system for intertrochanteric femoral fractures were demonstrated by numerous biomechanical investigations.[13] There are geometric differences between the PFNA system and the proximal femur, despite the fact that the PFNA technique is known to give high union rates with low major complication rates. When the PFNA is inserted, lateral cortical impingement-which results in lateral cortical fracture and intraoperative loss of reduction-is linked to this geometric Mismatch.[14]

To address these issues, PFNA II devices-an enhanced PFNA design-have been released. The proximal portion's flat lateral shape and the mediolateral bending angle's reduction from 6 to 5 degrees, which permits a somewhat more lateral entrance site through the greater trochanter's tip, are two of the PFNA II design alterations. According to pilot research, the lateral shape of PFNA II may minimize the likelihood of lateral cortical impingement during nail insertion. It may also decrease the risk of intraoperative lateral wall fracture and intraoperative loss of reduction.[15]

The objective of the study is to evaluate the functional outcome of treatment of intertrochanteric fracture femur with internalfixation by using PFNA II.

METHODS

The present study was a prospective follow up study conducted in rural hospital in central India in department of orthopaedics, Mahatma Gandhi institute of medical sciences, Sevagram from December 2020 to May 2022. All willing patients attending orthopaedics OPD and accident emergency centre in Rural hospital in central India with Intertrochanteric fracture that fulfil predetermined inclusion criteria that needed internal fixation were taken up for study. All patient with intertrochanteric fracture femur operated by using PFNA II from December 2020 to May 2022 were part of study and were followed accordingly. We have included patients of age above 18 years with Radiological diagnosis of displaced intertrochanteric fracture femur (Closed fractures) with no medical contraindications for anaesthesia and willing to provide informed consent. We have excluded patients with open fractures, fractures with neurovascular injury, medically unfit for anaesthesia and those who are unwilling to sign written informed consent.

Ethical committee approval given by ethics committee, MGIMS, Sevagram (Letter number-4442 dated 05/01/2021).

Sample size calculation was done by universal sampling. All patients with intertrochanteric fracture femur presenting to our hospital in the given study period taking care of inclusion and exclusion criteria were included in the study.

Statistical analysis was done using SPSS 23.0 software.

Preoperative protocol

The patients' neurovascular impairment was assessed. Other bone injuries and pertinent clinical findings were appropriately documented. With great care, the patient was positioned to get a hip trauma series radiograph, which included a pelvis with both hip anteroposterior view and anteroposterior and lateral view of the afflicted hip. Fractures were classified using Evans classification. Chest x ray, ECG, Blood investigations were done. Consent for surgery was taken and were operated after a preanesthetic check-up. Patient were kept NBM for a minimum 8 hours prior to the surgery and part preparation was done.

All patient will be given pre operative intravenous antibiotics. Appropriate size implants were arranged and checked prior to the day of surgery. The patients were be operated in a supine position on traction table.

Operative technique

The patient was positioned supine on a fracture table, and traction and internal rotation were used to reduce the fracture. For each patient, closed reduction was initially attempted and verified under the c arm. Open reduction and internal fixation were carried out if anatomic reduction could not be accomplished by closed methods. Following that, the patient was dressed and prepped like for any other hip fracture fixation.

Surgical approach

In patients who were slim, the greater trochanter tip was found by palpation; in patients who were fat, an image intensifier was used. A 5-cm longitudinal incision was made just proximal to the greater trochanter's apex. The greater trochanter tip was exposed.

Identifying the site of entrance and inserting the guide wire

The entry location is on the tip of the greater trochanter or somewhat medial to it in the AP view on the c-arm. The guide wire's location in the medullary cavity's center was verified in lateral view. A curved bone awl was used to enter the medullary canal, and the guide wire was then placed within.

Reaming intramedullary

Following confirmation of the proper guide wire location, entry reaming was completed to facilitate easier nail passage. Proximal femur was reamed using a reamer in increments up to 1 mm larger than nail diameter, beginning at 8 mm diameter.

Nail insertion

An appropriate size nail, as decided preoperatively, was attached to the insertion handle and manually inserted after sufficient fracture reduction was confirmed.

Inserting the guide wire for the helical blade

An aiming device attached to the insertion handle was used to assist with this. The drill sleeve was punctured, and a 2.8 mm guide wire was then placed through it. 5 mm was added to the planned screw size when inserting this guide wire. The center of the femoral head was reached by the guide wire. When viewed in AP or lateral views, the guide wire's final position should be in the lower part of the neck, or the center.

Helical blade insertion

The helical blade was inserted as follows: first, a lateral cortex reamer was used to drill over a 2.8 mm guide wire. Next, a conical reamer was used to reamed the material until it reached subchondral level. Finally, the unlocked helical blade was mounted on a screwdriver and inserted into the femoral neck and head over the guide wire.

Distal locking

One cortical screw was used for distal locking. Static locking was used on patients with unstable fractures, and dynamic locking was used on individuals with stable fractures.

Finalization

Following fixation, the incision was closed in layers and lavage with regular saline was administered. In the event of an open reduction, a suction drain was employed. A compression bandage is applied and a sterile dressing is placed over the wound.

Post operative protocol

The patient's limb was elevated on a pillow, and they were monitored in the recovery area until everything stabilized before being sent to the ward. After being administered IV for three days, the antibiotics were switched to an oral form. For open reduction, suction drainage was eliminated 48 hours later.

The day of procedure was also the commencement date for static quadriceps workouts. The third post-operative day was spent dressing. On the sixth and seventh post-operative days, active range of motion, quadriceps, and hip flexion exercises were initiated. After the 14^{th} day, the sutures were taken out. About six weeks after surgery, walking and partial weight bearing were initiated. Walking with full weight bearing was permitted only after a clinical and radiological union assessment.

Follow up

Patient was advised to come for follow up after 4 weeks, end of 3 months, 6 months or till radiological union of fracture. Clinicoradiological assessment was done till sign of clinicoradiological union were noticed.

Result evaluation

Functional outcome was assessed according to Harris hip score

Observations and results

From December 2020 to August 2022, the current study was undertaken. The PFNA II was used to treat 60 cases of intertrochanteric fractures in total. Before surgery, each admitted patient was assessed. The premade proforma was followed in gathering the details. In addition to maintaining records, patients received routine follow-up visits on an OPD basis. The gathered data was examined and contrasted with other series that were published in the field.

In this study majority of patients were in 60-70 years group which contributed to 56.67 % of the cases (Table 1).

Table 1: Age wise distribution, (n=60).

Age (in years)	N	Percentage (%)
20-39	6	10.00
40-59	10	16.67
60-79	34	56.67
80-99	10	16.67

In the present study 23 patients (38.33%) were females and 37 (61.67%) were males, showing male preponderance. In this study 30 patients (50%) have right sided involvement and left side was involved in 30 cases (50%). In 52 (86.67%) patients interval between admission and surgery was 3-6 days and in 7 patients (11.67%) patients it was 7-10 days. The delay was due to pre anaesthetic checkup workup and approval of insurance plan. 52 (86.67%) patients had mean hospital stay of 5-9 days and 7 (11.67%) patients had mean hospital stay of 10-14 days (Table 2).

Table 2: Duration of hospital stay, (n=60).

Duration of stay	N	Percentage (%)
5-9	52	86.67
10-14	7	11.67
15-19	1	1.67

The 58 (96.67%) patients were treated by closed reduction and internal fixation and only 2 (3.33%) required open reduction and internal fixation. 25 (41.67%) patients required nail of diameter 10 and 20 (33.34%) patients required nail of diameter 11. 44 (73.33%) patients required helical blade of length between 80-90 mm. In 35 (68.33%) patients the Cleveland's index was 5 accounting for centre-to-centre blade placement and in 12 (20%) patients the Cleveland's index was 4 (Table 3).

So, majority (88.33%) of patients had optimum placement of the helical blade. In 25 (41.67%) patients the tip apex distance was in the range of 21-25 mm and in 17 (28.33%) patients it was between 16-20 mm. The mean tip apex distance calculated in both anteroposterior and lateral views was 20.43 mm (Table 4).

Table 3: Cleveland's index.

Cleveland's index	Female	Male	% of female	% of male
1		1	0.00	1.67
2	3	4	5.00	6.67
3		2	0.00	3.33
4	2	10	3.33	16.67
5	17	18	28.33	30.00
6	1	1	1.67	1.67
8		1	0.00	1.67

Table 4: Tip apex distance (mm), (n=60).

Tip apexdistance (mm)	Female	Male	Total	Percentage of females	Percentage of males	Total percentage
11-15	6	5	11	10.00	8.33	18.33
16-20	9	8	17	15.00	13.33	28.33
21-25	7	18	25	11.67	30.00	41.67
26-30	1	6	7	1.67	10.00	11.67
Grand total	23	37	60	38.33	61.67	100.00

During study period, 4 patients expired within 6 weeks post-surgery due to advanced age and co-morbidities and 4 patients lost during follow-up due to incorrect contact details and difficulty in travelling due to COVID guidelines. The 47 (90.38%) patients started partial weight bearing at 6 weeks. While 3 (5.77%) patient started partial weight at 7 weeks. Two patients allowed delayed weight bearing due to delayed clinicoradiological union.

Out of 52 patients which were followed up till 6 weeks, 3 patients expired and 1 patient lost during further follow-up after 6 weeks due to incorrect contact details. The 31 (64.58%) patients allowed full weight bearing between 11-12 weeks and 16 (33.33%) were allowed full weight bearing between 8-10 weeks. Only 1 patient was allowed full weight bearing at 14 weeks due to lateral wall fracture. Mean time for full weight bearing was 11.29 weeks.

At 6 months, 29 (60.42%) patients had good Harris hip grade, 8 (16.67%) had excellent Harris hip grade, 7 patients had fair Harris hip grade and 4 patients had poor Harris hip grade which included patients with helical blade protrusion with non-union, another patient with helical blade protrusion, patient with lateral wall fracture and patient with fixed flexion deformity of knee. Fair, good and excellent Harris hip score accounted for total of 44 (91.67%) patients (Table 5).

Table 5: Harris hip grade at 6 months.

Harris hip grade at 6 months	N	Percentage (%)
Poor	4	8.33
Fair	7	14.58
Good	29	60.42
Excellent	8	16.67

Out of 48 patients followed up, 1 patient with loss to follow up had a helical blade protrusion at 6 months and was unwilling for revision surgery and went into non-union. So, out of remaining 47 patients, 30 (63.83%)

patients showed clinical and radiological union of fracture between 5-7 months. Sixteen (34.04%) patients showed complete clinical and radiological union of fracture between 3-5 months. One patient showed union at 7 months due to lateral wall fracture. During study period 4 patients expired within 6 weeks, 3 patients expired after 6 weeks and within 3 months of surgery. Four patients were lost during follow up within 6 weeks and 1 patient was lost to follow up after 6 weeks (Table 6).

Table 6: Complications.

Complications	N	Percent (%)
Protrusion of blade and non-union	1	2.08
Protrusion of blade (Fracture united)	1	2.08
Blade backout (Fracture united)	1	2.08
Infection (both losses to follow up)	2	4.17
Lateral wall fracture (Both fracture united)	2	4.17
Total	7	14.58

So, total 48 patients were followed up post-surgery. Two patients had helical blade protrusion out of which 1 did not agree to revision surgery and went into non-union and 1 was reoperated with helical blade removal and achieved Harris hip score of 70 at 1 year with fracture union. One patient had blade backout which did not affect union and patient achieved Harris hip score of 93 at 1 year. Two patients had superficial infection and were lost to follow up immediate post op. Two patients had lateral wall fracture out of which 1 had a poor Harris hip score of 68 and other achieved a good Harris hip score of 80 at 6 months with both fractures united eventually (Table 7).

Table 7: Time to union.

Union (months)	N	Percent (%)
3 to 5	16	34.04
5 to 7	30	63.83
>7	1	2.13

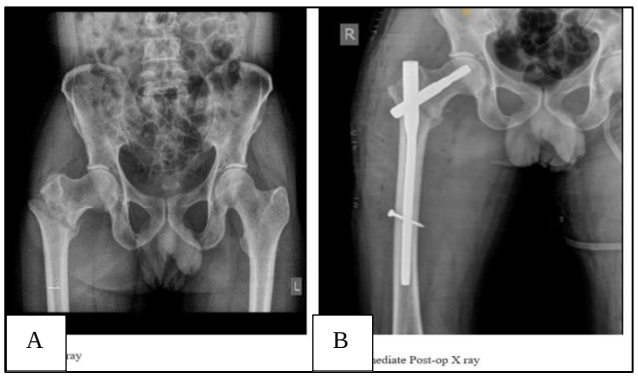

Figure 1 (A and B): Preop and immediate post op images.

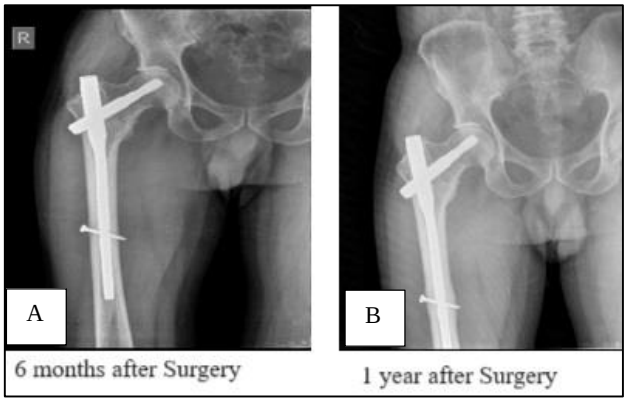

Figure 2 (A and B): Imaging after 6 months and 1 year.

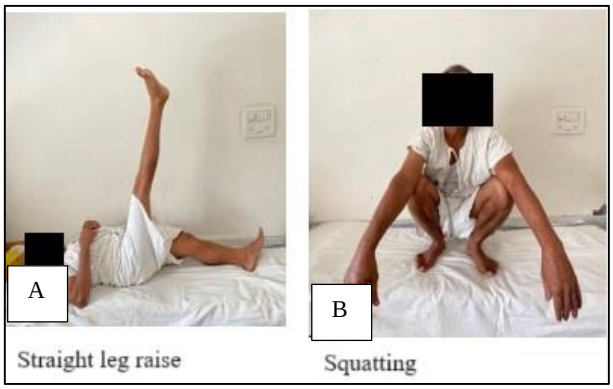

Figure 3 (A and B): Clinical images.

DISCUSSION

An intramedullary load-sharing device with good design is the PFNA II. In terms of biomechanics, PFNA II is more rigid than conventional PFN and has a shorter moment arm-that is, from the tip of the helical blade to the center of the femoral canal. In contrast, the DHS has a longer moment arm that is subjected to considerable stress during weight bearing, increasing the risk of varus malunion and lag screw cut out.[16] The benefits of PFNA II include less blood loss, a shorter recovery period, early weight bearing, a lower risk of implant failure, a quicker fluoroscopy time, and simpler helical blade insertion (as opposed to difficult lag screws and derotation screws

The current investigation was carried out between August 2022 and December 2020. The 60 cases of intertrochanteric fractures treated with PFNA II were examined in this study. The data, which was gathered over a year, was examined and contrasted with comparable series found in published works. Within three months of surgery, seven patients passed away during follow-up, and five patients were lost.

The male to female ratio in this study was 37:23. The current study revealed a male sex preponderance, which is likely related to men's increased outside activities.

Compared to Kripalani et al (where right hip fracture was seen in 52 instances and Left side was seen in 58 cases), 30 cases of right hip fracture and 30 cases of left side hip fracture were observed.[17] Type IV fractures accounted for 40% of all fractures. These findings are similar to those of Singh et al research from 2018, where 66.25% of the fractures were type IV.[18] Undisplaced and simple fractures were less due to osteoporosis and mean age more than 60 years. 78.33% patients had domestic fall which is more than in other studies due to more elderly patients in present study. Mean duration of hospital stay was 8.05 days in present study as compared to 14.5 days in Loo et al study.[19] Mean operative time in present study was 51.75 minutes which is comparable to 48 minutes in study by Srinivas et al and 50.01 minutes in study by Kripalani et al.[17,20]

In present study most commonly used nail diameter was 10 mm (in 41.67% patients) which is consistent with studies by Loo et al and Kripalani et al 2018.[17,19] Tip apex distance was less than 25 mm in 88.33% of the patients as compared to 86.88 % in the study by Swaroop et al.[21]

Mean tip apex distance was 20.43 mm in present study as compared to 21.72 in study by Swaroop et al.[21] Mean time of union for fracture is 5.07 months in our study which is comparable tostudy conducted by Minghui et al which is 16±2.5 weeks.[22] In the current study, 16.67% of instances showed excellent outcomes, and 60.42 percent of cases showed good results while Kripalani et al recorded excellent results in 35.5% of cases and good results were seen in 45.5 % of cases. Excellent and good Harris hip grade accounted for 77.08% of cases in the present study.

For older patients with osteoporotic unstable intertrochanteric fractures, intramedullary nailing with the PFN A-II offers several advantages over traditional PFN or DHS, including a shorter operating time and less blood loss.

The fact that the current study was conducted at a remote tertiary care facility with a large number of elderly patients who had osteoporosis, were less cooperative, and had lower incomes meant that they began early ambulation, which made the study significant. Therefore, even in the case of rural populations, PFNA-II is a better, safer, and more effective implant with a low rate of complications when treating stable and unstable intertrochanteric femur fractures.

Limitations of the study was that it was conducted in a tertiary care hospital in a rural area so patient compliance to the post operative instructions was not adequate and due to COVID-19 regulations few patients lost to follow up.

CONCLUSION

We conclude that PFNA-II is a better, safer implant with a low rate of complications for treating stable and unstable intertrochanteric femur fractures even in rural populations. The time of clinical treatment of PFNA II and the clinical samples observed were relatively small so the long term complications remain unclear. Therefore, large-sample multicenter studies are required.

The 43 years old male patient with unstable intertrochanteric fracture of the femurmanaged with PFNA II.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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