

## Original Research

### Management of unstable intertrochanteric fractures of femur using proximal femoral nail (PFN): A retrospective study

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#### ABSTRACT:

**Aim:** To study of proximal femoral nail in management of unstable intertrochanteric fractures of femur. **Materials and methods:** A retrospective study was conducted in the Department of Orthopaedics. 80 patients with unstable intertrochanteric fractures AO type 31-A2.1, 31-A2.2, 31-A2.3, 31-A3.1, 31-A3.2, 31-A3.3 were included in study and which had been treated with Proximal femoral nail at our institution. **Results:** There were 55 female patients and 25 male patients. Hip fractures occurred on the left side 45.25 percent of the time and on the right side 35.75 percent of the time. The average operational time was 36 minutes. The average duration of the follow-up period was 12 months. On the postoperative radiograph, the Cleveland zone 8 (central - inferior) was the most favourable location for the lag screw. 82.5 percent of patients had a fracture gap of less than 3mm, whereas 12.5 percent had a fracture gap within an acceptable range (3-5mm). Garden alignment index was judged to be very excellent to good in 76.25 percent of instances. The clinical result was determined by the Harris hip score, which ranged from excellent to good in 87.5 percent of patients. At the last follow-up at the time of radiological and clinical union, 70 patients were entirely happy with good to outstanding outcomes, and they were able to walk independently with the exception of 8 patients who need assistance to walk. Radiological union was reported in all patients, with mal reduction in two patients who had a Garden Alignment Index of 150 degrees in the lateral view. **Conclusion:** We believe that the proximal femoral nail has benefits for the fixing of unstable intertrochanteric fractures while requiring less operating time. It is simple to implant and provides solid fixation with fewer difficulties. However, correct operating technique is required to achieve fracture stability and minimise significant problems.

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#### INTRODUCTION

The morbidity of intertrochanteric femoral fractures (IFFs) is increasing in tandem with the fast growth in the senior population. Furthermore, IFFs account for around half of all hip fractures in senior individuals. Surgical therapies have increasingly been favoured for returning to pre-injury function and activity levels. IFFs are now treated with either intramedullary or extramedullary fixations.<sup>1,2</sup> Extramedullary fixations, which have the advantages of less stress, less bleeding, lower doses of anaesthetic, quicker healing after surgery, and avoiding subsequent procedures, have long been seen to be the best option for treating IFFs. However, because the failure rate for unstable IFFs is greater, IFFs are treated with intramedullary fixation devices (proximal femoral nail anti-rotation-Asia (PFNA-II), InterTan (IT)).

PFNA-II or IT is often used and has achieved good clinical outcomes in the treatment of unstable IFF in the elderly due to its reduced failure and good biomechanical advantage that enables for immediate postoperative long-term, full-weight bearing of the hip. With a helical neck blade, PFNA-II is significant in osteoporotic bone and offers rotational and angular stability. Extramedullary implants and intramedullary nails are the two types of implants utilised in these fractures. The fracture pattern mostly influences implant selection (stable or unstable). Unstable intertrochanteric fractures have major disruption of the posteromedial cortex due to comminution, or they have reverse oblique patterns or subtrochanteric extension. Fractures with no damage of the posteromedial cortex or subtrochanteric extension are classified as considered stable.<sup>3,4</sup>

## MATERIALS AND METHODS

After receiving clearance from the protocol review committee and the institutional ethics committee, a retrospective research was undertaken at the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar from April 2019 to May 2021. The study comprised 88 patients with unstable intertrochanteric fractures of the AO types 31-A2.1, 31-A2.2, 31-A2.3, 31-A3.1, 31-A3.2, and 31-A3.3 who had been treated with a proximal femoral nail at our hospital. Patients with AO type 31A1.1, 31A1.2, 31A1.3 fractures, medical comorbidities, and concomitant pelvic fractures on either side or ipsilateral femur were excluded from the research. After 6 months, 8 patients were lost to follow-up.

As a result, 80 patients were recruited for the research. There were 55 females and 25 men in the group, with a mean age of 58 years. The fractures in 62 patients were caused by minor trauma, while the remainder were caused by a car accident or a fall from a great height. The AO classification system was used to classify fractures. Based on pre-operative radiographs, 35 fractures were classified as A2, with 16 patients classified as A2.1, 12 patients classified as A2.2, and 9 patients classified as A2.3. The remaining 45 patients were classified as A3, with 19 patients classified as A3.1, 8 patients classified as A3.2, and 18 patients classified as A3.3. All procedures were completed in an average of four days (range: two to twelve days) from the date of injury. Within 1 hour after the skin incision, all patients received a prophylactic antibiotic. Closed manipulation and traction under fluoroscopic supervision were used to accomplish reduction. If closure reduction was not effective, the fracture site was only marginally exposed. Aproximal femoral nail (9-11mm in diameter), lag screw (85-105mm in length), and antirotation pin were employed in the fixing (10-15 mm shorter than the lag screw). Cleveland zones<sup>5</sup> and tip apex distance (TAD)<sup>6</sup> were utilized to evaluate lag screw insertion in the femoral head.

On the first post-operative radiograph, the fracture reduction was assessed using the Garden Alignment

Index (GAI)<sup>7</sup> and the fracture gap (mm). The Garden Alignment Index was used to categorise the outcomes as very good, good, acceptable, or bad.<sup>8</sup> The fracture gap was graded as good (0-3 mm), acceptable (3-5 mm), or unsatisfactory (more than 5 mm).

On the first postoperative day, vigorous quadriceps strengthening activities, ankle and toe motions, and knee mobilisation exercises were begun. The average length of stay in the hospital was 5.5 days. On the 12th post-operative day, the suture was removed. During the research period, certain complications (intraoperative or postoperative) were also documented. The mean follow up period was 12 months. Clinical evaluation was done using Harris hip score<sup>7</sup> and radiologically at 6 weeks, 12 weeks, 6 months, 9 months and thereafter every 6 months. Full weight bearing was allowed once radiological evidence of bone union was evident. Anteroposterior and lateral plain radiographs were taken at every visit to look for the fracture union, tip apex distance, cut-out or lateral migration of lag screw or antirotation pin.

## RESULTS

Union was detected in all patients at the last follow-up, with radiologically trabeculae crossing the fracture site at least three cortices in two views and clinically with no discomfort at the fracture site. At the time of operation, the average age was 58 years. There were 55 female patients and 25 male patients. Hip fractures occurred on the left side 45.25 percent of the time and on the right side 35.75 percent of the time. The average operational time was 36 minutes. The average duration of the follow-up period was 12 months. On the postoperative radiograph, the Cleveland zone 8 (central - inferior) was the most favourable location for the lag screw. 82.5 percent of patients had a fracture gap of less than 3mm, whereas 12.5 percent had a fracture gap within an acceptable range (3-5mm). Garden alignment index was judged to be very excellent to good in 76.25 percent of instances (Table 1).

**Table 1: Assessment of fracture gap and garden alignment index**

	No of cases (n)	Percentage (%)
<b>Fracture Gap</b>		
Good (< 3 mm)	66	82.5
Acceptable (3-5mm)	10	12.5
Poor (> 5 mm)	4	5
<b>Garden alignment index (anteroposterior -angle)</b>		
Very good (180 <sup>0</sup> )	18	22.5
Good (180 <sup>0</sup> -160 <sup>0</sup> )	43	53.75
Acceptable (160 <sup>0</sup> -150 <sup>0</sup> )	16	20
Poor (<150 <sup>0</sup> ) / Lat <180 <sup>0</sup>	3	3.75

In two patients, reoperation was necessary due to therapy or implant-related problems. One example received wound debridement for infection, and

another had a lag screw removed for lateral thigh pain (Z effect or cut out) following fracture union. Two patients with inadequate reduction had delayed

healing. Two patients complained of anterior thigh soreness. On the fifth degree of follow-up, one patient developed secondary varus. None of them suffered femoral shaft or greater trochanter fractures. The clinical result was determined by the Harris hip score, which ranged from excellent to good in 87.5 percent of patients. At the last follow-up at the time

of radiological and clinical union, 70 patients were entirely happy with good to outstanding outcomes, and they were able to walk independently with the exception of 8 patients who need assistance to walk. Radiological union was reported in all patients, with malreduction in two patients who had a Garden Allignment Index of 150 degrees in the lateral view.

**Table 2: Results According to Harris hip Score**

Harris hip score	Number (n)	Percentage (%)
Excellent	38	47.5
Good	32	40
Fair	8	10
Poor	2	2.5

## DISCUSSION

In this study, we treated unstable intertrochanteric fractures with a proximal femoral nail. Moran et al. found that delaying surgery by up to four days in individuals without an acute medical comorbidity has no effect on postoperative mortality, morbidity, or rehabilitation time.<sup>8</sup> In our study, the average duration from fracture to surgery was 3.6 days. The proximal femoral nail is secured with two screws; the larger screw provides compression at the fracture site and carries the majority of the strain, while the smaller screw offers rotational stability.

If the antirotation screw is longer than the lag screw, vertical pressures on the antirotation screw begin to cause cut-out or Z-effect. Schipper IB et al. concluded that if the antirotation screw was 10 mm shorter than the lag screw, the proportion of total load borne by the antirotation screw ranged from 8 to 39 percent (mean 21 percent), and there was no cut-out of the femoral head or fracture displacement. The anti rotation screw was 10-15 mm shorter than the lag screw in our investigation.<sup>9</sup> Geller et al. found a 44 percent frequency of cut outs in intertrochanteric fracture fixation with TAD greater than 25 mm and no cut outs with TAD less than 25 mm.<sup>10</sup>

In our series, we found one cut out with TAD 25 in 75 percent of the patients. Nikoloski et al. also suggested that the TAD be maintained between 20 and 30 mm.<sup>11</sup> When there is severe anterior curvature of the femur, Jinet al.<sup>12</sup> favoured a long proximal femoral nail over a shorter nail. We observed impingement of the nail tip on the anterior brain in two cases due to severe bending and low femur length in Indians in our study. In all situations, we employ a lengthy proximal femoral nail.

In their collection of 107 intertrochanteric fractures, Yaozenget et al. documented 6 intraoperative femoral shaft fractures.<sup>13</sup> We found no intraoperative shaft femur fractures in our investigation. The risk of this problem can be lowered by reaming the femoral canal properly, especially when using longer nails. In 31 unstable intertrochanteric fracture fixations, Boopalanet al.<sup>14</sup> observed a 21% frequency of intraoperative lateral wall fractures. According to the findings, lateral wall fracture has no effect on fracture

union. In their investigation, Gotfried and colleagues reported 24 occurrences of lateral wall fractures.<sup>15</sup> On x-ray, he found varus malalignment with medialisation of the femoral shaft in all of these instances. We described 5 instances of intraoperative lateral wall fractures, one of which produced a 5 degree secondary varus collapse.

G.N. Kiran Kumar et al evaluate the outcome of proximal femoral nail antirotation II by using Harris hip score and found Excellent and good results were found in 78% of cases.<sup>16</sup> In our study 47.5% Excellent and 40% good results were observed. Several studies like Gardenbroek TJ et al, Sahin S et al, Strauss E et al<sup>17-19</sup> have reported successful outcome with low complication rates with PFN in unstable intertrochanteric fractures Our study supports this finding and suggesting that proximal femoral nail is a reasonable treatment option in unstable trochanteric fractures.

## CONCLUSION

We believe that the proximal femoral nail has benefits for the fixing of unstable intertrochanteric fractures while requiring less operating time. It is simple to implant and provides solid fixation with fewer difficulties. However, correct operating technique is required to achieve fracture stability and minimise significant problems.

## REFERENCES

- Shen J, Luo F, Sun D, Huang Q, Xu J, Dong S, et al. Mid-term results after treatment of intertrochanteric femoral fractures with percutaneous compression plate (PCCP). *Injury-International Journal of the Care of the Injured*. 2015;46(2):347-57. doi:10.1016/j.injury.2014.04.033.
- Li M, Wu L, Liu Y, Wang C. Clinical evaluation of the Asian proximal femur intramedullary nail antirotation system (PFNA-II) for treatment of intertrochanteric fractures. *Journal of Orthopaedic Surgery and Research*. 2014;9. doi:10.1186/s13018-014-0112-5.
- Muller ME, Nazarian S, Koch P, Schatzker J. *The comprehensive classification of fractures of long bones*. 1<sup>st</sup> ed. Berlin, Heidelberg, Germany, New York, NY, USA: Springer-Verlag 1990.
- Orthopaedic Trauma Association Committee for

- Coding and Classification. Fracture and dislocation compendium. J Orthop Trauma 1996; 10(Suppl 1): v-ix, 1-154.
5. Cleveland M, Bosworth DM, Thompson FR, Wilson HJ Jr, Ishizuka T. A ten-year analysis of intertrochanteric fractures of the femur. J Bone Joint Surg Am 1959; 41-A: 1399-408.
  6. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tipapex distance in predicting failure of fixation of peritrochanteric fractures of the hip. J Bone Joint Surg Am 1995; 77: 1058-64.
  7. Lenich A, Mayr E, Rüter A, Möckl Ch, Füchtmeier B. First results with the trochanter fixation nail (TFN): a report on 120 cases. Arch Orthop Trauma Surg 2006; 126: 706-12.
  8. Moran CG, Wenn RT, Sikand M, Taylor AM. J Bone Joint Surg Am. 2005;87(3):483-489.
  9. Schipper IB, Steyerberg EW, Castelein RM, van der Heijden FH, den Hoed PT, Kerver AJ, van Vugt AB. J Bone Joint Surg Br. 2004 Jan;86(1):86-94.
  10. Geller JA, Saifi C, Morrison TA, Macaulay W. Tip-apex distance of intramedullary devices as a predictor of cut-out failure in the treatment of peritrochanteric elderly hip fractures. Int Orthop 2010; 34: 719-22.
  11. Nikoloski AN, Osbrough AL, Yates PJ. Should the tip-apex distance (TAD) rule be modified for the proximal femoral nail antirotation (PFNA)? A retrospective study. J Orth Surg Res 2013; 8: 35.
  12. Jin HH, Jong KO, Sang HH, *et al.* Mismatch between PFNA and medullary canal causing difficulty in nailing of the peritrochanteric fractures. Arch Orthop Trauma Surg 2008; 128(12): 1443-6
  13. Yaozeng X, Dechun G, Huilin Y, Guangming Z, Xianbin W. Comparative study of trochanteric fracture treated with the proximal femoral nail antirotation and the third generation of gamma nail. Injury 2010; 41: 1238.
  14. Boopalan PR, Oh JK, Kim TY, Oh CW, Cho JW, Shon WY. Incidence and radiologic outcome of intraoperative lateral wall fractures in OTA 31A1 and A2 fractures treated with cephalomedullary nailing. J Orthop Trauma 2012;26(11): 638-42.
  15. Gotfried Y. Percutaneous compression plating of intertrochanteric hip fractures. J Orthop Trauma 2000; 14: 490-5.
  16. G.N. Kiran Kumar et al. Treatment of Unstable Intertrochanteric Fractures with Proximal Femoral Nail Antirotation II: Our Experience in Indian Patients, *The Open Orthopaedics Journal*, 2015, 9, 456-459
  17. Gardenbroek TJ, Segers MJ, Simmermacher RK, Hammacher ER. The proximal femur nail antirotation: an identifiable improvement in the treatment of unstable peritrochanteric fractures? J Trauma 2011; 71: 169-74.
  18. Sahin S, Erturer E, Ozturk I, Toker S, Sec, kin F, Akman S, Radiographic and functional results of osteosynthesis using the proximal femoral nail antirotation (PFNA) in the treatment of unstable intertrochanteric femoral fractures. Acta OrthopTraumatolTurc 2010; 44: 127-34.
  19. Strauss E, Frank J, Lee J, Kummer FJ, Tejwani N. Helical blade *versus* sliding hip screw for treatment of unstable intertrochanteric hip fractures. Biomechanical evaluation. Injury 2006; 37: 984-9.