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Assessment of clinical & radiological outcome of fixation of intertrochanteric femoral fractures with PFNA2 (Proximal femoral antirotation augmentation nail): A case series

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Abstract
Aim and Objective: Intertrochanteric femoral fractures are associated with trivial trauma. Although many treatment methods have been developed, controversy exists regarding the optimal management of these fractures. This study evaluated the clinical outcome of intertrochanteric femoral fractures fixed with proximal femoral anti-rotation augmentation nail (PFNA2).
Materials and Methods: In this study between JUNE 2018 and OCTOBER 2019, 25 patients with traumatic intertrochanteric fractures of the femur were treated with PFNA2. Closed reduction and internalfixation were performed in 24 cases and open reduction internal fixation done in 1 patient. Results were assessed by modified harris hip scoring system.
Results: The average follow-up time was 6 months. All intertrochanteric femoral fractures healed. The mean union time was 12 weeks. No implant failure was observed.
Conclusion: PFNA2 is effective in treatment of intertrochanteric femoral fractures, with a high rate of bone union, minor soft tissue damage, early return to function and few implant-related complications.

Keywords: Intertrochanteric fracture, PFNA2, modified harris hip score

Introduction
With improved medical facilities and prolonged life expectancy, the incidence of intertrochanteric fractures has increased drastically. Surgery is the preferred treatment of choice in view of early mobilization. The basic principle of surgery is to use an implant that is minimally invasive, that has a less operative time and one which allows for early mobilization and weight bearing. The implants used are of two types, extramedullary and intramedullary. The implant to be used is decided on the basis of the type of fracture(stable or unstable).A fracture is said to be unstable if it has comminution of the postero-medial cortex, reverse oblique type of fractures and fractures of subtrochanteric extension.
This study evaluated the clinical outcome of intertrochanteric femoral fractures both stable and unstable fixed with proximal femoral anti-rotation augmentation nail (PFNA2) in local population around Chidambaram.

Materials and Methods
From June 2018 to October 2019, 25 cases of both stable and unstable intertrochanteric fractures were managed with the PFNA2 and were followed prospectively. There were men and women with mean age of 65.7years (range, 35-90). Right hip was involved in 13 patients and left in12 patients. The most common mechanism of injury was a trivial fall followed by RTA. The fractures were classified based on Boyd and Griffin classification for intertrochanteric fractures. The patients were operated within one week from date of injury. 24 cases underwent closed reduction internal fixation and in 1 case with lateral wall comminution open reduction internal fixation done. Average operative time (skin to skin) was 67minutes (range 35 - 90 minutes). Prophylactic antibiotics were administered on the day of surgery one hour prior to skin incision. The sizes of PFNA 2 nail used are depicted in Table 1. Commonly

used nail diameter was 10 mm, which was used in 18 patients. In remaining patients, 9 mm nail was used. Most commonly used nail size was the smaller version (200 mm length) and commonly used blades were between 90-105 mm. Tip apex distance (TAD) was used to assess the position of helical blade in the femoral head. Garden's alignment index and fracture gap were used to estimate the reduction in post-operative X-rays. The results were classified using GAI as very good (anteroposterior 160°); good (anteroposterior 180°-160°); acceptable (anteroposterior 160°-150°); or poor (anteroposterior <150°/lateral not 180°. The fracture gap was classified as good (0-3 mm); acceptable (3-5 mm); or poor (> 5 mm) (Table 2). The patient was allowed to weight bear partially on the first post-operative day. The position of helical blade was found to be in the centre or postero-inferior in both AP and lateral views. There were no intra-operative complications like greater trochanter and shaft of femur fractures. The average duration of stay in the hospital was 13 days (range, 8 - 20). Suture removal was done on 13thpost-operative day.

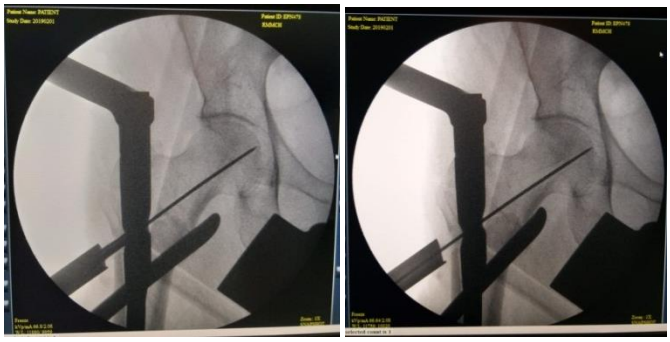

Fig 1: Intra operative images showing fracture reduction using strategically placed hohmann retractors.

Fig 2: 70 year old male patient, who sustained unstable intertrochanteric fracture after a trivial fall and post-operative radiographs showing good fracture reduction.

The patients were followed for a period of 6 months. Clinically, the patients were assessed using the Harris hip score and radiological photographs were taken at first, second and sixth months. Average time for full weight bearing was6weeks.At each visit, the X rays were assessed for TAD, fracture healing and screw pull out.

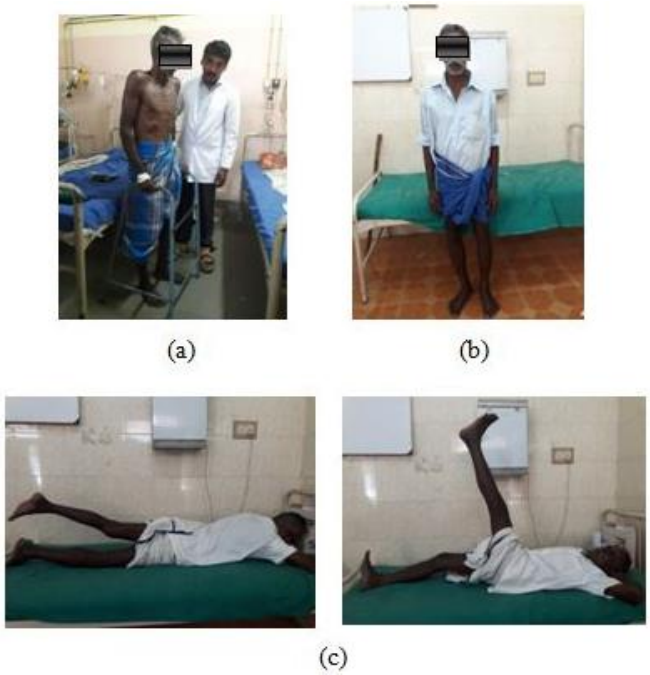

Fig 3: Showing immediate post op mobilization (a), follow up at 1 month (b) and follow up at 6 months showing full range of movements (c)

Results

All fractures achieved complete union by 6 months.84% of cases showed fracture gap of lessthan3mmand remaining 16% showed acceptable reduction. Garden Alignment Index (GAI) was graded as very good to good in 84% of cases (Table 2). A TAD of less than 20 mm was achieved in almost 95% of cases.

Intra and post-operative complications are depicted in Table 3. There were no cases of cut through or breakage of the implant.

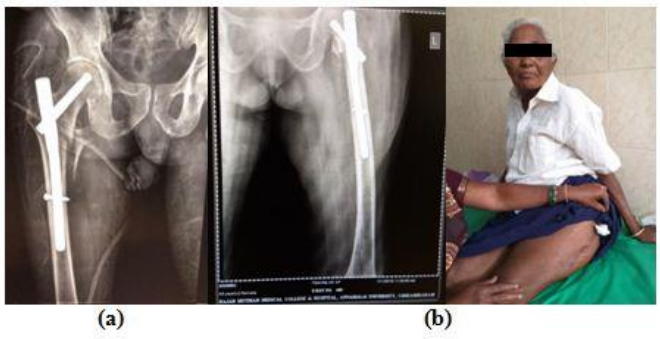

Fig 4: (a) Mismatch between proximal end of nail and greater trochanter noted (**b)** Case with heterotopic ossification and infection

Table 1: Nail sizes used in our series

Nail Size	Number (n)	Percentage (%)
Small (200 mm)	23	92
Very small (170 mm)	2	8

Table 2: Assessment of fracture gap

Fracture gap	Number (n)	Percentage (%)
Good (0-3 mm)	21	84
Acceptable (3-5 mm)	4	16
Poor (>5 mm)	0	0

Table 3: Intra-and post-operative frequencies of complications

Complications		Number (n)	Percentage (%)
Intra-operative	Fracture of greater trochanter	0	0
	Femoral shaft fracture	0	0
Post-operative	Nail mismatch at the proximal end	2	8
	Anterior thigh pain	0	0
	Fascia lata pain	1	4
	Secondary varus development	1	4
	Persistent limp	2	8
	Heterotopic ossification	1	4
	Infection	1	4

There were no documented cases of any femoral shaft fractures. One patient complained of pain in the lateral aspect of thigh because of the helical blade impinging on the fascia lata. There was a case of secondary varus that was detected at the final follow up.

Clinical evaluation was done using Harris hip score (Table 4). The results were classified to be excellent in about 32% of cases and good in 60% of cases.

Table 4: Functional assessment using Harris hip score.

Harris Hip Score	Number (n)	Percentage (%)
Excellent	8	32
Good	15	60
Fair	2	8
Poor	0	0

At the final visit, 23 patients (92%) were able to walk independently, 2(8%) needed walker or crutches. Walking to pre-operative levels was achieved in almost all the patients.

Discussion

With the increasing incidence of osteoporosis, the occurrence of unstable intertrochanteric fractures has been on the rise and is likely to remain very high for a few decades atleast [1-3]. The choice of implants ranges from extra-medullary implants like dynamic hip screw to intra-medullary implants like the proximal femoral nail to arthroplasty. However the ideal choice of implant is still a contraversial area [4]. In this article we put forward the concept of Proximal femoral antirotation augmentation nail in the treatment of stable and unstable intertrochanteric fractures [5, 7]. There have been various article in the western continent however resources from the Asian sub-continent have been scarce. This was a prospective study done at Rajah Muthiah Medical College and Hospital from June 2018 to October 2019.

The most important difference from the conventional PFN was the introduction of a helical blade that was thought to reduce the cut-out. This was achieved partially, the incidence of cut out was reduced. However, the most common cause of failure was still cut through of the screw [8, 9].

Our study reported no cut outs. However other studies reported cut-outs in the range of 5-25%. Even though the helical blade was thought to reduce the cut through, medial cut-through of the sub-chondral bone still occurred [10-12].

Baumgaertner *et al* [6]. concluded that the optimal position of the helical blade was in the centre of the femoral head. The exact location of both the lag screw and helical blade at the centre of the femoral head and neck is absolutely essential in both the AP and lateral films. The Tip apex distance (TAD) was considered to be the prime factor with respect to occurrence of a cut through. Geller *et al.* documented 44% of cut outs in unstable intertrochanteric fractures fixation which were fixed with a TAD of more than 25 mm [19]. Our study documented no cut through even though a couple of cases were fixed with a TAD of more than 25mm [1]. We agree with Jin *et al.* and preferred to use a substantially shorter blade than the one optimally recommended to prevent the dreadful complication of femoral head collapse at the fracture site [20]. Nikoloski *et al.* concluded that the helical blade was fundamentally different to the lag screw being used in PFN and suggested to maintain a TAD of less than 25 mm [21].

Jin *et al* [20]. suggested the use of a longer nail than the shorter one to encounter excessive femoral shaft curvature. In our case series, we found impingement of nail tip (170mm length) to the anterior cortex in about 2 cases due to increased anterior bowing and short femoral length in Indian population [14]. In these 2 cases we used longer nail of size 200mm It is better to use longer nail to bypass the curvature or relatively shorter nail to prevent this complication especially inpatients with excessive anterior bowing of femur.

We did not encounter any femoral shaft fractures in our case series. Yaozeng *et al* [22]. documente atleast 6 (5.6%) intra operative shaft of femur fractures in their case series. While using a longer nail, adequate reaming of the medullary cavity seemed to prevent this complication.

Boopalan *et al* [23]. documented an 21% incidence of intraoperative fracture in the lateral walls especially in 31 A1 and A2 pertrochanteric fracture fixation, however this did not seem to affect the fracture union. Gotfried documented 24 cases of lateral wall fractures in his case series [24]. On radiographic examinations, there was a common finding, a varus malalignment of the femoral head which was found to the reason for the lateral wall fractures. This was because of the use of a lateral cortex drill of 16mm in diameter for the helical blade. We documented 1 case of infection and heterotopic ossification post operatively as patient suffered secondary trauma [26].

We reported no cases of fracture distraction in our case series which was attributed to the narrow portion of the nail when it is crossing the fracture site [25]. The mechanism is thought to be due to the translation of the proximal fragment along the line of fracture and the lower part of the nail pushing the distal fragment laterally leading to distraction, usually leading to a varus malalignment. We didn't face this kind of complication intraoperatively [27].

In the past 5 years, multiple case series have documented more success rates and reduced complication rates with PFNA2 in the treatment of both stable and unstable inter-trochanteric fractures. Our case series supports this result, validating the fact that PFNA2 is a very good and feasible option in treatment unstable trochanteric fractures [28]. Our sample size was small with wide variability in the age. However there is a need for further studies validating the use of different implants in treatment of inter-trochanteric fractures [29].

Conclusion

- To conclude, we infer that once fracture union occurs, functional outcomes are similar irrespective of the type of implant used.
- The number of implant related complications however, is less when a helical blade device is used, indicating its biomechanical superiority over a dual screw design.
- PFNA2 has a superior performance over PFN in the setting of osteoporosis, which is attributed to compaction of cancellous bone by the helical blade.
- Nevertheless, it must be remembered that no implant design can compensate for poor reduction or poor implant placement in these fractures.

We would like to conclude by recommending the PFNA2 for the treatment of both stable and unstable intertrochanteric fractures because of its stable fixation, decreased operating time, minimal complications and early mobilization.

References

1. Lenich A, Fierlbeck J, Al-Munajjed A, *et al*. First clinical and biomechanical results of the Trochanteric Fixation Nail (TFN). Technol Health Care. 2006; 14(4-5):403-9.
2. Strauss E, Frank J, Lee J, Kummer FJ, Tejwani N. Helical blade *versus* sliding hip screw for treatment of unstable intertrochanteric hip fractures: a biomechanical evaluation. Injury. 2006; 37(10):984-9.
3. Muller ME, Nazarian S, Koch P, Schatzker J. The comprehensive classification of fractures of long bones. 1st ed. Berlin, Heidelberg, Germany, New York, NY, USA: Springer-Verlag, 1990.
4. Orthopaedic Trauma Association Committee for Coding and Classification. Fracture and dislocation compendium. J Orthop Trauma. 1996; 10(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. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am. 1969; 51:737-55.
9. Brunner A, Jockel JA, Babst R. The PFNA proximal femur nail in treatment of unstable proximal femur fractures-3 cases of postoperative perforation of the helical blade into the hip joint. J Orthop Trauma. 2008; 22:731-6.
10. Simmermacher RKJ, Ljungqvist J, Bail H, *et al*. The new proximal femoral nail antirotation (PFNA) in daily practice: results of a multicentre clinical study. Injury. 2008; 39:932-9.
11. Zou J, Xu Y, Yang H. A comparison of proximal femoral nail antirotation and dynamic hip screw devices introchanteric fractures. JInt Med Res. 2009; 37:1057-64.
12. Pu JS, Liu L, Wang GL, Fang Y, Yang TF. Results of the proximal femoral nail antirotation (PFNA) inelderly Chinese patients. Int Orthop. 2009; 33:1441-4.
13. Brunner A, Jockel JA, Babst R. The PFNA proximal femurnail in treatment of unstable proximal femur fractures—3 cases of postoperative perforation of the helical blade into the hip joint. J Orthop Trauma. 2008; 22(10):731-6.
14. Mereddy P, Kamath S, Ramakrishnan M, Malik H, Donnachie N. The AO/ASIF proximal femoral nail antirotation (PFNA): a new design for the treatment of unstable proximal femoral fractures. Injury. 2009; 40(4):428-42.
15. Penzkofer J, Mendel T, Bauer C, Brehme K. Treatment results of pertrochanteric and subtrochanteric femoral fractures: A retrospective comparison of PFN and PFNA. Der Unfallchirurg. 2009; 112(8):699-705.
16. Takigami I, Matsumoto K, Ohara A, *et al*. Treatment of trochanteric fractures with the PFNA (proximal femoral nail antirotation) nail system - report of early results. Bull New York Univ Hosp Joint Dis. 2008; 66(4):276-9.
17. Rubio-Avila J, Madden K, Simunovic N, Bhandari M. Tiptoapex distance in femoral intertrochanteric fractures: a systematic review. J Orthop Sci. 2013; 18:592-8.
18. Andruszkow H, Frink M, Frömke C, *et al*. Tip apex distance, hip screw placement, and neck shaft angle as potential risk factors for cut-out failure of hip screws after surgical treatment of intertrochanteric fractures. Int Orthop. 2012; 36:2347-54.
19. 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.
20. Jin HH, Jong KO, Sang HH *et al*. Mismatch between PFNA andmedullary canal causing difficulty in nailing of the pertrochanteric fractures. Arch Orthop Trauma Surg. 2008; 128(12):1443-6.
21. Nikoloski AN, Osbrough AL, Yates PJ. Should the tip-apexdistance (TAD) rule be modified for the proximal femoral nail antirotation (PFNA)? A retrospective study. Jorth Surg Res. 2013; 8:35.
22. 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 gammanail. Injury. 2010; 41:1238.
23. Boopalan PR, Oh JK, Kim TY, Oh CW, Cho JW, Shon WY. Incidence and radiologic outcome of intraoperative lateral wall fractures in OTA31A1 and A2 fractures treated with cephalomedullary nailing. J Orthop Trauma. 2012; 26(11):638-42.
24. Gotfried Y. Percutaneous compression plating of intertrochanteric hip fractures. J Orthop Trauma. 2000; 14:490-5.
25. Hak DJ, Bilat C. Avoiding varusmalreduction during cephalomedullary nailing of intertrochanteric hip fractures. Arch Orthop Trauma Surg. 2011; 131:709-10.
26. Janardhana Aithala P, SharathRao. Proximal femoral nailing: technical difficulties and results introchanteric fractures. Open J Orthop. 2013; 3:234-42.
27. Gardenbroek TJ, Segers MJ, Simmermacher RK, Hammacher ER. The proximalfemurnail antirotation: an identifiable improvement in the treatment of unstable pertrochanteric fractures? J Trauma. 2011; 71:169-74.
28. 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 Orthop Traumatol Turc. 2010; 44:127-34.

29. Strauss E, Frank J, Lee J, Kummer FJ, Tejwani N. Helical blade *versus* sliding hip screw for treatment of unstable intertrochanteric hip fractures. A biomechanical evaluation. Injury. 2006; 37:984-9.