"PFNA-II for unstable intertrochanteric fractures - A prospective study on short term functional outcome"

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Abstract

Background: This study was carried out to study the short term functional outcome of proximal femoral nail antirotation-II (PFNA-II) in the treatment of unstable intertrochanteric fractures.

Materials and Methods: This prospective study includes 20 cases of unstable intertrochanteric fractures in the age group between 55-94 years. The patients included in the study underwent fixation of intertrochanteric fractures using PFNA-II. The study was conducted in the department of Orthopaedics in an advanced trauma centre in Kerala between August 2018 and June 2019. Patients were followed up and assessed clinically and radiologically at regular intervals at 6 weeks, 3 months and 6 months. Functional score was assessed using Oxford Hip Score and Harris Hip Score.

Results: 20 patients were followed up for a period of 6 months. The minimum and maximum age was 55 and 95 years respectively. Majority of the fractures were fell into AO A2.2(45.0%). The average OT time was 58.75 minutes with standard deviation 21.82. The average blood loss was minimal (124.5 ml). 85% cases could achieve good reduction. Good results were achieved in 75% (n=15) and Excellent results in 20% (n=4) cases according to Harris hip score. There was a significant relationship between Oxford hip score and fracture reduction (p-value is less than 0.05). There was a significant progress in Oxford hip score and Harris hip score 3 month and 6 months. No cases of cut out or breakage of the implant were noted during the study period. There was no major complication or mortality noted during the follow up period.

Conclusion: PFNA-II is ideal implant for fixation of unstable intertrochanteric fractures in elderly patients with less operative time, low complication rate and with a good clinical outcome. However it is important to follow proper operative technique in order to attain fracture stability and to avoid major complications.

Keywords: Intertrochanteric fracture, Hip fracture, Intramedullary nail, PFNA-II, Complications, Harris hip score, Oxford Hip Score, unstable.

Introduction

Intertrochanteric fractures commonly occur in elderly patients with osteoporosis and its incidence is rising due to the increasing life expectancy [1,2]. Trochanteric fractures account for approximately half of the hip fractures in elderly, out of this more than 50% fractures are unstable [3].

If they are not adequately treated, they may cause a considerable deterioration in the quality of life [4].

The goal of treatment of any intertrochanteric fracture in elderly is to restore the mobility early while minimizing the complications [5,6].

In the treatment of unstable intertrochanteric fractures Intramedullary fixation devices have become increasingly popular compared with extramedullary fixation due to its biomechanical advantages [7].

Previous intramedullary fixation devices, such as the Gamma Proximal Femoral Nail are persistently associated with complications like femoral shaft fracture, fixation failure, the Z effect, and distal locking complications requiring reoperation with subsequent morbidity and mortality [8]. Therefore, other intramedullary fixation devices have been introduced [9].

Use of the PFNA for treatment of proximal femoral fractures has achieved good clinical efficacy and

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Figure 1: Pre and Post operative radiographs

reduced complications compared to other Intramedullary implants [10], However complications such as difficult insertion, femoral shaft fracture, lateral hip pain, lateral blade migration, and lateral cortex blowout have been noticed among Asian populations when using standard implant [11].

Since Asians have a shorter femoral neck, a smaller neck-shaft angle, and a larger anterior bowing of the femoral shaft, such anatomical differences can result in mismatch when using standard implants and are reported to be one possible reason for these complications.

To overcome these issues, the Asian version of the Proximal Femoral Nail Antirotation (PFNA-II) was developed. This new PFNA-II, has sizes adapted for a better fit into the smaller trochanteric area and narrower intramedullary canal of the Asian population [12].

Material and Methods

This Prospective analytical study was carried out in a leading hospital at Kerala ,India. Study population included was patients with unstable intertrochanteric fracture fixed with PFNA-II (20 cases) during the period of 1st august 2018 to 30th June 2019.

The inclusion criteria were patients age > 20 years, with unilateral unstable intertrochanteric fractures undergoing surgical fixation using PFNA-II.

Those having open fractures, pathological fractures and the patients with associated injuries in the same limb or other limbs were not included in this study. Pre fracture Non ambulatory patients were also excluded.

After initial assessment and stabilization, antero-posterior and lateral radiographic views of the involved extremity are obtained along with routine blood investigations. Preoperatively, the fractures are classified according to the AO classification. Only AO type 31.A2 and 31.A3 fractures (unstable trochanteric fractures) are included in the study.

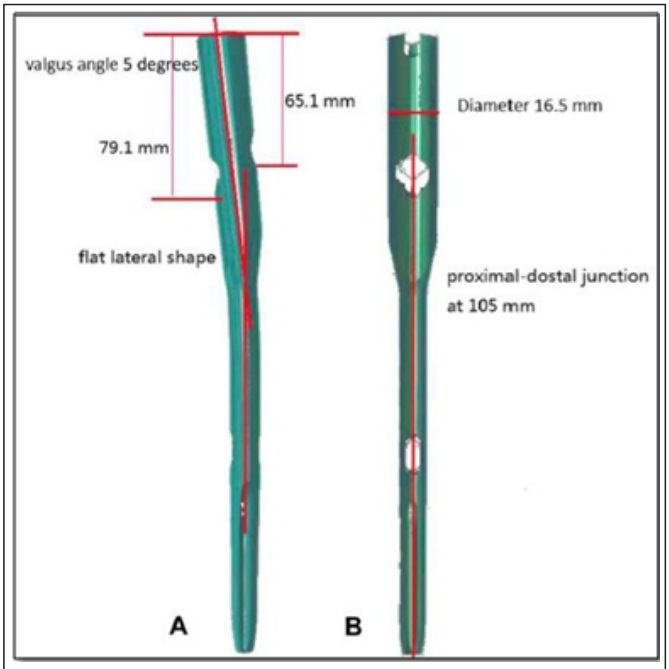

Figure 2: Anterior (A) and lateral (B) views of PFNA-II

Affected limb was put on skin traction. Age, sex, co-morbidities, pre-fracture walking ability and mechanism of injury was recorded preoperatively.

Surgery was performed through a lateral approach with the patient supine and in traction on a fracture table. Implant used was either Short PFNA-II or long PFNA-II. Standard antibiotic prophylaxis (Injection. Cefuroxime 1.5 mg)was given ½ before incision time to all patients. Intra operatively following parameters - Anesthesia used (General/ Spinal/Epidural/Regional block), Implant

Table 1: AO classification of fractures

AO Classification	Frequency	Percent
A2.1	6	30.00%
A2.2	9	45.00%
A2.3	1	5.00%
A3.1	1	5.00%
A3.2	2	10.00%
A3.3	1	5.00%

Table 2: Distribution of Harris Hip Score

Harris Hip Score at 6 month	Frequency	Percent
Poor	0	0.00%
Fair	1	5.00%
Good	15	75.00%
Excellent	4	20.00%

Table 3: Distribution of Oxford Hip Score

Oxford Hip Score at 6 month	Frequency	Percent
Score 0 to 19	0	0.00%
Score 20 to 29	0	0.00%
Score 30 to 39	7	35.00%
Score 40 to 48	13	65.00%

Table 4: Progression of Oxford Hip Score			
Oxford Hip Score	Mean	SD	p - value
6 Weeks	26.35	3.453	
3 Months	33.7	3.147	0
6 Months	40	3.095	0

Table 5: Progression of Harris Hip Score			
Harris Hip Score	Mean	SD	p - value
6 Weeks	60.82	6.907	
3 Months	76.14	5.977	0
6 Months	86.72	4.5	0

used (Short or Long PFNA-II), Mode of reduction (Open/closed), Amount of blood loss, Operation time, Intraoperative complications are noted. Three doses of intravenous antibiotics were given post operatively as per protocol. Analgesics are given for pain management. Patient was encouraged to do Hip and knee ROM exercises under the supervision of physiotherapist. Partial weight bearing with the aid of walker was started on immediate post operative day depending on pain tolerance. Suture removal was done on 12-14th days post surgery. Patient was discharged on average of 7-14 days.

Patient was assessed clinically and radiologically on the day of surgery, at 6 weeks, 3 months and 6 months.

The quality of reduction was assessed by comparing the neck-shaft angle of the operated hip, to that of the normal hip on the antero-posterior view [good (< 5°varus/valgus and/or anteversion/retroversion), acceptable (5°-10°), poor (>10°)].

The quality of fixation was assessed using the tip-apex distance. The tip-apex distance (TAD) is the sum of the distances from the tip of the helical blade to the apex of the femoral head on both the AP and lateral X-Rays. These measurements were corrected for magnification by calculating them based on the width of the PFNA-II blade which was constant in all implants. A tip apex distance <25mm prevents screw cut out and was considered adequate [13].

Table 6: Comparison of morphological dimensions of proximal femur anatomy with PFNA and PFNA-II [17].			
Dimensions	Proximal femur	PFNA	PFNA-II
	Mean +/- SD		
Proximal length (mm)	61.1mm +/- 5.2	56/61/65	65.1mm(medial), 79.1mm (lateral)
Proximal diameter(mm)	18.1mm +/- 1.5	16.5mm	16.5mm
AP bending angle	8.4 +/- 2.2	6°	5°
Lateral inclination angle	11.9 +/- 1.1	6°	Flat lateral shape, gradual reduction in diameter
Lateral impingement length (mm)	54.2mm +/- 4.7	56/61/65	No impingement (flat lateral surface)

Measurement of the tip apex distance was done as described by Johnson et al [14].

At each follow-up, hip range of motion, pain in the hip and thigh, walking ability , postoperative complications, including wound infection and pulmonary, cardiovascular, thrombo embolic disorders, fracture complications, including cutout, implant breakage, and revision surgery were recorded.

Healing is judged by Clinical (Pain at fracture site) and Radiological criteria -Bridging callus (3 out of 4 cortices had bridging trabeculae).

Functional outcome is reviewed at each visit according to the HHS (Harris Hip score) and Oxford hip score [15, 16]. Ethical and scientific committee clearance was obtained.

Results

The following observations were made from the data collected during this period. The minimum and maximum age of the patients was 55 and 95 years respectively (Average age was 78.35 years). 16 female patients (80%) and 4 male patients (20%) were included in this study, Mode of injury of all fractures were following domestic fall. Among 20 cases taken for the study, 85.0% of the cases were walking unaided outdoor and 10.0% of the cases were walking unaided indoor only. 5.0% of the cases were walking with stick. 7 patients (35%) had fracture over right side and 13 patients (65%) had fracture over left side. Co-morbidities were noted. Type of fracture according to AO classifications is as follows in (table-1).

Short PFNA-II was used in 11 patients (55%), Long PFNA-II was used in 9 patients (45%). All fractures were reduced by closed method intraoperatively. Average OT time taken was 58.75 minutes and in 70.0% of the cases the average blood loss was 124.5 ml with standard deviation 38.93. Only 3 patients had blood transfusion post operatively.

Mean tip apex distance was 18.51mm, 60% of the cases had TAD <20 mm, rest 40 % had TAD between 20-25mm.

Good reduction was achieved in 85.0% of the cases and in rest of the cases reduction was considered acceptable. Fracture union was achieved after a mean period of 10 weeks. None of the patient had screw cut out, No screw

or implant breakage was seen. The functional results were graded according to Harris Hip Scoring System and Oxford hip score.

The average Oxford hip score at 6 months was 40.00 with standard deviation 3.095. The minimum and maximum Oxford hip score at 6 months was 33 and 44 respectively. 20.0% of the cases have excellent Harris hip score and 75.0% of the cases have good Harris hip score. 5.0% cases with fair/poor Harris hip score were noted. The average Harris hip score at 6 months was 86.72(79.7 - 96.0) with standard deviation 4.500.

The relationship between Oxford hip score, Harris Hip score and reduction found significant with a p-value 0.05. The table reveals that Oxford hip score is significantly higher in good (76.5%) compared to acceptable reduction (0.0%).

Oxford hip score is significantly improved at 3 month (33.70 ± 3.147) and further improved at 6 months (40.00 ± 3.095) compared to the Oxford hip score at 6 weeks (26.35 ± 3.453). Harris hip score is significantly improved at 3 month (76.14 ± 5.977) and further improved at 6 months (86.72 ± 4.500) compared to the Harris hip score at 6 weeks (60.82 ± 6.907).

Most common immediate post-operative complication was electrolyte imbalance (4 patients) followed by post-operative delirium.

There was no incidence of deep vein thrombosis, pneumonia, or cardiovascular complication in the early post-operative period. No patient had complaints of lateral thigh pain. Shortening of 1.5 cm was noted in one patient, none of the other patients had significant shortening. There was no mortality during the study period.

Discussion

Treatment of unstable intertrochanteric fractures remains a challenge. If they are not adequately treated, they may cause a considerable change in the quality of life. Achieving stable fixation in intertrochanteric hip fractures is quite important to enable satisfactory clinical outcomes including early weight bearing in elderly patients with osteoporotic bones.

The biomechanical, deforming muscle forces and poor bone quality due to osteoporosis all together leads to failure of fixation. This resulted in the introduction of various implants, all of which have their specific advantages and disadvantages

Extramedullary fixation like Dynamic Hip Screw and Dynamic Condylar Screw has been used for a long time with great success in stable fractures. However both DHS and DCS require relatively larger skin incision, more tissue handling, all of which increases the probability of infection, blood loss, operating time. Varus collapse of the fracture, non union and implant failure are also commonly seen in unstable fractures.

In 1998 AO/ASIF introduced new cephalomedullary reconstruction nail (PFN) with trochanteric entry port. This nail has shown to be biomechanically stronger than DHS fixation and other extra articular modalities of fixation. Moreover, Proximal Femoral Nails have also reduced the chances of infection, blood loss, morbidity and patients were allowed early weight bearing.

Due to some design flaws of the PFN, the AO/ASIF improved the design of the PFN and introduced the PFNA system in 2003. The gradual increase in diameter of the helical screw blade of PFNA, allows compression of the bone around the femoral head, thereby stabilizing the femur and facilitating antirotation and 39 compressions. However, there are several reported disadvantages with PFNA in short patients with a specific anatomical pattern, challenges with proximal implant geometry, pain in the hip and thigh, femoral shaft fracture, and lag screw cut-out. In an attempt to address some of these challenges, new implants with improved designs named PFNA II were developed for elderly Asian patients.

The PFNA-II was developed as the Asian version of the PFNA to fit into the Asian femoral bone geometry with a smaller femoral neck and intramedullary cavity and a larger anterior bowing. The bending point is higher by 5 mm in the PFNA-II and the valgus angle is 5° compared to the standard PFNA with 60.

The principal aim of this study was to evaluate Harris Hip Score and Oxford hip score of patients with unstable intertrochanteric fractures treated with PFNA-II.

TAD is one of the most important predictive factors for cutout of helical blade. Ideal TAD is <25 mm to prevent cutout [18]. Our study had a mean tip apex distance of 18.51 mm which was <25mm. Geller et al. reported 44% of cut outs in Intertrochanteric fractures fixation with TAD of > 25 mm and no cut out in TAD <25 mm [19]. There were no cases with blade cut out in our study.

There was no intraoperative femoral shaft fractures noted in our study unlike the study by Yaozenget al. who reported 5.6% intra operative femoral shaft fractures in their series

of 107 intertrochanteric fractures [20].

There were no cases with significant intra operative fracture distraction or other major complications in our study.

The clinical samples observed in clinical treatment were relatively small and since it's a short term follow-up study, the long-term complications are not known. Therefore, long term follow-up, larger sample size, multicenteric studies are required.

Conclusion

This study concludes that, the use of the PFNA-II in the treatment of unstable intertrochanteric fractures in elderly patients has many advantages such as a shorter operative time, simpler operative procedure, early post-operative mobilization, high union rate, fewer complication rate and good functional outcome. However it is important to follow proper operative technique in order to attain fracture stability and to avoid major complications.

Clinical relevance

PFNA-II designed suitable for Asian femoral geometry and hence reduces the chance of lateral impingement and other major complications. Although this large multicentre long term studies are required to understands its merits and demerits.

References

1. Dimon JH, Hughston JC. Unstable intertrochanteric fractures of the hip. J Bone Joint Surg Am. 1967; 49(3):440–50.
2. Burge R, Dawson-Hughes B, Solomon DH, Wong JB, King A, Tosteson A, et al. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005–2025. J Bone Miner Res 2007;229(3):465–75.
3. Koval KJ, Aharonoff GB, Rokito AS, Lyon T, Zuckerman JD.Patients with femoral neck and intertrochanteric fractures. Are they the same? Clinical orthopedics and related research. 1996; (330):166-72.
4. Chong CP, Savige JA, Lim WK. Medical problems in hip fracture patients. Arch Orthop Trauma Surg. 2010;130:1355–61.
5. Kaufer H, Mathews LS, Sonstegard D. Stable Fixation of Intertrochanteric fractures. J Bone Joint Surg. 1974; 5 6A:899-907.
6. Monte-Secades R, Peña-Zemsch M, Rabuñal-Rey R, Bal-Alvaredo M, Pazos-Ferro A, Mateos-Colino A. Risk factors for the development of medical complications in patients with hip fracture. Rev CalidAsist. 2011; 26:76–82.
7. Kuzyk PR, Lobo J, Whelan D, zdero R, McKee MD, Schemitsch EH, et al. Biomechanical evaluation of extramedullary versus intramedullary fixation for reverse obliquity intertrochanteric fractures. J Orthop Trauma 2009;23 (1):31–8. 8Ma KL, Wang X, Luan FJ, Xu HT, Fang Y, Min J, Luan HX, Yang F, Zheng H, He SJ. Proximal femoral nails antirotation, Gamma nails, and dynamic hip screws for fixation of intertrochanteric fractures of femur: a meta-analysis. Orthopedics & Traumatology: Surgery & Research. 2014 Dec 1;100(8):859-66.
9. Al-Yassari G, Langstaff RJ, Jones JW, Al-Lami M.The AO/ASIF proximal femoral nail (PFN) for the treatment of unstable trochanteric femoral fracture.Injury. 2002 Jun 1;33(5):395-9.
10. 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): 428-32.
11. Hwang JH, Oh JK, Han SH, et al. Mismatch between PFNA and medullary canal causing difficulty in nailing of the pertrochanteric fractures. Arch Orthop Trauma Surg. 2008;128:1443–1446.
12. Tyagi V, Yang JH, Oh KJ. A computed tomography-based analysis of proximal femoral geometry for lateral impingement with two types of proximal femoral nail antirotation in subtrochanteric fractures Injury.2010;41:857–861.
13. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. JBJS. 1995 Jul 1;77(7):1058-64.
14. Johnson LJ, Cope MR, Shahrokhi S, Tamblyn P. Measuring tip–apex distance using a picture archiving and communication system (PACS). Injury. 2008 Jul 1;39(7):786-90.
15. Banaszkiewicz PA. 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. In Classic Papers in Orthopedics 2014 (pp. 13-17).Springer, London.
16. Murray DW, Fitzpatrick R, Rogers K, Pandit H, Beard DJ, Carr AJ, Dawson J.The use of the Oxford hip and knee scores.The Journal of bone and joint surgery.British volume.

2007 Aug;89(8):1010-4.
17. Tyagi V, Yang JH, Oh KJ. A computed tomography-based analysis of proximal femoral geometry for lateral impingement with two types of proximal femoral nail antirotation in subtrochanteric fractures Injury.2010;41:857–861.
18. Rubio-Avila J, Madden K, Simunovic N, Bhandari M. Tip to apex distance in femoral intertrochanteric fractures: a systematic review. Journal of Orthopedic Science. 2013 Jul 1;18(4):592-8.
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. International orthopedics. 2010 Jun 1;34(5):719-22.
20. Yaozeng X, Dechun G, Huilin Y, Guangming Z, Xianbin W. Comparative study of trochanteric fracture treated with the proximal femoral nail anti-rotation and the third generation of gamma nail. Injury. 2010 Dec 1;41(12):1234-8.

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