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Original Research Article

A comparative study of intertan nail versus proximal femoral nail antirotation in the treatment of peritrochanteric fractures

Pranav Kothiyal*, Kunal Vij, Puneet Gupta, Shashank Sharma

Department of Orthopaedics, Sri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

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***Correspondence:**
Dr. Pranav Kothiyal,
E-mail: kothiyalpranav@gmail.com

ABSTRACT

Background: Over the past decades the incidence of intertrochanteric fractures has increased and there is a universal agreement about the intramedullary nail being the preferred implant of fixation for these fractures.
Methods: In this study we have attempted to assess and compare the results and immediate as well as long term outcome of fractures managed by proximal femoral nail anti rotation and the intertan nail. We included 102 patients in our study, half in the group managed by proximal femoral nail anti rotation group and half in the group managed by intertan nail. Over a period of almost one and half years we evaluated the patients in immediate and late post op period for the union of the fracture, functional outcomes and the short- and long-term complications.
Results: The results were evaluated in the terms of intraoperative variables like fluoroscopy time, mean blood loss and reduction achieved and postoperatively in terms of superficial wound infections and Harris hip score and mobility score of paper and palmer which were comparable for both groups of patients with slight differences in some variables.
Conclusions: We concluded that the intertan nail is a good option for fracture fixation in patients with unstable intertrochanteric fractures and though associated with a steeper learning curve it has lesser complications and slightly better functional outcomes as compared to the proximal femoral nail anti rotation.

Keywords: PFNA2, Intertan, Peritrochanteric

INTRODUCTION

A trochanteric hip fracture occurs between the greater trochanter, where the gluteus medius and the gluteus minimus (hip extensors and abductors) attach, and the lesser trochanter, where the iliopsoas (hip flexor) attaches.[1,2] According to the epidemiologic projections, this worldwide annual number will rise to 6.26 million by the year 2050. This rise will be in great part due to the huge increase in the elderly population of the world.[3,4] As most patients are elderly treatment must be rapid to allow immediate postoperative weight bearing.[5] With evidences in support of intramedullary fixation, a large number of implants are available (e.g., gamma nail, InterTAN, PFNA).[6,7] PFNA (AO/ASIF) was developed especially for elderly patients to negate the Z effect complications as it has a single helical neck blade with a large surface area, for better purchase in osteoporotic bone. Helical blade avoids bone loss during drilling, permits antirotation, radial compaction of cancellous bone during insertion.[8] Increased stability caused by bone compaction around the PFNA blade has been biomechanically proven to retard rotation and varus collapse. Despite of all these mechanical advantages, few complications have been reported in few studies, ranging from lateral blade migration, lateral cortex splitting, shaft fracture, hip and thigh pain especially in Asian patients.[9,10] Concerned with these complications a newer nail PFNA II has been introduced with flat lateral shape and thereby reducing the chances of impingement of lateral proximal femoral cortex.[11] On the other hand

InterTAN (Smith & Nephew) uses two lag screws in an integrated mechanism, which allow linear intraoperative compression and rotational stability. The main design features of InterTAN are as follows: proximal square cross-sectional design, which avoids the pressure on the femoral lateral wall with a 4° valgus angle suitable for the anatomic features of the Asian femur.[2] It has lag screw (11 mm) and a compression screw (7 mm), and when the two screws integrate, they produce an alignment pressor effect within the fracture, the unique tail bifurcation design can effectively disperse far-end stress and reduce the morbidity of femoral shaft fractures.[3,13]

A recent biomechanical study carried on fresh specimens of the proximal femur goes in favour of InterTAN which has a firmer and biomechanically superior performance than PFNA. However the in-vitro study does not take in consideration the effect of osteoporosis on implant stability, additional in- vivo studies are required to analyze clinical outcomes after fixation of intertrochanteric fractures to comprehensively characterize the effects of the design enhancements of these two implants.[13] To our knowledge, there has been little research on the comparison between InterTAN and PFNA for management of intertrochanteric fractures therefore a prospective study is carried out to report clinical and radiological outcome in Indian patients with intertrochanteric fractures.

METHODS

Our study was a non-randomized comparative type of observational study in which we created two groups of patients afflicted with the same condition and managed one group by fixation with PFNA2 and other group by fixation with intertan nail and then we followed then clinically and radiologically for outcome.

Place and duration of study

The present study was carried out from April 2020 to November 2021 at Sri Guru Ram Rai Institution Medical Sciences Dehradun, Uttarakhand, India. Patients were operated in this duration for intertrochantric fractures with various modalities of treatment using DHS, PFN, PFNA and InterTAN.

The inclusion criteria were: recently sustained closed intertrochanteric fractures (AO/OTA type 3.1A1.1-A2.3) in patients of age group more than 60 years who were walking independently without any equipment before the fracture.

The exclusion criteria were: all patients having pathological fractures, open fractures and multiple fractures; inability to walk before sustaining the fracture, and patients suffering from severe medical co-morbities.

The interTAN is a titanium nail with a 4^0-lateral offset with a trapezoidal proximal end and has a diameter 15.25×16.25 mm at the proximal end. The proximal end of the nail accepts 2 cephalo-cervical screws at 125^0-130^0 optional neck angle. The larger superior 11-mm lag screw and a smaller 7-mm compression screw integrate with each other and has the effect of creating an oval screw with a composite diameter of 15.5 mm. InterTAN comes with optional distal diameter and the distal end has a clothespin tip for stress modulation in the femoral shaft.

The PFNA II is an Asiatic modification with 5^0 mediolateral angle with lateral flattened surface with a helical blade.

Procedure

A total of 102 patients, treated using InterTAN (52) and PFNA II (50) were included in the study. Surgery for both the groups that is PFNA2 and intertan was done as per standard protocols for routine elective surgery. All the patients received a prophylactic antibiotic pre and intraoperatively in the form of 1.5 gm of cefuroxime intravenously.

Nailing was done in supine position on the fracture table after achieving closed reduction and confirmation under fluoroscopy. The surgical steps as defined in the protocol by the implant manufacturers were followed as they were mentioned. The first step of surgery was making of the entry point of the nail followed by guide wire passing and sequential reaming of medullary cavity by reamers of successively increasing size. After this was done nail of adequate size was passed over the guide wire and finally the proximal and distal locking was done. Distal locking was done by screw placement in the static slot. Vaccusuction drain was not placed in any case and no use of bone graft, autologous or synthetic was done. Use of fluoroscopy was made throughout the surgery to confirm the position of the nail, the proximal and distal screws. Post-operatively the patient was kept in post op room for 6 hours with administration of I.V. fluids, antibiotics and blood transfusions if required along with vital monitoring. After this time period the patients were shifted to the ward and 3 hourly vital monitoring and medications as prescribed were administered.

On the next day of surgery, the patients were allowed to stand with full weight bearing with a walker support and gait training assisted by a physiotherapist was started. Active ROM knee and hip started as per tolerance of patient. Prophylactic antibiotic coverage was continued for 48 hours. Plane skiagrams were ordered at the time of discharge to analyze fracture reduction and implant position. Patients were followed for a minimum of 6 months to 1 year. The intraoperative variables evaluated were duration of surgery, the estimated blood loss and number of blood units transfused. Adequacy of fracture reduction was evaluated using the criteria proposed by Baumgaertner modified by Fogagnolo et al the position of lag screws were evaluated using TAD, and the Cleveland index.[14-17]

Figure 1: Intertan nail with a clothespin tip and a trapezoidal proximal end.

Figure 2: Proximal femoral nail antirotation attached to the zig.

Table 1: Modified criteria proposed by Baumgaertner for adequacy of fracture reduction.

Criteria	Parameters
Alignment	
AP	Normal cervico. diaphyseal angle or slight valgus
Lateral	Less than 20^0 of angulation
Displacement of main fragment	More than 80% overlapping in both planes; less than 5 mm of shortening
Good	Both criteria met
Acceptable	Only one criterion met
Poor	Neither criterion met

The two groups were given similar pre and postoperative care. Both groups were compared via surgical time, fluoroscopy time, blood loss, hospital stay in days and intraoperative complications. Postoperative clinical outcome was evaluated in terms of hip and knee range of motion, pain in hip and thigh, Harris hip score, complications in terms of superficial to deep wound infection. Systemic complications from pulmonary, cardiovascular or thromboembolic were recorded. Radiologic outcomes were evaluated using time to bony union, fracture complications including implant failure, change in TAD, sliding distance of cervical screw, breakage and implant cutout were recorded. Capability of mobility and function were assessed by 'mobility score of Parker and Palmer' and 'social score of Jensen'.[18-19] Bony union was defined as evidence of bridging callus or cortical continuity in at least two cortices in AP and lateral views.[20]

Figure 3: Pre op X-ray of a 50-year-old female patient showing a unstable intertrochanteric fracture.

Figure 4: Immediate postop X-ray of the same patient managed by Intertan nail.

Ethical approval

The proforma of the study was reviewed by the ethical committee of Sri Guru Ram Rai Institute of Medical and Health Sciences and approval was given after establishing that the study was to be done in accordance with the guidelines of declaration of Helsinki.

Data analysis

Statistical evaluation was done using statistical package for the social sciences (SPSS) software version 22.0.

Quantitative and qualitative variables were analysed using student 't' test and chi square test respectively. The p value of less than 0.05 were considered to be statistically significant.

Figure 5: 6 months post X-ray showing consolidation at the fracture site.

Figure 6: 12 months post op X-ray showing union of the fracture.

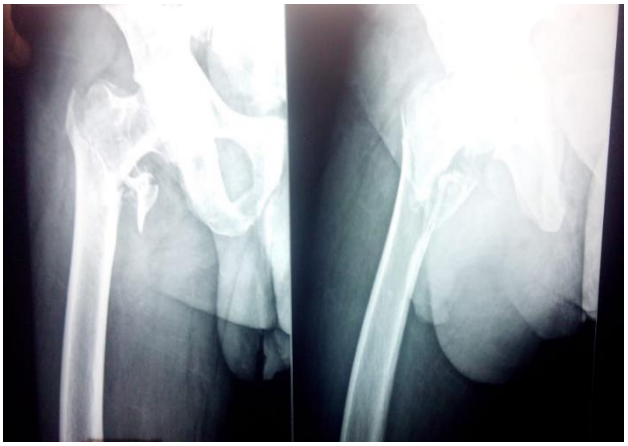

Figure 7: Pre op X-ray of another patient with a comminuted inter trochanteric fracture.

Figure 8: Immediate postop X-ray after fixation with proximal femoral nail anti rotation.

Figure 9: 6 months follow-up of the same patient showing some callus formation at the fracture site.

Figure 10: 12 months follow-up showing union at the fracture site.

RESULTS

There was statistically no difference between various preoperative variables as shown in. Mean operative (p=0.011) and fluoroscopy (p=0.012) time were significantly longer in the InterTan group. Intraoperatively a total of 28 cases required open reduction, 12 in PFNA II and 16 in InterTAN group. Few intraoperative

complications like femoral shaft fractures were recorded in 8 patients, 4 in the InterTan group and 4 in the PFNA II group. Both the cases were managed by longer nail. A total of 28 lateral trochanter splits were encountered, 16 in PFNA II group and in 12 cases of InterTAN group. All splits were minor and undisplaced and were managed without any special intervention. Few technical difficulties occurred in both groups in terms of ease of insertion, lag screw measurement error which was managed by re-reaming and change of lag screw. Postoperatively patients were instructed for regular follow up till 1 year. Out of 102 patients 12 patients were not available for follow up at 1 year. Postoperatively 2 patients operated by InterTAN died in intensive care unit within first week of surgery due to thromboembolic phenomenon. 6 more patients were readmitted in intensive care units within 6 months but all were revived. Mean time to fracture union was 15 weeks for InterTAN and 19 weeks for PFNA II.

The Harris hip score in the initial 1 to 3 months was similar for the patients in both groups however after 3 months the HHS improved in patients managed by PFNA2 and the mean HHS at final follow-up at the end of 4 years was higher for patients managed by PFNA2. The mobility score of Parker and Palmer showed similar trend however there was not much difference in the score values at final follow-up.

The progress of bone union was monitored at all follow up visits and union were said to be achieved once a solid callus was evident at the fracture site in AP and LAT views.

Table 2: Preoperative variables.

Variable	PFNA II (n=52)	InterTAN (n=50)	P value
Gender M/F	28/24	28/22	
Age in years (mean±SD)			
Side (L/R)	26/34	24/26	
Mode of injury			
Fall/slip at home	28	26	
Fall/slip outside	20	22	
Road traffic accident	4	2	
A.O classification			
31A1	14	12	
31A2	30	32	
31A3	8	6	
Preoperative HHS (mean±SD)	55.3±8.6	56.7±7.8	

Table 3: Intraoperative variables.

Variables	PFNA II (n=52)	InterTAN (n=50)	P value
Mean operative time (min)	58.7±10.4	79.9±11.8	0.04
Mean blood loss (ml)	87±5	86±6	
Mean hospital stay (d)	10.83±1.41	11.13±1.25	
Fluoroscopy time (min)	2.8±0.16	3.6±0.18	
Open reduction	12	16	
Reduction results (n)			
Anatomical	40	40	
Acceptable	12	8	
Poor	0	2	
Position of the distal end of implant (n)			
Medial	2	2	
Central	48	46	
Lateral	2	2	
Femoral shaft fracture	2	2	
Lateral trochanteric split	8	6	
Position of lag screw			
Central-central	40	36	
Posterocentral	8	4	
Inferocentral	4	0	
Anterosuperior	0	2	

Continued.

Variables	PFNA II (n=52)	InterTAN (n=50)	P value
Superocentral	0	8	
TAD (mm)	25.8	27.3	

Table 4: Postoperative analysis.

Complication	PFNA II (n= 52)	InterTAN (n=50)	P value
Superficial wound infection	4	2	
Wound hematoma	6	2	
Thigh pain	14	4	
Femoral neck shortening (mm)	2.2±0.54	2.6±0.31	0.02
Cardiovascular disorder	4	2	
Deep venous thrombosis	0	2	
Pulmonary embolism	0	2	
Urinary tract infection	2	2	
Bed sore	4	2	
Change of TAD	5	0	
Implant cut out	4	0	
HHS at 4 years	Mean score: 93.4	Mean score: 89.6	<0.05
Parker and Palmer score at 4 years	Mean score: 8.9	Mean score: 8.9	<0.05

Table 5: Mean values of Harris hip score and mobility score of Parker and Palmer over a follow up of two years.

At 6 months	At 12 months	At 18 months	At 24 months	At 36 months	At 48 months
Mean Harris hip score					
PFN2-80.4	84.14	90.6	91.2	93.33	93.4
IT nail-79.6	83.15	85.0	87.34	89.12	89.6
Mobility score of Parker and Palmer					
PFNA2- 7.2	8.0	8.8	8.9	8.9	8.9
IT nail-6.4	7.4	8.8	8.9	8.9	8.9

The p value was found to be <0.05 which indicated that the data was statistically significant

DISCUSSION

Fractures around the peritrochanteric region always compels the surgeon to take a second thought regarding the choice of implant for fixation. The stresses in this region are high along with a large number of deforming forces that often lead to post-surgical complications. In the follow up time period of this study that was more than two years we compared the outcomes of intertrochanteric fracture fixation by intertan nail and PFNA2.

We followed up our patients in this study for a period of two and a half years and the outcomes were reflected in the form of a improved Harris hip and Parker and palmer score. Most of the patients had satisfactory outcomes after surgery however there were differences in the outcomes of the patients managed by IT nail and PFNA2.

The third-generation nail called the proximal femoral nail was introduced as a load sharing device working on the principle of controlled collapse.[21] However, the PFNA2 has been associated with complications like screw cutout, various collapse and implant related problems. The learning curve for it is however short and the fixation can be achieved with less soft tissue dissection.

The INTERTAN nail on the other hand is a recently introduced implant and there are claims regarding its increased stability and resistance to screw cutout. Other features of this nail include interlocking head screws and slits at nail end that prevent shaft fractures later on.[22] However IT nail has drawbacks when it comes to implant costs and learning of operative skills.

We operated 102 patients with intertrochanteric fracture and followed them for two and half years. The patients were evaluated over the above-mentioned period under various criteria and we found that PFNA2 had a few advantages and certain disadvantages over IT nail. Overall, the results were comparable and the patients in both groups had slight differences in pain scores. Similar results were shown by Zhang et al where they found PFNA2 slightly better as compared to IT nail.[23]

Intraoperative variables like mean operative time, blood loss and fluoroscopy time were compared in both groups and it was seen that the operative and fluoroscopy time were more for the patients managed by IT nail whereas the blood loss was slightly higher in patients managed by PFNA2. This could be attributed to the fact that the IT nail has a trapezoidal end which is difficult to insert into the

femoral canal especially in the isthmus region hence requiring repeated manipulations and also because the IT nail is a relatively new implant with a difficult learning curve.

Postoperatively wound related complications like superficial wound infections and persistent haematoma were seen with a increased frequency in patients managed by PFNA2 even though the operative time was less. Delayed post-op complications like deep vein thrombosis and two cases of pulmonary embolism were seen in patients managed by IT nail.

More extensive soft tissue dissection in PFNA2 patients as compared to patients managed by IT nail could be the reason for slightly increased incidence of infection.

The functional and radiographic outcomes were evaluated for all the patients according to Harris hip score and mobility score of parker and palmer values. The mobility score of Parker and Palmer was initially slightly higher for the PFNA2 group but at two years of follow-up the score was similar. The Harris hip score showed a trend similar to the parker and palmar score in the list year after surgery but the improved HHS was consistent in the PFNA2 group even at two years of follow-up.

Thus, we found that the patients managed with PFNA2 had better functional outcomes as compared to the IT group. This was in contrast to the study done by Yu et al that showed that both the IT nail group and the PFNA2 group did not show much differences in outcome.[24]

The patients managed by PFNA2 had higher incidence of thigh pain in follow-up as compared to IT nail. This could be attributed to the fact that the distal end of the IT nail has a clothespin tip which modulates the stress at the tip of the implant in the distal femoral canal decreasing chances of thigh pain.

The mean time for union which was decided by visualization of bridging callus in both AP and LAT skiagrams was found to be slightly higher in the group of patients managed by PFNA2 as compared to the patients managed by IT nail. The reason behind this could be the hybrid worm-gear mechanism of IT nail that converts rotational displacing forces at the fracture into compressive forces.

Change in TAD and screw cut out were seen in a few cases only in patients managed by PFNA2. The reason for this could be due to the fact that early weight bearing soon after the surgery was allowed owing to the snug anatomical fit and good bone purchase of the helical blade in the femoral head and neck. Also, the two anti-rotation screw of the IT nail are placed in the inferior neck where it gives good resistance against load failure, varus displacement and screw migration.

Similar results of screw cutout were reported by Takigami et al with an incidence of 2% which he attributed to inadequate screw length and immediate weight bearing postoperatively.[25]

Certain limitations of our study were that we could have conducted it for a longer period of time with a bigger sample size to avoid errors.

The patients were selected without randomization and various factors that might cause confounding and bias by the doctor patient interactions are also limiting factors of this study. Despite these limitations the study does provide statistically significant data regarding outcome of patients with peritrochanteric fractures managed by PFNA2 or Intertan nail.

CONCLUSION

With our study we concluded that the intertan nail is a good option for fixation of peritrochanteric fractures. Specially for unstable intertrochanteric fractures the IT nail provides a good stable fixation with less complications as compared to PFNA2. Although being a relatively new implant the learning curve is more so the operative time for fracture fixation by IT is more as compared to the PFNA2 but overall, it can be considered as good alternative to the PFNA2 with lesser complications.

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