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Our experience of managing intertrochanteric fractures in osteoporotic patients with trochanteric femoral nail (TFN) and proximal femoral anti-rotation augmentation nail (PFNA2)

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Abstract

Introduction: Managing intertrochanteric fractures, especially the unstable variety has often been a challenge to the orthopaedic surgeon. However there is little data available when comparing the Trochanteric femoral nailing (TFN) and the Proximal femoral antirotation augmentation nail (PFNA2), especially in the background of an osteoporotic population.

Aim: To compare the outcome of management of intertrochanteric fractures fixed with TFN and PFNA2 in the setting of osteoporosis.

Materials and Methods: From June 2016 to October 2019, 40 cases of both stable and unstable intertrochanteric fractures were managed with TFN and PFNA II were followed prospectively. Postoperatively clinical and radiological outcomes assessed by tip-apex distance, union rate, Harris hip score, Singhs index. Patients were followed up for a period of six months.

Result: This study was done in 40 patients with both stable and unstable intertrochanteric fractures, of which 20 of them managed with TFN and 20 managed with PFNA2. The most common mode of injury was a trivial fall followed by RTA. Fracture pattern segregated under Boyd and Griffin classification and majority of patients were found to fall under Type 2. Patients operated with PFNA2 had an average hospital stay of 15.2 days and 16 days for TFN. Patient was allowed to weight bear fully at 12.6 weeks in TFN and 12.2 weeks in PFNA2 averagely. Visible marked Union in X-rays was noted around 12-14 weeks in both TFN and PFNA2. Excellent results were found in about 90% of cases in PFNA2 group and in 85% of cases in the TFN group. The average Harris Hip Score was 84.57 and 86.56 in TFN and PFNA2 groups ($p=0.54$) respectively among patients with Singh's grade 3, 2 (25%) in TFN group suffered from implant related complication whereas all 13 patients in PFNA2 group had successful outcome ($p=0.04$).

Conclusion: In our study, PFNA2 is a technically and biomechanically more stable than TFN in the management of intertrochanteric fractures in setting of osteoporosis. Hence, we highly recommend use of the PFNA2 for the treatment of intertrochanteric fractures.

Keywords: Intertrochanteric fractures, PFNA2, TFN, 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^[13]. 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. Even though Trochanteric femoral nail (TFN) is a very good implant in the management of unstable intertrochanteric fractures, it has shown to be less effective in managing reverse oblique type of fractures, fractures with subtrochanteric extension and in setting of osteoporosis^[1, 2, 3]. This is where the importance of Proximal Femoral Antirotation Augmentation nail comes into play. PFNA2 has shown to be an effective implant in managing these type of fractures because of its variable

nail length, single strong helical blade and a valgus angulation of the nail which is tailor made for the Asian population and patients with onset of osteoporosis [4, 5]. The helical blade is said to increase the bone-implant interface and result in compaction of cancellous bone, thereby providing excellent stability of fixation which is the key factor in preventing malrotation and a varus collapse [11, 12, 13]. This is not seen in a conventional TFN which is attributed to the reaming out of the cancellous bone resulting in loss of cancellous bone, a delayed union and varus collapse whereas there is preservation of the cancellous bone in PFNA2 which resists the malrotation and varus collapse in osteoporotic bones [8]. This prospective study was carried out to compare the clinical and radiological outcomes and complications of a single screw construct (PFNA2) versus a double screw construct (TFN) in the treatment of intertrochanteric fractures in the setting of osteoporosis [9, 10].



Fig 1: TFN

Fig 2: PFNA 2

Materials and Methods

From June 2016 to October 2019, 40 cases of both stable and unstable intertrochanteric fractures were managed with both

TFN and PFNA2 were followed prospectively after obtaining appropriate approval from the institution’s ethical committee. There were men and women with mean age of 60.58yrs in TFN group and 65.7yrs in PFNA2 group (Range, 35 - 90). Right hip was involved in 11 patients and left in 9 patients in the PFNA2 group and 9 right and 11 left in the TFN group. Most common mechanism of injury was a trivial fall and the most common type was Boyd and Griffin Type 2. The patients were operated within one week from date of injury. 19 cases underwent closed reduction internal fixation and 1 case with open reduction internal fixation in the PFNA2 group and 16 cases underwent closed reduction and 4 cases had to be fixed open in the TFN group. Average operative time (Skin to Skin) was 61 minutes (range 40 - 90 minutes) in the PFNA2 group and the average operating time was 67 minutes (range 45-90 minutes) in the TFN group. Prophylactic antibiotics were administered on the day of surgery one hour prior to skin incision. Preoperative and postoperative hemogram and data regarding blood transfusion were noted. The adequacy of reduction was measured by taking the neck-shaft angle of the operated hip and comparing it to that of the contralateral normal hip on the antero posterior radiograph. Reduction was said to be good if there was a variation of less than 5 degrees between the two hips, reduction was said to be acceptable if the variation was between 5-10 degrees and poor if it was more than 10 degrees. The quality of fixation was assessed using the tip-apex distance (TAD). A TAD<25 mm was considered to be protective in view of preventing a screw cut-out. A centre or postero-inferior placement of the compression screw or helical blade was considered adequate. The Harris Hip score was assessed at every follow up and improvement of the patient’s functional ability was monitored. Complications like infection, screw cut out, screw loosening, varus collapse, shortening, nail mismatch and anterior thigh pain was monitored in both groups of patients.

Table 1: Demographic data and patient distribution of the two groups.

Variables	TFN (20)	PFNA 2(20)
Average age (in years)	60.58	65.7
Gender Distribution Males	9/20	11/20
Females	11/20	9/20
Number of patients with Boyd and griffin type 2 fractures	6/20	7/20
Number of patients with significant osteoporosis (Singh’s index 3)	8/20	11/20
Distribution by Singh’s grade in those with significant osteoporosis		
Grade 3	6 (75%)	9 (69.2%)
Grade 2	2 (25%)	3 (23.1%)
Grade 1	0 (0%)	1 (7.7%)

Patient operated with PFNA 2

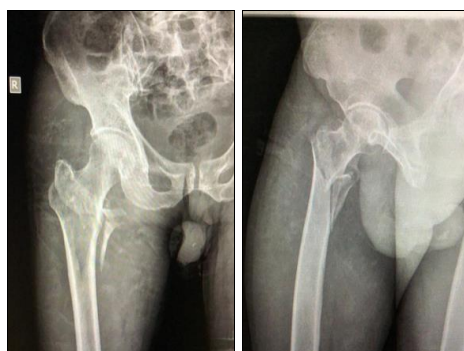


Fig 3: Pre-operative images



Fig 4: Immediate post-images

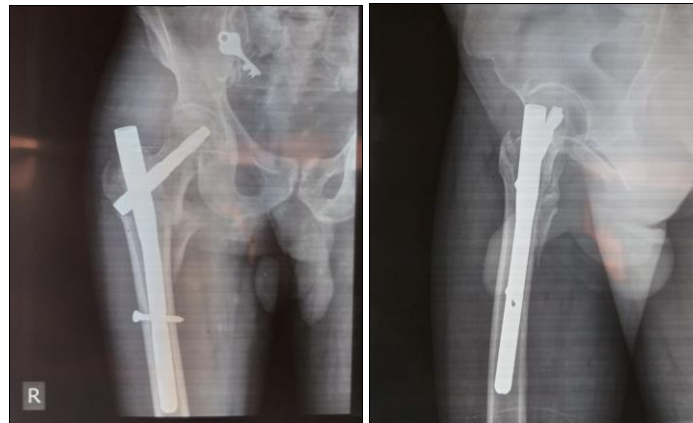


Fig 5: 6 months follow up x-rays of patient operated with PFNA 2



Fig 6: Pre-op, immediate post op and follow up after 6 months of intertrochanteric fracture fixed with TFN respectively.

Results

Of 40 patients with intertrochanteric fractures, 20 were treated with TFN and the other 20 with PFNA2. The mean age group of the TFN group was 60.5years (30-90 years) and that of the PFNA2 group was 65.7 years (37-96 years).

Comparison of reduction and quality of fixation

Good fracture reduction achieved in 18 patients and fair reduction in 2 patients in the TFN group. In the PFNA2 group 18 patients had a good reduction and acceptable reduction was seen in 2 patients. Screw loosening and screw cut out occurred in 2 cases with good reduction of which both of these were from the TFN group.

Table 2: Comparison of TFN and PFNA2 groups in terms of quality of fixation, functional outcomes and complications.

Parameters	TFn (20)	PFnA2 (20)	p-value
Percentage with tip-apex distance (TAD) 25 mm	4 (17.4%)	8 (32%)	0.32
Percentage with sub-optimal position (as per Cleveland index)	4 (17.4%)	8 (32%)	0.32
Average postoperative Harris hip score	84.57	86.56	0.54
Complications (overall)	2 (8%)	2 (8)	0.04
Complications (in patients with Singh’s index 3 or less)	2(25%)	0 (0%)	0.06

Tip-apex distance: The mean TAD for both groups was within the normal limit of 25 mm. It was 19mm for the TFN group and 18.5mm for the PFNA2 group. In one cases of TAD > 25 In the TFN group had a screw pull out (z effect). No cases of screw pull out or implant failure was noted in our study.

was found to be 13.6 weeks and mean time for fracture union was found to be 12.9 weeks.

Time for Union: The radiological assessment of union of intertrochanteric fractures were done at 1, 2 and 6 months follow up. The mean duration of fracture union in TFN group

Complications: Out of 20 patients operated in the TFN group, "Z" effect (pull out of proximal derotation screw) was seen in 1 patient, screw cut out seen in 1 patient where as in PFNA2 group nail mismatch was seen as a complication in one patient and one patient got infected as she was immunocompromised. No implant loosening was seen in PFNA2 group when compared to TFN group.

Table 3: The number and type of implant related complications encountered with both devices.

Complications	Group		Total
	TFN	PFNA2	
Screw/blade cut out	1	0	1
Screw back-out	0	0	0
Medial migration or reverse Z effect	0	0	0
Z effect	1	0	1

Implant breakage	0	0	0
Nail mismatch	0	1	1
Infection	0	1	1
Total	2	2	4



Fig 7: Z" effect and screw pull out in a patient operated with TFN

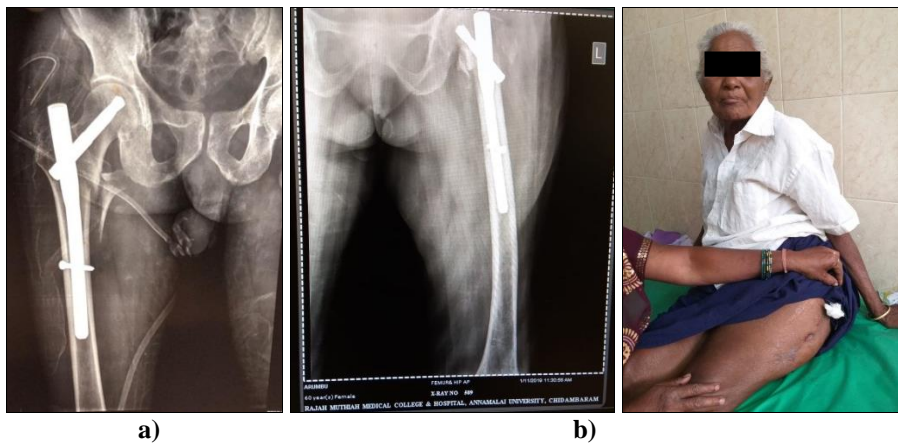


Fig 8: a) Nail mismatch in PFNA2 at the proximal end b) 1 patient developed post operative infection with PFNA 2

Harris hip score

The mean Harris Hip Score obtained at the end of final follow up was assessed in both TFN and PFNA2 groups. At the end of 6 weeks of follow up, the harris hip score of TFN was

82.18 and PFNA2 was 84.76. Further improvement in harris hip score around 84.57 was seen in TFN group and 86.56 in PFNA2 group was seen at the end of 20 weeks. The PFNA2 group had early rehabilitation and weight bearing.



PFNA2 a) at 6 months flexion and extension



b) at 8 months squatting



TFN a) at 6 months flexion b) at 8 months squatting

Fig 9: Range of Movements

Discussion

Treatment of intertrochanteric fractures superadded with osteoporosis is a challenge in the community of orthopaedic surgeons. Screw pull out in a dual screw design due to osteoporosis in old age is the most common cause of implant failure [8]. Clinical studies have also shown that osteoporosis is associated with inferior outcomes in intertrochanteric fractures [6]. Various nail designs and augmentation techniques introduced in market to enhance the fixation in both stable and unstable intertrochanteric fracture. Selecting an ideal implant for these patients with osteoporosis is a challenge for showing functional outcomes. In view of this helical blade device introduced in PFNA2 for osteoporotic bones [7]. While introducing the helical blade inside the proximal femur the cancellous bone is retained thus the bone stalk is preserved. This is the main reason behind prevention of complications such as varus collapse and rotational stress [11]. This cancellous bone stalk within the proximal femur offers significant resistance to the implant and increases the purchase in the bone and also augments bone healing and better union rate [16]. This study compares TFN and PFNA2 implants in both stable and unstable intertrochanteric fractures in osteoporotic setup. In this study PFNA2 is used in slightly older patients (Mean age group 65.5) when compared to TFN (Mean age group 60.5). Our results show no statistically significant differences in the functional outcomes between the two implants as determined by the Harris Hip Score but a significantly lower complication rate overall.

The data that we obtained from our study is comparable with studies conducted by others using same construct More A *et al.* [10] found out that there is a decreased incidence of screw cut out with the use of a single helical blade construct when compared to dual screw system in setting of osteoporosis. This was further confirmed by our studies where there is an incidence of screw cut out loosening in TFN group whereas no such complications were seen in PFNA2 group on the contrary Park JH *et al.* [11] concluded that the overall functional outcome scores range of motion were drastically better with the use of helical blade device. In another study conducted by Gardenbroek *et al.* [12] they came to conclusion that the incidence of secondary, late complications and resurgery were significantly more with the use of dual screw construct when compared to helical blade device.

Numerous advantages of helical blade over a dual construct that are presently reported in various papers include easy insertion decreased operative time and minimal fluoroscopic exposure [13, 14]. Our comparison also depicts the same where the mean operating time in TFN group was 67mins whereas

for PFNA2 group was 61. Our study also concluded relatively decreased blood loss or need for transfusion with the use of either system. Stern R *et al.* [16] analysed the use of a single screw system improves the positioning of the screw in the head of femur and concluded that there was no significant difference in positioning the implant whether a nail or blade is used. In our study there was no difference in the optimal positioning of the implant whether a helical blade or screw was used which supports the previous study.

In our study out of 20 patients operated with TFN one patient suffered screw pull out and 1 patient suffered screw cut out. No helical blade pull out or cut out witnessed in all 20 cases operated with PFNA2 indicating a better purchase of the helical blade into the osteoporotic bone. This signifies that the cancellous bone stalk retained, offers resistance to the helical blade construct ensuring decrease implant failure. Due to the short period of follow up (Minimum nine months), we cannot comment on the long term complications, if any, of these implants. Our use of the Singh's index rather than a Dual Energy X-Ray Absorptiometry (DEXA) scan to assess osteoporosis was due to financial constraints and makes our inference of the effect of osteoporosis on the performance of these implants subjective.

Conclusion

We conclude that once the fracture is reduced and aligned adequately, the union rates are similar in both the TFN and PFNA2 groups. However the mean union time was slightly better in the PFNA2 group because of its capability of preserving the cancellous bone which helps in augmentation of the union and early rehabilitation post-operative mobilisation. The functional outcomes at the end of 6 months was marginally better in the PFNA2 group which could be attributed to the efficacy of a single strong helical blade construct when compared to a dual screw design like the TFN in setting of osteoporosis.

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