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Original Research Article

# Comparative & Prospective Analysis of Unstable Trochanteric Fractures Fixed with PFN vs PFN AII: A Prospective Observational Study

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**Conflict of interest: Nil**

**Abstract**

**Introduction:** Intertrochanteric fractures (IT) also referred to as peri trochanteric fractures, possess a huge burden on elderly individuals, due to their increased prevalence. Several modalities of operative procedures are in place, with varying results.

**Aims and Objectives:** To assess the functional outcome such as intraoperative time, intraoperative blood loss, fracture Union duration, hip range of motion, Harris hip score and complications of unstable trochanteric fractures managed by Proximal Femoral Nailing Anti-rotation II (PFN AII) against Proximal Femoral Nailing (PFN).

**Methods:**

**Design:** Prospective observational type

**Study duration:** Two years

**Study tool:** using a semi-structured pre-tested that included Hip Harris Score

**Data analysis:** Data was analysed using SPSS version 20. The comparison of Hip Harris Score was compared between the PFN and PFN A-II across the follow-up months, while the comparison of other parameters was done between PFN and PFN A-II groups. A p-value of less than <0.05 was considered statistically significant.

**Results:** We included around 20 patients who had Boyd and Griffin types II-1V closed fractures. We observed that there was a significant difference in time taken for operation, amount of operative blood loss and time taken for union between the groups with PFN A-II having better results. (p value<0.05) We did not observe any difference with respect to HHS distribution, while thigh pain was more commonly seen in the PFN group (p-value 0.02)

**Conclusion:** Thus, PFN A-II can be considered as a vital option for IT fractures among elderly individuals who need surgical correction when compared to PFN.

**Keywords:** Fractures, intertrochanteric femur, PFN, PFN A-II, Harris Hip Score Elderly, Postoperative complications, Closed fractures, Blood loss, Intraoperative time.

## Introduction

Intertrochanteric fractures (IT) are also known as peri trochanteric fractures, which comprises fractures involving enclosing and adjacent areas between extracapsular basilar neck to femur's lesser trochanter. These fractures are commonly seen affecting the elderly population, especially following low energy trauma like accidental falls at home, owing to weakened osteoporotic bones. [1] It can also be seen among the younger population of it involves a higher velocity trauma like road traffic accidents. Of late, the incidence of these intertrochanteric fractures has risen enormously and is now estimated that these fractures account for around 1/3rd of all hip fractures. [2] A report by Gill *et al* has estimated that >50 years males have 5.6% lifetime risk of attaining this fracture, while >50 years women have almost 20% risk of developing such fractures in their lifetime. [3]

Operative treatment options for intertrochanteric fractures had always been ever-changing and evolving. Due to the high burden of such fractures and the need for surgical treatment, operative procedures for IT fractures had always remained the most performed surgeries worldwide. Several modalities of operative procedures are in place, with varying results. The choice of implants for the same has also evolved over time. Furthermore, the high cost of surgery, rate of functional recovery during follow up, increased post-op morbidity and mortality among the elderly population has always posed huge constraints. Even for the operating surgeon, it poses several issues such as high incidence of implant failure, lower and delayed post-operative recovery, and higher risk of unstable reduction. [4]

Proximal femoral nailing has always remained the first-line treatment in treating unstable intertrochanteric and subtrochanteric fractures. Of late, reduction of such unstable fractures with implants that allow early mobilisation and weight-bearing are advocated. Several recent studies have debated the use of extramedullary and intramedullary implants.[5] Recently studies have shown that a single helical blade proximal femoral nailing PFNA2 is considered to be better for treating the Asian population due to the smaller length of the femur. Biomechanically also it is noted that helical blades have better cut out resistance levels when compared to screws.[6,7]

In addition, PFN has now seen newer advancements such as anti-rotation type I and II, each having its own advantages with respect to biomechanical properties and stability. Research articles comparing the functional outcome of PFN with PFN AII are sparse, especially from a south Indian setting. Thus we aimed at assessing the functional outcome such as intraoperative time, union duration, hip range of motion, blood loss, Harris hip score, local and wound complications of unstable trochanteric fractures managed by Proximal Femoral Nailing Anti-rotation II (PFN AII) against Proximal Femoral Nailing (PFN) among cases admitted to our tertiary care centre.

## Methods

### Study design, setting and participants:

We did our study as a prospective observational type, where we selected 20 patients conveniently (10 were operated with PFN and the other ten were operated with PFN AII) with the inclusion criteria age more than 50 years, unstable trochanteric (Boyd and Griffin types II-1V), closed type fractures, with Singh's osteoporotic index ≤ 3, admitted to the orthopaedics department of Govt Rajaji Hospital, Madurai, Tamil Nadu. We excluded patients having compound fractures, that are stable, and patients having ipsilateral lower limb injuries, severe

osteoarthritis of the knee joint and having neurological comorbidities. We did this study over a period of 2 years (Aug 2017- Sept 2019).

**Study tool:**

We collected data using a semi-structured pre-tested questionnaire which included 4 domains i) demographic details ii) examination details and radiological findings ii) pre-operative assessment and iv) post-operative assessment. We collected clinical details and radiological investigations including x rays.

**Study procedure:**

The study stared after obtained the Ethical approval from the IEC, and after obtaining informed consent. The pre-operative evaluation among the patients included a full clinical examination, biochemical investigations such as complete hemogram and blood grouping. And X-ray (anteroposterior view of the pelvis). Patients requiring IV fluids and blood transfusion were managed according to their hemodynamic status. Upper tibial pin traction was also done to immobilize and maintain the alignment and length of the fractures. Computed tomography (CT) of Hip and proximal femur was done wherever necessary to access the fracture pattern precisely, following which the fractures were classified using Boyd and Griffin classification. PFN was done using the minimally invasive approach for IM nailing, after applying traction using traction boot in the theatre table. The upper end of the femur was approached through a skin incision along the lateral aspect of the buttocks and after ideal positioning of the patient. The reduction was achieved through fluoroscopy-guided manoeuvres like traction and internal rotation. In the case of PFN A-II, the entry was made directly over the center of the greater trochanter's superior aspect, while in the case of PFN it was made over the medial border of the greater trochanter. Nail insertion was done using a guided wire, adjusted with the help of X-ray control. Reaming was done using a reamer and nailing was achieved and fixed after confirming through X rays. The prime difference with respect to PFN A-II and PFN was a single helical blade screw that was used to fix fractures in PFN A-II, whereas PFN used two screws namely the head screw and a derotation screw. In addition, a coupling screw and proximal cap were used in the case of PFN A-II. Range of motion was achieved after the first week of the postoperative period and weight-bearing was encouraged after the 2$^{nd}$ post-operative day. Static and dynamic quadriceps strengthening exercises and hamstring stretching exercises were started early. Sutures were removed between 10-12$^{th}$ postoperative days. All patients were advised for a review once in two weeks until the union was achieved, and thereafter monthly for the initial three months, and once in three months for a period of 2 years. In every visit, functional outcomes such as hip range of motion, Harris hip score, local and wound complications were assessed through clinical examination and serial x rays. Harris hip score consists of 3 sections, with a range of 0-100, and is further categorised as <70 denotes poor, 79-79 as fair, 80-89 as good and 90-100 as excellent scores. It is also noted that a post-operative increase in Harris hip score (HHS) of more than 20 points with the addition of radiographically stable implant is considered a successful result. The follow up of change in HHS and incidence of complications were noted at 6 weeks, 3 months, 6 months and at 12 months.

**Statistical Analysis**

Data was collected using datasheets entered into Microsoft Excel and analysed using SPSS version 20. Continuous variables were summarized as mean (SD) or median (IQR) based on normality. Categorical variables were summarized as frequency and

proportions. The compassion of HHS scores was compared between the study groups (PFN and PFN A-II) across the follow-up months. The scores can be further categorized into as <70 denote poor, 79-79 as fair, 80-89 as good and 90-100 as excellent scores. A p-value of less than <0.05 was considered statistically significant. Based on the distribution of the data, the Student t-test or Mann Whitney U test was used for intergroup comparison of normal and skewed data respectively. Categorical data were analysed using the chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

## Results

We enrolled a total of 20 cases who had unstable closed trochanteric fractures. Everyone agreed to participate in the study and everyone was followed up for the period of 2 years with no loss to follow up. We operated 10 individuals with PFN and the rest with PFN A-II. We observed that the mean age of our study participants were 60 ± 6.7 and 58.2 ± 5.3 with the PFN A-II and PFN group respectively. There was almost equal representation of the sex between the study groups. Right side injuries were more common, with almost 75% reporting to have type II Boyd and Griffin fractures, and around 80% had accidental fall as the mode of injury (Table 1)

**Table 1: Study characteristics of the study participants (N=20)**

| Characteristics | PFN A-II, Frequency (%) | PFN, Frequency (%) |
|---|---|---|
| Age | | |
| Mean (SD) | 60 ± 6.7 | 58.2 ± 5.3 |
| Sex | | |
| Female | 6 (60) | 5 (50) |
| Male | 4 (40) | 5 (50) |
| Side of injury | | |
| Left | 3 (30) | 4 (40) |
| Right | 7 (70) | 6 (60) |
| Subtype | | |
| II | 8 (80) | 7 (70) |
| III | 1 (10) | 1 (10) |
| IV | 1 (10) | 2 (20) |
| Mode of injury | | |
| Accidental fall | 9 (90) | 7 (70) |
| RTA | 1 (10) | 3 (30) |

Table 2 explains the comparison of time taken for procedure and Intraoperative blood loss between groups. We observe that there was a significant difference with respect to the time taken for operating (in mins), and intraoperative blood loss (in ml) between the groups. (p-value <0.001) We performed an unpaired t-test to compare the parameters as they were normally distributed.

**Table 2: Comparison of time taken for procedure and Intraoperative blood loss between groups (N=20)**

| | PFN A II (n=10) | | PFN (n=10) | | |
|---|---|---|---|---|---|
| | **Mean** | **Std. Deviation** | **Mean** | **Std. Deviation** | **p value** |
| Time taken for operation (in mins) | 65.5 | 13.632 | 91.5 | 9.733 | 0.001* |
| Intraoperative blood loss (ml) | 238 | 37.357 | 300 | 36.209 | 0.001* |

**Table 3: Comparison of time taken for union (in weeks) between groups**

| N | Mean | Std. Deviation | Median | IQR | P value |
|---|---|---|---|---|---|
| PFN A II | 12.4 | 2.797 | 12 | 2 | 0.019* |
| PFN | 15.6 | 2.951 | 16 | 4 | |

Table 3 explains the comparison of time taken for union (in weeks) between groups. We assessed the fracture union by comparing the standard digital anteroposterior radiograph of the pelvis with the operated hip. We observed that PFN took a longer duration in weeks for the union when compared to PFN A-II and it was found to be statistically significant by unpaired t test. (p-value 0.01)

**Table 4: Comparison of HHS interpretation at various intervals between groups**

| HHS score | Categories | PFN AII, N (%) | PFN, N (%) | P value |
|---|---|---|---|---|
| at 6 weeks | Poor | 4 (40) | 7 (70) | |
| | Fair | 5 (50) | 3 (30) | 0.31 |
| | Good | 1 (10) | 0 (0) | |
| at 3rd month | Poor | 1 (10) | 5 (50) | 0.14 |
| | Fair | 5 (50) | 3 (30) | |
| | Good | 4 (40) | 2 (20) | |
| at 6 months | Poor | 0 (0) | 1 (10) | 0.25 |
| | Fair | 2 (20) | 5 (50) | |
| | Good | 7 (70) | 4 (40) | |
| | Excellent | 1 (10) | 0 (0) | |
| at 12 months | Fair | 1 (10) | 5 (50) | |
| | Good | 5 (50) | 3 (30) | 0.14 |
| | Excellent | 4 (40) | 2 (20) | |

Harris Hip Score (HHS) was calculated with the help of a standard scoring sheet. Table 4 shows the comparison of Harris Hip Score interpretation at 6 weeks, 3 months, 6 months and 12 months between the groups. We assessed the significance using Fischer's exact test and was found it not to be statistically significant. (p-value >0.05) (Table 4).

Table 5 explains the he two commonly noted complications with respect to the implant were found to be anterior & lateral thigh pain and screw pull out. No case of wound infection was reported. We found that thigh pain was more commonly seen in the PFN group when compared to PFN A-II group and was found to be statistically significant by fischer's exact test. (p-value 0.02)

**Table 5: Comparison of Post-operative complication between groups**

| Post OP Complications | Categories | PFN AII, N (%) | PFN, N (%) | P value |
|---|---|---|---|---|
| Screw pulls out | No | 9 (90) | 8 (80) | 0.5 |
| | Yes | 1 (10) | 2 (20) | |
| Thigh Pain | Absent | 9 (90) | 4 (40) | 0.029* |
| | Present | 1 (10) | 6 (60) | |

## Discussion

Treatment and comprehensive management for intertrochanteric fractures have always remained a hot research topic. There exist numerous problems and factors that determine the outcome and choice of surgery for IT fractures. The choice of management is largely influenced by the need to preserve life at first, followed by the limb and attain maximal functional recovery out of it. Earlier the sole aim of surgical management was to achieve earlier and accepted union of fractures, whereas of late, the emphasis is also laid upon the extent of functional outcome and recovery following hip surgeries.

These fractures are often linked with a high incidence of morbidity and mortality owing to prolonged bed rest such as bed sores and pulmonary complications, while age and related osteoporosis, in addition, adds to the complications. This affects the quality of fixation and results in implant failures. Thus, it is regarded that early fixation and mobilisation is the treatment of choice.[8] Earlier extramedullary implants such as dynamic hip screws had higher failures rates specifically in the case of lateral wall fractures and oblique fractures. Thus to overcome the same intramedullary devices came into the picture due to its biomechanical advantages.[9,10]

Intra medullary nailing has added advantages of reducing the stress concentrations through the specially designed nail tip and in the case of PFNA-II it has a helical blade that compacts the weak cancellous bones, thereby increasing the contact surface area.[11] Uncontrolled dynamic fixation has also resulted in complications such as bony erosion progressing to collapse, weakening the abductors, shortening the extremities and making it more functionally unstable.

Our study showed that there was equal representation of the gender with respect to the type of surgery, similar results were shown by previous studies from India.[12] We noted that the fracture union time as noted by standard digital AP X-ray pelvis showed that the average time of union in weeks for patients operated with PFN was 15.6 weeks and in patients operated with PFN A-II was 12.4 weeks, thereby proving that PFNA-II has a lesser duration time for union. Similar results were shown in studies that have compared both previously.[13]

Our study showed that cases operated using PFN A-II had a lesser duration for surgery, lower blood loss, a comparatively lesser duration for the union when compared to cases operated using PFN and found it to be statistically significant. A similar study done by Harshwardhan *et al* from India, have also shown that PFN A-II has less operative time, minimal blood loss, early weight-bearing and less union time.[14] Our study also showed that during the time of follow up of cases, we did not observe any statistically significant difference with respect to the HHS measured at various follow-up time points. A study by Loo *et al* also emphasised relatable results.[15] Whereas a study was done by Bajpai *et al* including 77 operated cases of PFN and PFN A-II showed that both had comparable results with respect to time of surgery, functional assessment, duration of hospitalization and blood loss.[16] This

variation from our study finding could be explained by differences in patient characteristics, comorbidity pattern, type of fractures and intraoperative complications observed across the study settings.

We also noted that cases operated with PFN A-II had a lower incidence of thigh pain when compared to cases operated with PFN alone (p-value 0.02), such findings were also found to be comparable with other study findings[17]

Our study had a few strengths; ours was one among the few studies that have compared PFN with PFN A-II in treating IT fractures for a comprehensive list of functional outcomes and complications. We have utilised internationally acceptable scales to measure the functional outcome. Despite this, our study has a few limitations. We had enrolled only a smaller sample size for establishing the association. The cases were operated by several surgeons, so chances of surgeons bias are possible. Moreover, our findings are from a single hospital, thus it is generalisable to only similar settings.

## Conclusions and recommendations

Our study findings suggest that PFN A-II has comparable results to PFN in case of functional outcome, and is a better option than PFN with respect to the incidence of complications, duration of surgery, intraoperative blood loss and time to fracture union. Thus, we advocate further studies, especially randomised control trials, with a larger sample size to assess the change in functional scores between the two operative procedures. Thus, we recommend the use of PFN A-II for IT fractures specifically among the elderly for early functional recovery and good quality of life.

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