Section: Orthopedics

Original Research Article

A PROSPECTIVE OBSERVATIONAL STUDY EVALUATING THE EFFECTIVENESS OF PFNA WITH HELICAL BLADE IN ELDERLY UNSTABLE TROCHANTERIC FRACTURES.

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ABSTRACT

Background: The choice of implant in stable trochanteric fractures is DHS however still failures encountered with some subtypes. The helical blade of PFNA is believed to provide stability, impaction, compression as well as rotational control of the fracture in unstable trochanteric fractures. So PFNA is optimal choice of implant in unstable trochanteric fractures in elderly with advantages of intramedullary fixation. **Aim:** Aim of study was to prospectively evaluate the functional outcome of unstable intertrochanteric fracture fixation with PFNA.
Materials and Methods: An observational study was conducted to assess the results of 30 patients of age above 65 years (12 males and 18 females) with unstable trochanteric fractures treated with PFNA during the period from December 2020 to December 2022 were followed up for a period of at least 12months in a tertiary care hospital. we used AO system of classification of fractures. 20, 10 Patients were AO; 31-A2 and A3. 31-A2 was commonest type. Radiological assessment and Functional outcome were measured at one, three, six, 12 months by using modified Harris hip score.
Results: All patients' fractures were healed uneventfully with the follow-up of 12 months. Out of 30 patients, 18 (60%),8 (26.6%), patients excellent, good functional outcome respectively and 20 (66.6%) patients achieved preoperative mobility by the 12 months follow-up, with two(6.6%) patients with complications like one was superficial infection and one was wound gaping but no implant related complication slike cut out.
Conclusion: Good results with low complication rate can be achieved with PFNA in unstable trochanteric fractures with good reduction and adequate fixation and acceptable position of hip blade especially in osteoporotic bone.
Keywords: Helical blade; PFNA; trochanteric fractures.

INTRODUCTION

The incidence of osteoporotic hip fractures are increasing in recent days due to increasing life expectancy of the population. Among the hip fractures femoral neck, intertrochanteric and subtrochanteric fractures account for approximately 45%, 45%, and 10% respectively.[1] Intertrochanteric femur fractures are more common in the elderly, who often have a poorer general condition, osteoporosis, cardiovascular and cerebrovascular diseases and other comorbidities. Therefore, disability and death rates associated with intertrochanteric fractures are high.[2,3]
Despite marked improvements in implant design, surgical technique and patient care, intertrochanteric fractures continue to consume a substantial proportion of our health care resources and remain a

challenge to date due to its increasing incidence and considerable post operative failure rates.[4]

Complications with intertrochanteric fractures arise primarily from fixation rather than union or delayed union because the intertrochanteric area is made up of spongiousbones.[5] The strength of the fracture fragment-implant assembly depends upon various factors including (a) bone quality, (b) fragment geometry, (c) reduction, (d) implant design and (e) implant placement. Of these factors, surgeon can only control the quality of the reduction, choice of implant and its placement.

The sliding hip screw is a widely used extramedullary implant in the treatment for stable trochanteric fractures. However, studies have reported that this implant is not appropriate for unstable intertrochanteric fractures, and have supported the use of intramedullaryfixation devices for such fractures.[6,7]As compared to extramedullary devices, intramedullary nails can be inserted with less exposure of the fracture, less blood loss, although they may require more fluoroscopic exposure. Biomechanically, nails allow for stable anatomical fixation of more comminuted fractures without shortening the abductor moment arm or changing the proximal femoral anatomy.

Implants used for femoral head fixation varies with each type of intramedullary device. These include lag screw, helical blade, screw blade hybrid and integrated screw. Each type of fixation has got its own merit and demerits. The common IM devices used for unstable intertrochanteric fractures today include proximal femoral nail (PFN) and proximal femoral nail anti-rotation (PFNA).PFN was introduced by AO/ASIF in 1996 for treatment of trochanteric fractures. It includes an Intramedullary nail through which two screws are inserted into the neck of femur. One is a lag screw that stabilizes the fracture allowing collapse and other is an anti-rotation screw used to provide rotatory stability to the fracture. PFNA was introduced in 2003 and it utilizes a helical blade instead of the conventionally used two screws. The helical blade is believed to provide stability, compression as well as rotational control of the fracture. Theoretically, it compacts the bone during insertion into the neck and hence has higher cut out strength as compared to other devices. Hence there is less chance of implant failure especially in elderly, osteoporotic bones.

Even though many studies were available comparing the biomechanical property, radiological and functional outcome of each type of femoral head fixation, no conclusions were made regarding the femoral head fixation method of choice, indication and contraindications of each fixation method. Still more studies are required to be conducted in various population across the globe to arrive at a conclusion.

Aim/Objective:

1. To assess the functional outcome of PFNA of unstable trochanteric fractures.
2. To evaluate the time taken for the clinical and radiological union of the fracture.
3. To study the complications of fracture fixation.

MATERIAL AND METHODS

A prospective observational study of 30 patients of age above 65 years (12 males and 18 females) with unstable trochanteric fracture (AO; 31A2 and A3) were treated with PFNA during period from December 2018 to December 2019 was conducted in our hospital (tertiary care centre) after obtaining approval from the Institutional Ethics Committee, patient consent taken for study participation and publication.

Patients with unstable trochanteric fractures above 65 years who are independently ambulant prior to injury were included in the study while polytrauma patients with trochanteric fractures, pathological fractures and those with neuromuscular disorders were excluded in this study. Thirty patients fulfilling the inclusion and exclusion criteria, were taken up for surgery after obtaining anaesthesia fitness. All of them under-gone CRIF with PFNA. Surgical exposures and steps were similar to the standard PFN techniques. Background and demographic variables including age, gender, side of fracture, associated comorbidities and pre-injury ambulatory status were recorded. Fracture type was assessed and recorded as per AO classification system using orthogonal radiographs of the affected hip. All patients were administered either spinal or epidural anaesthesia and positioned supine on a fracture table.

Entry pointwas taken with awl/guide pin over a protector sleeve, it was 5 mm medial to the tipof the Greater Trochanter antero-posterior and lateral view. 2.8mm guide wire was inserted into the femoral shaft and across the fracture site. Serial reaming was done with five millimetres and PFNA was fixed on the jig and the alignment waschecked. Then the nail was inserted into the proximal femur. The ideal position ofthe guide wire was in the lower half of the neck in AP views, in a single line in the center of the neck in the lateral views. The guide pins were inserted up to five millimetres from the articular surface of the femoral head and size of helical bladewas determined. Moreover, the distance between the pin tip and the apex of femoral head could be visible in anterio-posterior and lateral film ,namely Tip-ApexDistance(TAD), which was not over 20mm.

All patients received three doses of prophylactic antibiotics including the pre-operative dose given within 30 minutes prior to skin incision. Post operatively all patients received thrombo-prophylaxis with low molecular weight heparin for the duration of hospital stay or first ten post-operative days, whichever was shorter, followed by Aspirin for four weeks. Suture removal was done on tenth post op day. All patients were allowed touch down weight bearing ambulation using a walking frame starting from the first post op day till four weeks, following which progressive weight bearing was allowed depending on the status of fracture union. Clinical and radiological assessment of fracture healing and implant position for all the patients was done post-operatively during each follow up visit at one, three, six and twelve months.Functional outcomes were measured using modified Harris Hip Score, radiological assessment was done by bridging callus on three to four cortices on two views(anteroposterior,lateralview) during each visit.

Statistical Methods

Modified Harris Hip Score (MHHS), achieved pre op mobility etc., were considered as primary outcome of interest. pre ambulatory status, time between injury and fixation etc., were considered as primary explanatory variables.

Descriptive analysis was carried out by frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram.

The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Odds ratio along with 95% CI is presented. Chi square test/ Fisher's was used to test statistical significance. P value < 0.05 was considered statistically significant. Data was analysed by using SPSS software, V.22.[1]

1. SPSS I. IBM SPSS Statistics Version 22 Statistical Software: Core System Users' Guide. SPSS Inc. 2014.

RESULTS

A total of 30 subjects included in the final study.

Descriptive analysis of parameters like age, gender, side of fracture, pre ambulatory status, complications, time between injury and surgery, ASA grading in the study populationare given in Table1.

Bar chart of pre ambulatory status in the study population given see graph:1

Pie chart of time between injury and fixation in the study population given see graph:2

Descriptive analysis of functional outcome at one, three, six,12 months, achieving pre operative mobility in the study population given see Table:2

Bar chart of 12 months (1 year) in the study population given see graph:3

Pie chart of achieved pre operative mobility in the study population given see graph:4

Comparison of pre ambulatory status across modified Harris hip Score (1 year) given see Table:3

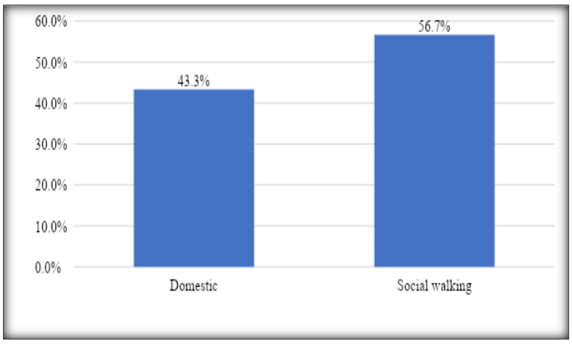
Comparison of pre ambulatory status between achieved pre operative mobility given see Table 4:

Staked bar chart of comparison of pre ambulatory status between achieved pre operative mobility given see graph:5

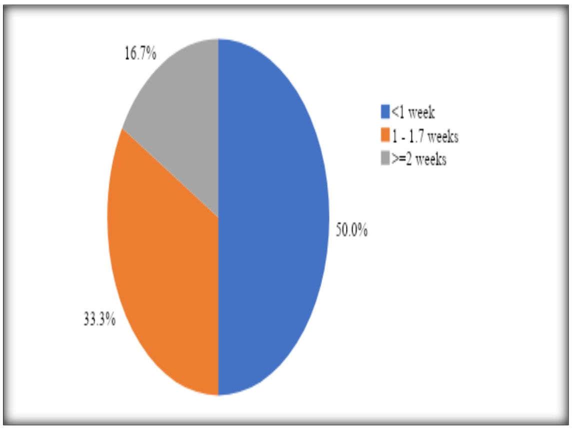
Comparison of time between injury and fixation across modified Harris hip score (one year) given see Table:5

Comparison of time between injury and fixation between achieved pre operative mobility given see Table:6

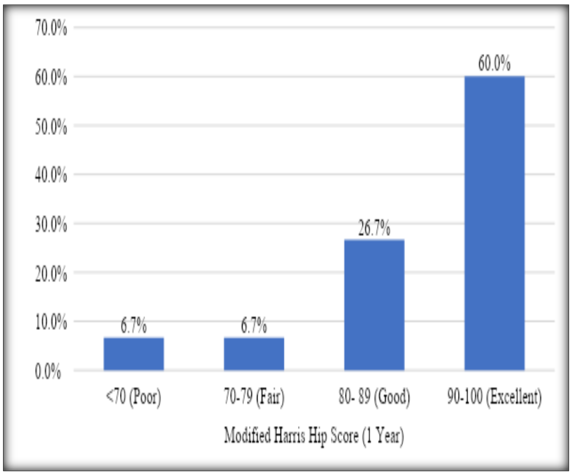
Staked bar chart of comparison of time between injury and fixation between achieved pre operative mobility given see graph: 6



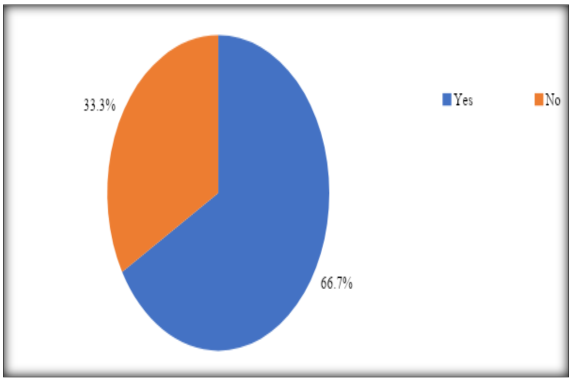
Graph: 1[1]



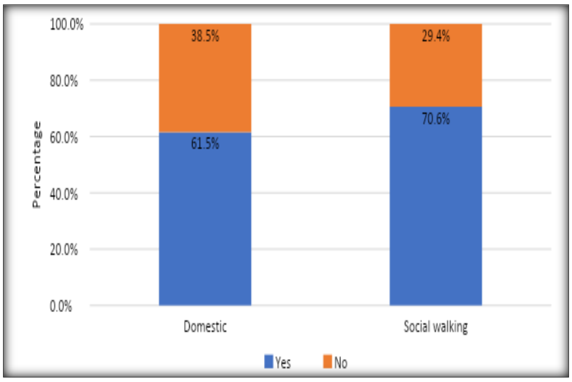
Graph:2[2]



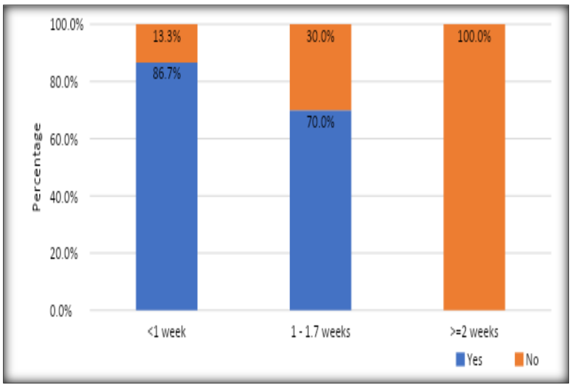
Graph: 3 [2]



Graph: 4 [2]



Graph:5 [5]



Graph: 6 [2]

Figure 1: unstable trochanteric fracture pre-operative,1,3-month post-operative x-ray

Figure 2: shows 6 months, 1year post-operative Antero posterior, lateral view with adequate callus and inferior centre position of implant.

Figure 3: shows immediate post op of unstable trochanteric with subtrochanteric extension, 3 months, 1-year post-operative x-ray with good holding status of implant and excellent callus formation was there.

Figure 4: unstable trochanteric fracture pre-operative x-ray, traction view x-ray achieved good reduction.

Figure 5: immediate, 6months, 1year post-operative x-ray with adequate callus and inferior position of implant.

Figure 6: unstable trochanteric fracture with lateral wall fracture pre-operative, 1-month post-operative x-ray with inferior position of implant in neck with minimal callus.

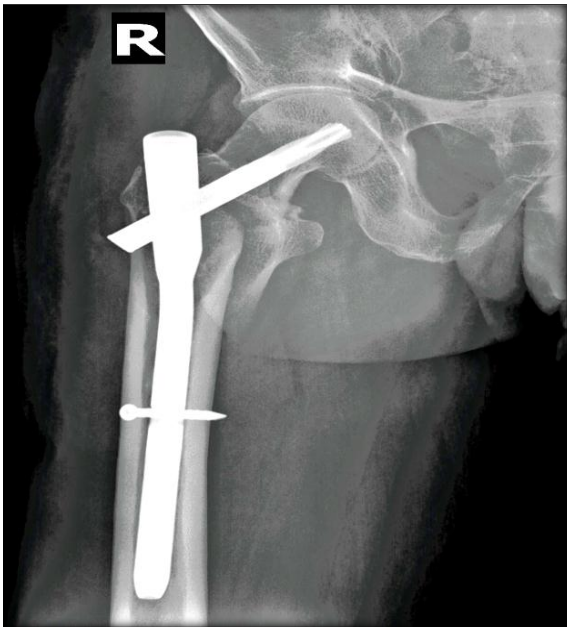
Figure 7: 3 months post-operative Antero posterior, lateral views with inferior center position of implant.

Figure 8: 6 months post-operative Antero posterior, lateral views with good amount of callus and excellent implant position- inferior in Antero posterior view and central in lateral view.

Figure 9: pre-Operative x-ray of unstable trochanteric fracture x-ray wise looks Osteoporosis, Immediate Post-Operative x-rays with excellent reduction.

Figure 10: 6 Months, 1year post-Operative x-rays with in-situ heling of fracture

MANIPRE OP X-RAY



1 MONTH POST OP X-RAY

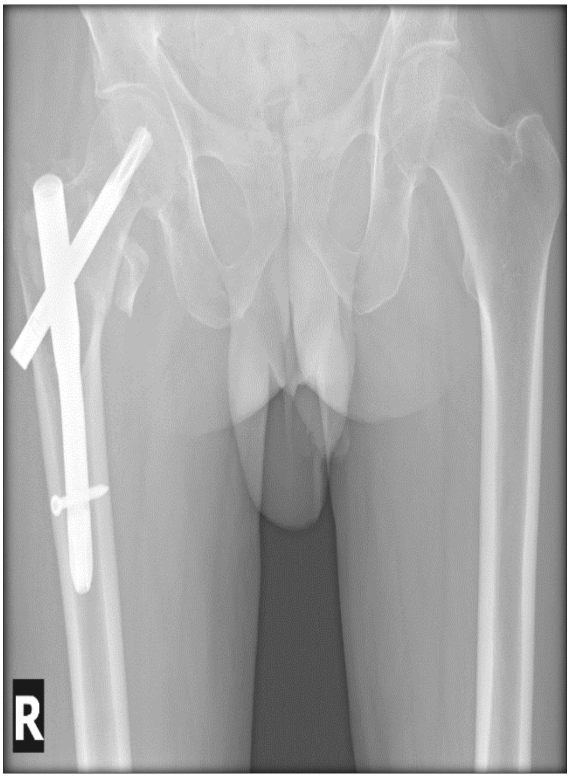
3 MONTHS POST OP X- RAY

1 YEAR POST OP X-RAY AP VIEW

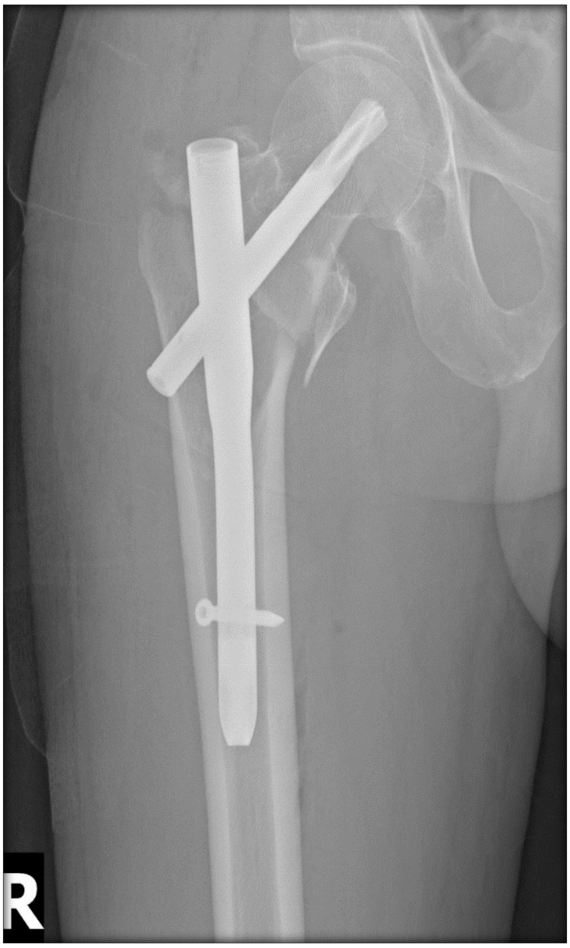
6 MONTHS POST OP X-RAY

1 YEAR LATERAL POST OP X-RAY LATERAL

PREOP X-RAY



1 MONTH POST OP



IMMEDIATE POST OPX-RAY

3 MONTHS POST OP

6 MONTHS POST OP

IMMEDIATE POST OP

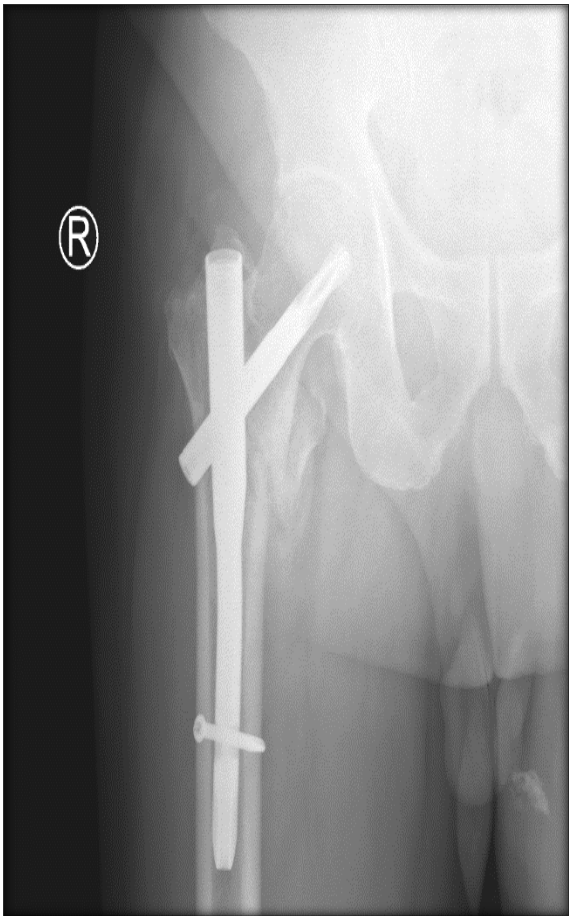
1 YEAR POST OP

3 MONTHS POST OP X-RAY

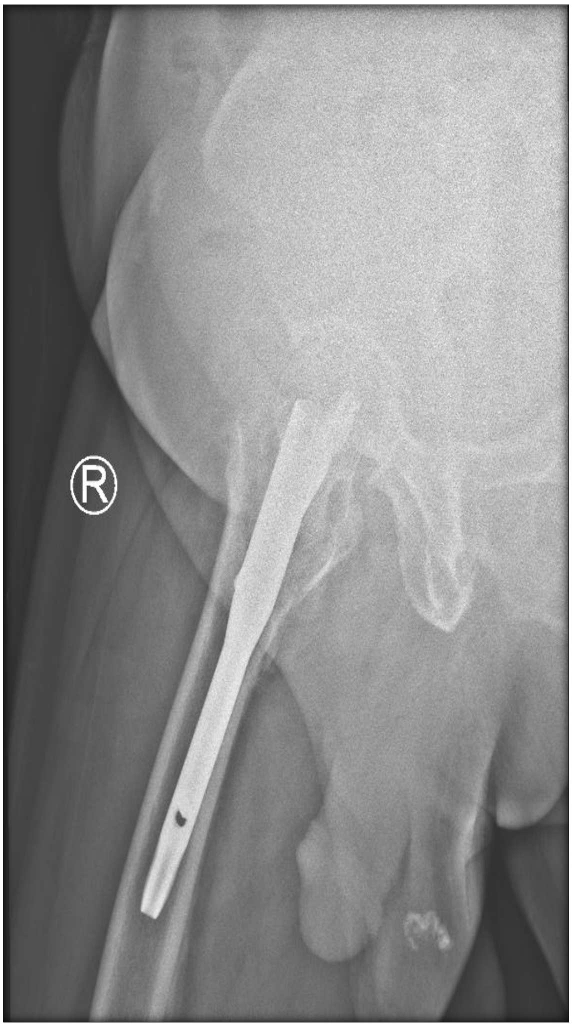
1 YEAR POST OP X-RAY

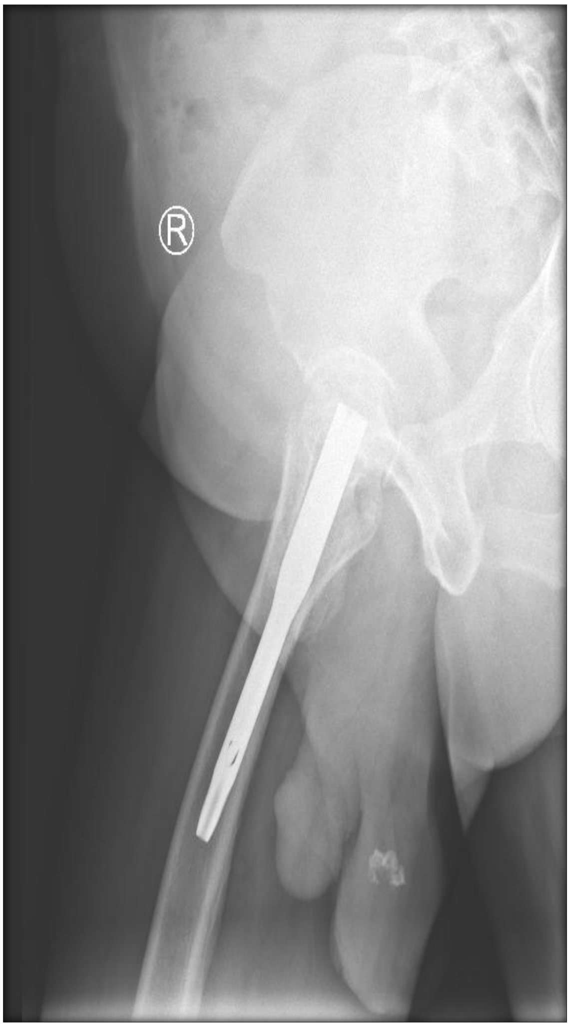
1 MONTH POST OP X-RAY

PRE OP X-RAY

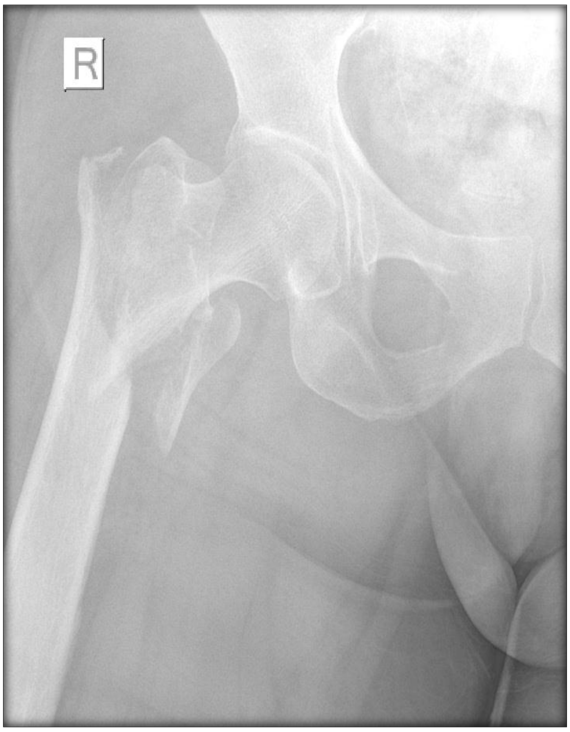


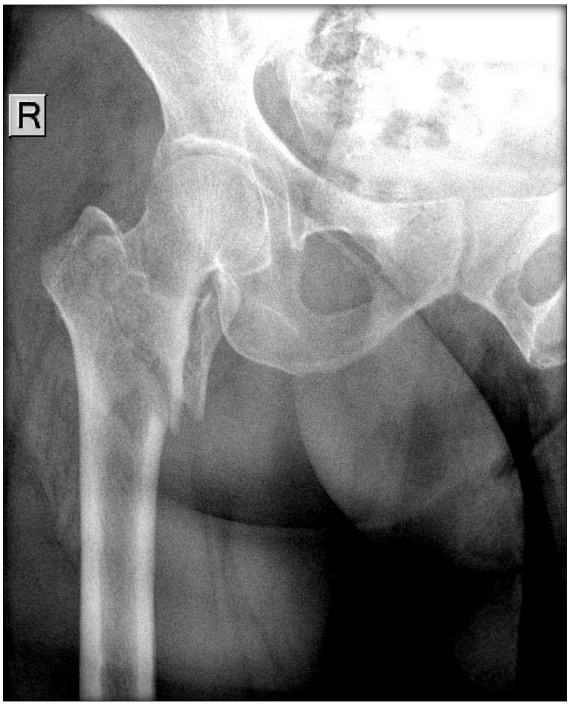
3 MONTHS POST OP AP


3 MONTHS POST OP LATERAL


6 MONTHS POST OP LATERAL X-RAYS


6 MONTHS POST OP AP


PREOP X-RAY



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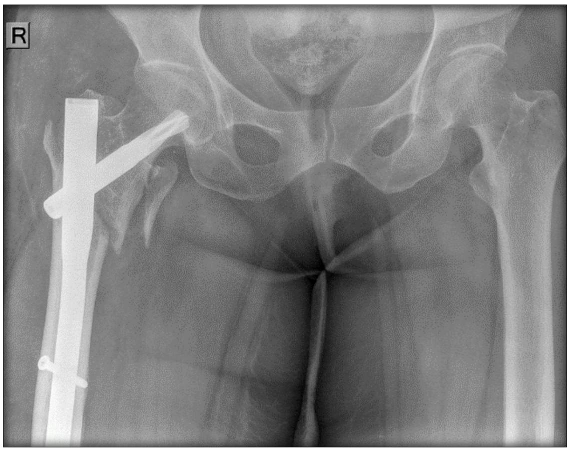
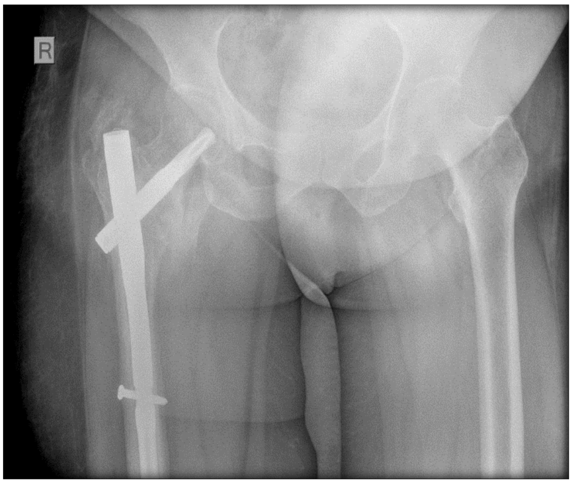
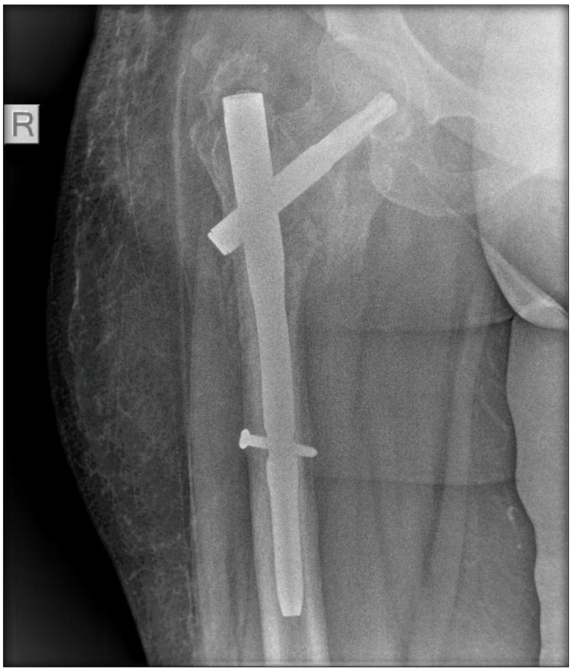


IMMEDIATE POST OP X-RAY



3 MONTHS POST OP X-RAY



6 MONTHS POST OP X-RAY

Table:1[1]

Parameter	Frequency	Percentages
Age (Years)		
65- 75 years	14	46.67%
>75 years	16	53.33%
Gender		
Male	12	40.00%
Female	18	60.00%
Side		
Right	18	60.00%
Left	12	40.00%
Pre ambulatory Status		
Domestic	13	43.33%
Social walking	17	56.67%
AO classification of fracture type		
AO 31A2	19	63.33%
AO 31A3	11	36.66%
Complications	2	6.7%
Time Between Injury and Fixation		
<1 week	15	50.00%
1 - 1.7 weeks	10	33.33%
>=2 weeks	5	16.67%
ASA Grading		

ASA I	1	3.33%
ASA II	13	43.33%
ASA III	15	50.00%
ASA IV	1	3.33%

Table: 2[2]

Parameter	Frequency	Percentages
Modified Harris Hip Score (1Month)		
<70 (Poor)	11	36.67%
70-79 (Fair)	19	63.33%
Modified Harris Hip Score (3 Months)		
<70 (Poor)	1	3.33%
70-79 (Fair)	9	30.00%
80- 89 (Good)	20	66.67%
Modified Harris Hip Score (6 Months)		
<70 (Poor)	1	3.33%
70-79 (Fair)	5	16.67%
80- 89 (Good)	22	73.33%
90-100 (Excellent)	2	6.67%
Modified Harris Hip Score (1 year)		
<70 (Poor)	2	6.67%
70-79 (Fair)	2	6.67%
80- 89 (Good)	8	26.67%
90-100 (Excellent)	18	60.00%
Achieved Pre-op Mobility		
Yes	20	66.67%
No	10	33.33%

Table: 3 [2]

Pre ambulatory Status	Modified Harris Hip Score (1 Year)			
	<70 (Poor)	70-79 (Fair)	80- 89 (Good)	90-100 (Excellent)
Domestic (N=13)	2 (15.38%)	1 (7.69%)	1 (7.69%)	9 (69.23%)
Social Walking (N=17)	0 (0%)	1 (5.88%)	7 (41.18%)	9 (52.94%)

*No statistical test was applied- due to 0 subjects in the cells

Table: 4 [2]

Pre ambulatory Status	Achieved Pre-op Mobility		Fisher exact P value
	Yes	No	
Domestic (N=13)	8 (61.54%)	5 (38.46%)	0.705
Social Walking (N=17)	12 (70.59%)	5 (29.41%)	

Table: 5 [2]

Time Between Injury and Fixation	Modified Harris Hip Score (1 Year)			
	<70 (Poor)	70-79 (Fair)	80- 89 (Good)	90-100 (Excellent)
<1 Week (N=15)	0 (0%)	1 (6.67%)	2 (13.33%)	12 (80%)
1 - 1.7 Weeks (N=10)	0 (0%)	1 (10%)	5 (50%)	4 (40%)
>=2 Weeks (N=5)	2 (40%)	0 (0%)	1 (20%)	2 (40%)

*No statistical test was applied- due to 0 subjects in the cells

Table: 6 [2]

Time Between Injury and Fixation	Achieved Pre-op Mobility	
	Yes	No
<1 Week (N=15)	13 (86.67%)	2 (13.33%)
1 - 1.7 Weeks (N=10)	7 (70%)	3 (30%)
>=2 Weeks (N=5)	0 (0%)	5 (100%)

*No statistical test was applied- due to 0 subjects in the cells

DISCUSSION

Few case series and randomized controlled studies are reported on PFNA implantation for the treatment of intertrochanteric femoral fracture. The majority of reports are case series, but most of these are retrospective studies and lack prospective, objective, rigorous scientific design and are thus not objective and reliable in their results. Although the current study is also a case series, it is a prospective design which can effectively avoid data bias.

This study was conducted on 30 elderly patients with unstable trochanteric fractures who were managed operatively using PFNA following closed reduction at a tertiary care centre. Intertrochanteric fractures are one of the most common fractures of the hip especially in the elderly with porotic bone, usually due to low-energy trauma like simple falls.

The incidence of intertrochanteric fracture is rising because of increasing number of senior citizens with osteoporosis.[8]The primary goal in the treatment in elderly patients with an intertrochanteric hip fracture is to return the patients to his pre-fracture activity level as soon as possible.

In Steinburg EL et al study concluded that surgery is the treatment of choice for early mobilization and prompt return to pre-fracture functional level, as well as for reducing mortality and morbidity.[9] Similarly in our study early fixation of fracture shows decreased morbidity compared to delay in fixation beyond one week.

Ankit Mittal et al studied 14month prospective randomized comparative study from July 2018 to August 2019, Early Functional Outcome of Osteoporotic trochanteric Fractures in Elderly Managed with PFN and PFNA, with 64 patients, 32 in each group concluded that two groups similar functional results once the fracture has united. However, with reduced implant-related complications and shorter operative time, PFNA can prove to be a boon for osteoporotic, elderly debilitated patients.[10] Similarity with in our study is elderly osteoporotic patients and less implant related complication rates with use of PFNA.

K. Ramaprathap Reddy et al studied a prospective study of 40 cases of trochanteric and subtrochanteric fractures above 20 years concluded that PFN is an excellent implant for the treatment of per trochanteric fractures. The terms of successful outcome include a good understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate instrumentation, good image intensifier, and exactly performed osteosynthesis.[12] similarly in our study proper fixation and good implant position and time between injury and surgery, comorbidities influenced the functional outcome. As time latency increased functional outcome will be low and achieving pre-operative mobility also will be affected.

DaliborKristek et al studied in 2010 with 76 patients of mean age of 73.4 years of proximal femoral fractures fixed with PFNA. The PFNA is an excellent implant for stabilisation of both trochanteric and complex combination fractures as well as an exceptional device for re-osteosynthesis. The majority of patients regained their pre-injury mobility status. It is easily inserted with few intra and postoperative complications and allows early weight bearing on the affected limb as well as quicker rehabilitation of patients. [11] Similarly in our study majority of patients 20 (66.67%) achieved re operative mobility and we excluded combination of fractures (poly trauma with trochanteric fracture) patients.

SharanMallya et al in 2020 studied an observational study of 40 patients, they took two groups (20 patients in each) based on medial and lateral entry point of Greater Trochanter of femur for treatment of Unstable Intertrochanteric Femur Fracture with Proximal Femoral Nail Antirotation-2. The Results are with respect to Different Entry Points.The lateral cortex impingement was seen in 14 patients of group L and six patients in group M with significant comparison (P=0.01). Three patients in group L had varus collapse with screw back out. Also, none in group M (0.05). They concluded that to achieve good quality of fixation and reducing damage to gluteus Medius entry point for PFNA-2 should be five millimetres medial to the greater trochanter tip.[13] Similarly in our study also we used five millimetres medial to grater trochanteric tip for all cases and we don’t have no screw backout as in above study M group.

Masuraj Atal Bihari Mandal et al 2020 conducted prospective randomized comparative study of intertrochanteric fractures treated with PFNA2 and PFNA with 60 patients showed that the PFNA2 reduces the surgery time, blood loss, and image shots number as compared to PFN. As the union rate is more with PFNA2, the functional outcome is significantly better with PFNA2 than PFN. Implant related late complication is more with PFN which was markedly reduced with PFNA2.[15] Similarly in our study also implant complication rate was less almost nil.

Ju-Feng Lu et al in 2012 studied a comparative study of 83 elderly patients with unstable intertrochanteric fracture of femur were divided into 45 cases treated with PFNA and 38 cases treated with DHS showed that the Harris score and SF-36(Mos 36-item Short Form Health Survey) score at 12 months after operation in both groups were higher than those before operation($P<0.05$), and the excellent and good rate in PFNA group was significantly higher than that in DHS group($P<0.05$). And concluded that compared with DHS, PFNA is more simple, less traumatic, less complications, better short-term survival rate and better quality of life for elderly patients with unstable intertrochanteric fracture of femur. PFNA can be used as an optimal treatment for elderly patients with unstable intertrochanteric fracture of femur.[14] Similarly in our study also shows that PFNA can be used as an optimal treatment for elderly patients with unstable intertrochanteric fracture of femur.

In our study pre-operative mobility achievability was shows correlation with pre-operative mobility status as a greater number (12 patients (70.59%)) of social walking patients are achieved pre-operative mobility status but in domestic waking patients less, 8 (61.54%) patients achieved. But Harris hip score was almost equal at end of one year in both domestic and social walking patients.

CONCLUSION

The helical blade is believed to provide stability, compression as well as rotational control of the fracture. Theoretically, it compacts the bone during insertion into the neck and hence has higher cut out strength as compared to other devices. Hence there is less chance of implant failure especially in elderly, osteoporotic bones. Hence PFNA with helical blade appears to be currently the optimal implant in unstable intertrochanteric fracture of femur treatment with PFNA for elderly especially osteoporotic bones.

Conflict of Interest: None

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