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Original Research Article

Unstable trochanteric fractures treated with proximal femoral nail show functional outcomes independent of the fracture type

Sourav Bhattacharjee[1]*, Ashir Abdul Rasheed[2]

[1]Department of Orthopedics, Calcutta National Medical College and Hospital, Kolkata, West Bengal, India
[2]Department of Orthopedics, LFHRC, Kochi, Kerala, India

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***Correspondence:**
Dr. Sourav Bhattacharjee,
E-mail: im.sourav99@gmail.com

ABSTRACT

Background: The proximal femoral nail has replaced the sliding hip screw devices and gamma nails as the implant of choice for unstable trochanteric fracture (AO 31A2-A3). In our study we aimed to find a correlation between fracture type, time taken for radiographic union and their functional outcome according to Harris Hip score at 6 months after PFN fixation of such fractures.
Methods: We assessed 38 patients sustaining unstable (AO 31A2-A3) trochanteric fractures. All the fractures were treated with short PFN. Functional outcome was assessed according to the HHS at sixth month follow-up.
Results: No statistically significant association was found between HHS with fracture type (p=0.184) and bone union time (p=0.587). The association between bone union time and fracture type was found to be statistically significant (p=0.007).
Conclusions: Functional outcome (HHS) does not depend upon the fracture type.

Keywords: Functional outcome, Harris hip score, Proximal femoral nail, Trochanteric fracture

INTRODUCTION

Trochanteric fractures of the femur are frequently encountered by orthopaedic surgeons. These fractures are common in the elderly population with a female preponderance and the majority of fractures sustained are fractures of unstable nature according to Association of the Study of Internal Fixation (AO/ASIF) classification.[1,2] The incidence of trochanteric fractures double every 5.6 years in women and every 7.8 years in men beyond the age of 30.[3] The sliding hip screw and plate fixation was initially recommended for such fractures as studies showed reduced incidence of delayed union and non-union.[4] Later gamma nails were introduced as it was argued that these nails had a biomechanical advantage and facilitated minimally invasive fixation with preservation of proximal femoral anatomy.[5] But soon studies emerged showing undue stress riser effect of the gamma nail causing fractures distal to the extent of the implant which lead to a wider acceptance of already proven sliding hip screw for trochanteric fractures in osteoporotic bone.[6] The proximal femoral nail (PFN) devised by AO/ASIF gained popularity with studies showing its biomechanical advantage over the sliding hip screw devices and a shorter learning curve and fewer complications compared to the gamma nail.[7] Although the debate continues to decide the optimum fixation devise for unstable intertrochanteric fractures, several studies have shown PFN to be an ideal fixation device for AO 31A2 and 31A3 fractures with the added advantage of minimally invasive surgical techniques.[8]

Studies showcasing easier surgical technique and early weight bearing with PFN also emerged stating PFN to be superior to SHS in treating unstable intertrochanteric fractures.[9,10] In our study we aimed to find a correlation between fracture type and their functional outcome following PFN fixation according to Harris hip score (HHS) at 6 months follow up.[11]

METHODS

This prospective observational study was done at Little Flower Hospital and Research Center, Angamaly, Kochi, Kerala which is a tertiary care center. The study period was set as 1 year (1 January 2019 to 31 December 2019) and the functional outcome was assessed at the end of 6 months. All patients undergoing surgical treatment for unstable trochanteric fractures (AO 31A2 and 31A3) in the department of orthopedics during the study period willing to participate in the study were selected through purposive sampling after obtaining informed consent. Participants having age less than 18 years, patients with pathological fractures or fractures following irradiation or chemotherapy, having a non-ambulatory status prior to injury were excluded from the study. A brief history was taken from the patients at presentation followed by initial evaluation, necessary resuscitation and adequate stabilization of the fractured limb by application of surface traction. The fractures were then classified according to the AO classification. Surgical fixation was then performed once the patient was fit for procedure under anesthesia. The patient was positioned supine in the fracture table with the opposite limb in lithotomy position. The fracture was reduced by putting longitudinal traction internal rotation and adduction on the affected limb, the cases where closed reduction was not possible, open reduction was done. Under fluoroscopy guidance the fractures were fixed with short proximal femoral nail having a proximal nail diameter of 17 mm, while the distal diameter ranged from 9 to 11 mm depending on the medullary canal width of the femur at the level of isthmus in Antero posterior skiagram (Figure 1). In all the cases, PFNs of 130° neck shaft angle with 10° of anteversion and 6° of mediolateral curvature with an entry point just lateral to the tip of greater trochanter were used. Of the two proximal screws, the lag screw was 8mm in diameter and its length ranged from 55 mm to 115 mm while the anti-rotation proximal screw was 6.4 mm in diameter with its length varying from 55 mm to 115 mm. Distally interlocking of the implant was done by interlocking bolts, the cranial one for static locking and the caudal one for dynamic locking. Following surgery patient's general conditions and vitals were monitored. IV fluids were supplemented till the patients began taking oral fluids. IV antibiotics were given for 3 days followed by oral antibiotics for 5 days. Analgesics were given according to patient's compliance and blood transfusion was started as per requirement. Foot end of the operated limb was elevated for a day. All patients were mobilized in the bed 24 hours after surgery and were taught static quadriceps exercises along with knee and ankle mobilization. Suction drains if placed were removed after 48 hrs. Sutures were removed on postoperative day 10. Gait training along with assisted weight bearing and mobilization was started from 3rd postoperative week. Scheduled outpatient visit was done at 6th week, 3rd, 4th and 6 months. During every visit, patients were assessed clinically regarding hip and knee function, ability to bear weight and walk, fracture union, deformity and other complications. X rays were taken as required. Partial weight bearing was started at 6th week but complete weight bearing was allowed only after evidence showing radiological union (Figure 2). Harris hip score was assessed at the end of 6 months. Other important parameters assessed were wound condition, hip and knee function, ability to bear weight, screw cut out, Z phenomenon, reverse Z phenomenon, breakage of nail, malunion, nonunion, abutment of nail and bolt breakage. All the data collected was entered into Microsoft excel sheet and analyzed using SPSS 20 statistical software. To test the association between demographic variables and functional outcome Fischer's exact test & Point Biserial Correlation test was used and a significant level of 5% ($p<0.05$) was considered as statistically significant.

RESULTS

There was total 40 participants out of which 2 participants were lost to follow-up making the effective sample size 38. The parameters we considered were, distribution of patients according to their age and gender, mode of injury, fracture laterality, type of fracture, time taken for bone union evident by presence of bridging callus at the fracture site and functional outcome according to HHS.[11] The age of the patients in our study ranged between 57 years to 91 years; with a mean age of 78.1±8.7 years (Table 1).

Table 1: Distribution of study subjects according to age.

Age (years)	N	%
≤70	8	21.1
71 - 80	12	31.6
81 - 90	16	42.1
>90	2	5.3
Mean±SD	78.1±8.7	

Table 2: Distribution of study subjects according to type of fracture.

Fracture type	N	%
A 2.2	28	73.7
A 3.1	2	5.3
A 3.2	6	15.8
A 3.3	2	5.3

There were 14 male patients and 24 female patients. All the patients sustained injuries after a trivial domestic fall and 18 patients had right side involvement whereas 20 patients had sustained injuries to their left side. In our

study we had 28 cases of type A 2.2 (73.7%) fractures, 2 cases of type A 3.1 (5.3%), 6 cases of type A 3.2 (15.8%) and 2 cases of type A 3.3 (5.3%) fractures (Table 2).

Table 3: Association of functional outcome with age, sex and co morbidities.

Parameters	P value	Statistical significance
Age	0.128	Insignificant
Sex	0.570	Insignificant
Co morbidities	0.333	Insignificant

Table 4: Comparison of HHS based on fracture type.

HHS	Fracture type				P value*
	A2		A3		
	N	%	N	%	
Fair/Good	12	42.9	8	80.0	0.184
Excellent	16	57.1	2	20.0	

*Fisher's Exact Test

Figure 1: PFN nail entry.

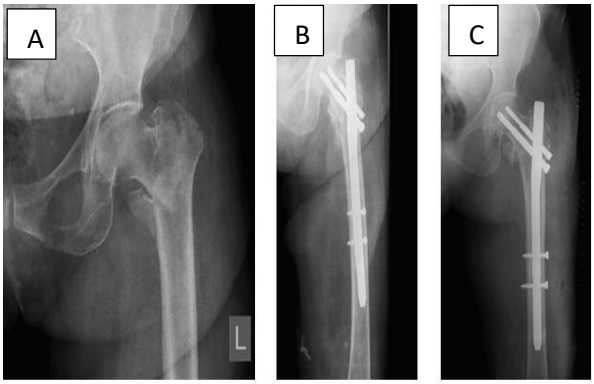

Figure 2: A) AO A2.2 fracture treated with PFN, B) immediate post op and C) 14 weeks postop with radiological union.

4 patients (10.5%) developed Z effect but there were no cases of reverse Z effect, abutment of nail, breakage of nail or bolt breakage detected radiologically. At 6th month follow up 18 patients had excellent outcome (47.4%), 12 patients had good outcome (31.6%) and 8 patients had fair outcome (21.1%) according to Harris hip score and the mean HHS was found to be 83.98 (Figure 3). No statistically significant association was found between the functional outcome (HHS) with fracture type and also with other patient parameters such as age and gender of the patients, and presence of co morbidities (Table 3-4).

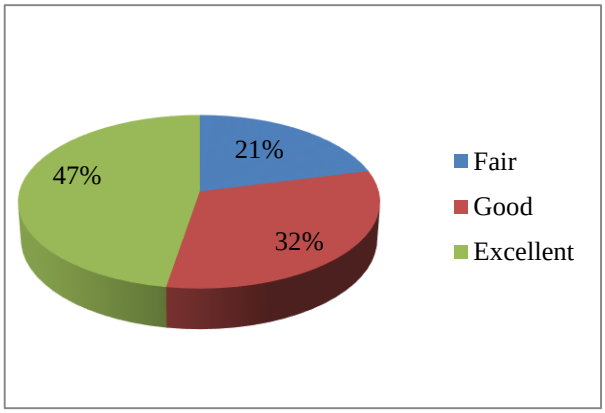

Figure 3: Percentage distribution of the sample according to HHS.

DISCUSSION

Unstable trochanteric fracture of femur has always been a challenge to orthopedic surgeons as the aim of the treatment is not only to treat and attain fracture union but also to focus on early mobilization and returning the patient to preinjury state at the earliest.

The sliding hip screw (SHS) has been the choice of implant in both stable and unstable trochanteric fractures initially due to its low rate of non-union, small learning curve. But due to high rates of complication when used in unstable trochanteric fractures i.e., intra operative lateral wall fractures and failure through cut-out, DHS is less preferred by surgeons now a days for unstable trochanteric fractures. The intramedullary implants inserted in a minimally invasive manner gained popularity due to better biomechanical properties with added advantages including early mobilization, better outcome in unstable fractures, lesser implant failure, prevention of the medialization of the femoral shaft, shorter surgical time, less blood loss and lesser complications like infections, DVT, respiratory distress, etc.[12] We assessed 38 patients with unstable inter trochanteric fractures and witnessed a female predominance in the sample size (24 females to 14 males) with a mean age of 78.1±8.7 years. These findings matched with the results found by Mattison et al (69% females and 82±11 years of mean age).[1] Mangram et al in his study recorded a female preponderance of 70.2% to 29.8% males with the average age being 82.2±9.3 years.[13]

We used AO classification system to classify unstable trochanteric fractures & had found 28 cases of A 2.2 (73.7%), two A 3.1 (5.3%), 6 cases of A 3.2 (15.8%) and 2 cases of A 3.3 (5.3%).[2] Fogagnolo et al in his study found the same predominance towards A2 fractures and recorded

it to be 63.8% while Shah et al found it to be 92%.[14] In another study Buecking et al found that A2 fractures occurred more (33%) compared to A3 fractures (19%) while the majority was A1 (36%).[15] 4 patients out of 38 (10.5%) developed Z effect with no incidence of reverse Z effect, abutment of nail, breakage of nail or bolt breakage detected radiologically. Smeets et al in his study demonstrated that 9% of the total sample size treated following trochanteric fractures developed Z effect which correlates with our finding.[16] In our study 18 patients had excellent outcome (47.4%), 12 patients with good outcome (31.6%) and 8 patients with fair outcome (21.1%) according to Harris hip score at the end of 6 months with the mean HHS of 83.98. This finding of mean HHS was similar with the results found by Jonnes et al and Vishwanathan et al which were 85.40 and 81±15.9 respectively.[17,18]

In this observational study of unstable trochanteric fractures treated with PFN we aimed to find a correlation between the functional outcome according to HHS at 6 months after surgery and fracture type. We included patient characteristics such as age, gender, presence of comorbidities and fracture characteristics such as type of fracture. Using 'Fischer's Exact Test' we however did not find any statistically significant association between HHS at 6 months and patients' age, gender and comorbidities. The correlation between HHS and type of fracture was also statistically not significant with a p=0.184 (p<0.05statistically significant). Korkmaz et al in his study demonstrated that HHS generally has no statistically significant correlation with fracture type, but at the same time he found a statistically significant correlation between HHS and patients age.[19] We believe that the superior biomechanical properties of PFN in terms of a greater load to failure, and compensation for the medial column of the femur by the implant are responsible for the well maintained HHS irrespective of the fracture type.[20,21] A study done by Timothy et al however found a significant association between HHS and patient factors and fracture type, but this study did not categorize trochanteric fractures according to AO classification and furthermore included stable intertrochanteric fractures unlike our study.[22] A smaller sample size in our study and patient follow up of a shorter duration (6 months) may be responsible for a statistically insignificant association between HHS and patient factors such as age, sex, comorbidities.

Limitations

No study is without limitations and constrains and ours is no different. A larger study population and longer post-operative observation is necessary to get better findings from such studies which were lacking in our study. Furthermore, a unanimous criterion to assess bony union following surgery, a population specific modified HHS and a standard post-operative rehabilitation regimen are essential for more accurate results.

CONCLUSION

Optimal treatment of unstable trochanteric fractures has always been equivocal and a matter of debate among orthopedic surgeons. Some surgeons prefer the time tested extra medullary implant whereas some are in favor of the intramedullary implant PFN described to have superior biomechanical properties in various studies. This study delves into the functional outcome of unstable intertrochanteric fractures treated with PFN and shows that HHS at 6 months following PFN fixation of inter trochanteric fractures does not depend upon the fracture type and patient characteristics. So, it can be stated that PFN fixations of unstable inter trochanteric fractures help to attain comparable HHS values irrespective of the degree of instability of the fracture. Yet more studies to evaluate the association between type of fracture and time taken for bony union are necessary.

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