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Functional Outcome of Sub- Trochantric Fracture Treated By Long PFN (Prospective Study of 50 Cases)

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Abstract

Background: Fractures of the proximal femur are relatively common injuries in adults and common source of morbidity and mortality among the elderly. Fractures of the proximal femur include trochantric and subtrochantric fractures. The present study was designed to evaluate and analyze the role of proximal femoral nail (PFN) in the treatment of proximal femoral fractures.

Methods: It was a prospective study on 50 cases of proximal femoral fractures. The fractures were classified according to Seinsheimer classification. Salvati and Wilson Score were used for functional assessment.

Results: In this study at 6 months follow up, union was achieved in all cases, open reduction was performed in 20% of cases (10 patients). Technical and mechanical complications were noted in 22% cases (11 patients). Reoperation rate was 0% . According to Salvati and Wilson scoring system excellent results were seen in 80% of cases (40 patients), good results in 16% cases (8 patients), fair result in 4% cases (2 patients) and poor results in (0% patients).

Conclusions: It is concluded from our study that Long PFN is safe, effective and patient friendly device useful for the treatment of all subtrochanteric fractures irrespective of their comminution.

Keywords: Proximal femoral nail, Subtrochanteric fractures, Proximal femur fracture.

Introduction

Subtrochanteric fractures -those between the lesser trochanter and the isthmus of the femoral shaft -account for approximately 5% to 34% of all hip fractures. In 1949, Boyd and Griffin [1] were the first to describe subtrochanteric femur fractures and differentiate them from intertrochanteric fracture, and noted unsatisfactory postoperative results in many subtrochanteric fracture patients. According to Koch's study [2] , the value of compressive stress on medial cortex was 1100 N, so the subtrochanteric fractures were generally comminuted fractures, due to which there was a need of reconstructing the medial cortex. Subtrochanteric fractures are often difficult to treat and may well be associated with a mortality of more than 20% [3, 4] . The subtrochanteric region is the site of very high mechanical stresses, the medial and posteromedial cortices were subject to high compressive forces whereas the lateral cortex experiences high tensile forces. This asymmetric high stress loading pattern is an important consideration in the selection of an

internal fixation device and in understanding the causes of fixation failure and healing disturbances. Furthermore, the cortical bone in the subtrochanteric region is less vascular than the cancellous bone in the intertrochanteric region, therefore, the risk of healing complications is greater with subtrochanteric fractures than with intertrochanteric fractures. Grundy (1970) [5] showed that the subtrochanteric area was the commonest site for femoral pathological fractures. In his study, 28.6% femoral fractures caused by Paget's disease occurred in the subtrochanteric area. Non-operative treatment of subtrochanteric fractures is rarely considered. It consists of skeletal traction followed by spica cast or cast brace. Nonoperative treatment is poorly tolerated, particularly in the elderly and multiply injured because of the need for prolonged bed rest and the potential for skin problems. Operative management is the treatment of choice to achieve the goals of early rehabilitation and optimal functional recovery. The purpose of the present study is to evaluate functional outcome of the subtrochanteric fractures -both high energy and low energy -treated by PFN. Functional as well as anatomical results were evaluated with regard to pain, limping, activities, deformity and range of movements. The present study was done with the hope to find out a solution for the treatment of subtrochanteric fractures.

Methods

This was a prospective study on cases of subtrochanteric fractures treated between July 2016 to Dec. 2018, who were admitted in Department of Orthopaedics, Trauma Centre, Sardar Patel Medical College, Bikaner. Fractures were classified according to Seinsheimer classification. 50 cases were followed at regular intervals and final assessment was done at 6 months. The Salvati and Wilson score of hip function was used at the last clinical assessment.

Operative technique

Patients were positioned supine on the fracture table under spinal or general anesthesia according to the condition of the patient. Fracture was reduced by longitudinal traction and the limb was placed in slight adduction to facilitate nail insertion through the greater trochanter. A straight lateral incision was made from 5 cm cranial to the tip of the greater trochanter, extending 3-5 cm proximally. A 2.8 mm threaded guide wire was inserted at the tip of the greater trochanter under C-arm control. In cases where standard proximal femoral nail (PFN) was used, the proximal part of the femur was reamed with a 13 mm reamer for a distance of about 7 cms; while where long proximal femoral nail (PFN) was used, distal femur was also reamed with increasing Diameters of flexible reamers up to 11 mm. After mounting the appropriate sized nail on the insertion device the nail was introduced manually into the Femoral shaft. The hip pin was introduced first, and then the neck screw of appropriate size was inserted. Afterwards depending on the type of fracture, distal interlocking either statically or dynamically was achieved via the same aiming arm in standard proximal femoral nail (PFN) and with free hand in long proximal femoral nail (PFN).

Results

Total of 50 patients were enrolled for the study. There were 40 males and 10 females, with an average age of 51.56 years (range: 31 to 90 years). RTA was the main injury mechanism accounting for 60% cases (30 cases). Twenty patients (40%) had Domestic Fall as mode of injury. Left side fractures were recorded in Twenty eight patients (56%) and Right side fractures in twenty two patients (44%). According to Seinsheimer classification

most common type was 3A. Associated injuries included ten patients (20%) of other bones fracture, head injury in eight patients (16%) and facial injuries also in two patients (4%). The average time from injury to surgery was 7 days (range: 1 to 13 days). Average duration of surgery was 71.88 min (range 45 to 145 min). Closed reduction was achieved in forty cases (80%). Open reduction was performed in ten cases (20 %). Mean intraoperative blood loss was 118.8 ml. In our study it was observed that in open reduction there was more blood loss. In our study, most commonly we used 10 mm diameter nail (28 cases) and 11 mm diameter nail was used in 18 cases. long PFN of in all subtrochantric fractures (360 mm to 420 mm). 38 cm length of nail was mostly used (24 cases).

Table No. 1 Intraoperative details.

S.No.	Intraoperative details.	N=50
1	Mean duration of surgery	71.88 min.
2 Reduction	Close Open	40 10
3	Mean Blood Loss	118.8

Table No. 2 Intraoperative Complications of PFN

S.No.	Intraoperative Complications	No of subject
1	Fracture of lateral cortex (shattering)	1
2	Varus angulation	0
3	Failure to put antirotation screw	4
4	Failure to lock distally	0
5	Jamming of nail	0
6	Drill bit breakage	2
7	Guide wire breakage	4

Table No. 3 Delayed complications.

S.No	Delayed complication subjects	No. of
1	Reverse Z effect	2
2	Shortening	4
3 2	Losssening of hip pin causing persistent pain in lateral surface of thigh	2
4	Z- effect	0
5	Stiffness of hip	4

Table No. 4 Functional results (Salvati and Wilson score)

Functional results	No. of Cases	%
Excellent	40	80
Good	8	16
Fair	2	4
Poor	0	0

In our study we encountered certain complications intraoperatively. In ten of our cases we had to perform open reduction due to wide displacement of fragments and communication of fragments. There was a fracture of the lateral cortex of proximal fragment during surgery. Shattering was in one case. In four cases, we failed to put anti-rotation screw. In four cases, there were guide wire breakages while drilling over guide wire. In this case guide wire was removed by using cannulated hand reamer and reaming over guide wire under IITV. In our series no other complications like deep vein thrombosis, systemic infection, acute respiratory distress syndrome and fat embolism was seen. The physiotherapy was started after 2nd or 3rd postoperative day according to patient's tolerance and associated injuries. Partial weight bearing walking was started at 1 month. Full weight bearing walking was started after the radiological union of the fracture site.The overall rate of late technical and mechanical complications was twenty four percent (12 cases).

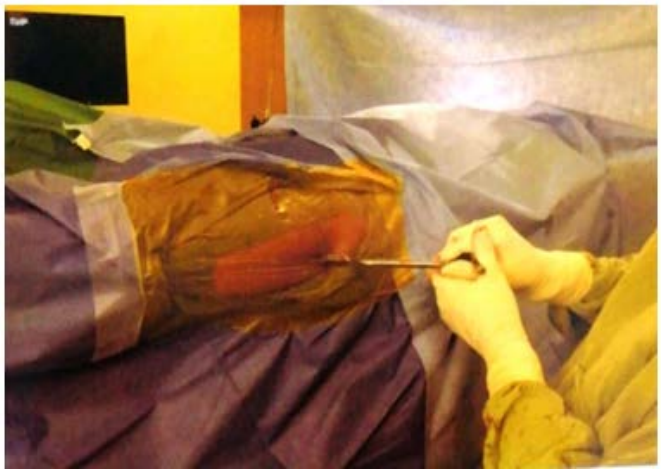

Fig. 1: Oval Insertion for Entry Point

Fig. 2: Guide wire insertion

Fig. 3: Closure of wound

In our series we had two cases of reverse Z effect, there was migration of hip screw in the joint with backing of antirotation screw (reverse Z effect). two patients had persistent pain in lateral surface of proximal thigh due to loosening of the hip pin. Stiffness of hip was noted in 4 patients which required vigorous physiotherapy. In our study, two patients developed shortening one more than 2cm. The average duration of hospital stay following surgery was days ranging from 5-20 days.

All patients were followed up in the out patients department up to 6 months. At each follow up radiographs of upper femur and hip were taken to assess the fracture union, implant failure and screw cut out. Radiological union was seen at 3 months for 14 patients, at 4 months- 16 patients, at 5 months- 18 patients or at 6 months- 2 patients.

Results were assessed by Salvati and Wilson scoring system and excellent results were seen in 40 cases, good results in 8 cases, fair result in 2 cases and poor results in 0% cases

Fig. 4: Case No. 1 24 Weeks

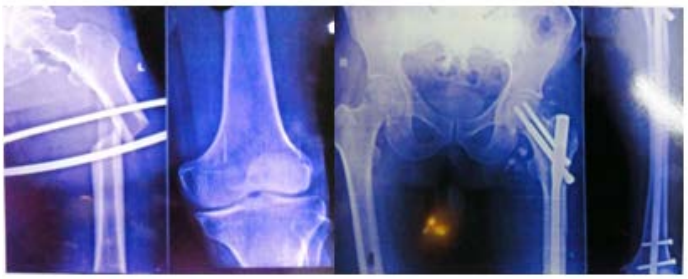

Fig. 5: Case No. 2 24 Weeks

Discussion

Unstable fractures of the proximal femur represent a significant challenge to the trauma surgeon. Surgical fixation is often technically difficult and poor surgical technique may lead to failure of primary fixation. The best treatment for these fractures remains controversial. DHS fixation is widely preferred but failure of fixation still occurs in up to 20% of cases. Common causes of fixation failure include fracture instability, osteoporosis, lack of anatomic reduction, implant failure, and incorrect placement of the lag screw in the femoral head (leading to cutting out of the screw).Cephalomedullary femoral reconstruction nails with a trochanteric entry point are biomechanically stronger than extramedullary implants. In unstable proximal femoral fractures, control of axial telescoping and rotational stability are essential. Intramedullary implants inserted in a less-invasive manner are better tolerated by the elderly. A new device was developed by AO/ASIF: the proximal femoral nail (PFN), with an additional antirotational hip pin preventing rotation and collapse of the head-neck fragment and an especially shaped tip together with a smaller distal shaft diameter resulting in less stress concentration at the tip.Parker et al. reviewed the epidermiology of subtrochanteric fractures and showed that the average age of the patients was 74 years[6]. Velasco and Comfort found that 63% of subtrochanteric fracture occurred in patients from 51 to more than 70 years old and 24% of patients between 17 to 50 years old.[7] Average age of the patients in this study is 51.56 years. This is mainly due to the increase in the incidence of fractures in younger patients due to high energy trauma.Simmermacher in their study the mean duration of surgery (skin to skin) was 68.7 min (range 25-240 min)[8]. Pajarinan et al in their comparative study of DHS and PFN in proximal femoral fracture, the average time of surgery in DHS was 45 min (range 20-105 min) and in PFN was 55 min (35-200 min)[9]. Wang in their study, the average operating time was 90 min (Range 60-155 min)[10]. In our study duration of surgery was longer in the initial operated cases. With frequent use of proximal femoral nail surgery the duration decreased. In our study average duration of surgery was 71.88 minutes.Fogagnolo et al reported 46 patients with an average rate of intra operative technical or mechanical complications of 23.4%, mostly problems with the distal nail locking and fracture of the lateral wall of the greater trochanter[11]. Kamboj et al studied 30 cases, in one case with trochanteric fracture extending to diaphysis encirclage wiring was done. One patient got intra operative fracture shaft of femur, three patients had poor placement of screw. The closed reduction was tried in all cases and achieved in 17 patients, in the rest of 13 cases fracture had to be opened. In their study, due to smaller diameter of the neck of Indian femora they were not able to pass anti rotational hip pin in four patients[12]. Alyassari et al in their study, two cases required open reduction, distal locking was difficult in three cases, nail insertion was difficult in one patient[13]. In our study, there was shattering of the proximal fracture fragment in one patient while insertion of the nail. In ten patients, it was not possible to achieve closed reduction, so open reduction was done by opening the fracture site. In four patients it was difficult to put the derotation screws. In Two patients, there were guide wire breakages while reaming over guide wires in femoral neck. Drill bit breakage in two patients.Pajarinan et al in their study of 83 patients, there was one case of heterotopic ossification corresponding to Brooker class 4, where PFN was used[9]. Werner et al was the first who introduced the term Z-effect, detected in five (7.1%) of 70 cases. The

incidence of cut-out of the neck screw in this study was 8.6%. The Z-effect phenomenon is referred as a characteristic sliding of the proximal screws to opposite directions during the postoperative weight- bearing period[14]. Reverse Z-effect described by Boldin et al occurred with movement of the hip pin towards the lateral side, which required early removal. In their prospective study of 55 patients with unstable intertrochanteric or subtrochanteric fractures, they had three cases with Z-effect and two with reverse Z-effect[15]. Fogagnolo et al, who reported 46 patients with an average rate of intraoperative technical or mechanical complications of 23.4%. They also reported two implant failures and one fracture below the tip of the nail. They also reported heterotopic ossification in two patients fixed with PFN[11]. Simmermacher et al in a clinical multicenter study, reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. A cut-out of the neck screw occurred in 0.6%.[8]. In our series there was shortening in four patients. In one patient, fracture was comminuted which caused shortening >2 cm on healing while in three patients it was of <2 cm where there was inadequate restoration of alignment and there was no medial buttressing that led to shortening. There was two cases of implant failure and three cases with 'reverse Z effect'. Revision Surgeries were done in these cases. In two patients, there was loosening of hip pin which caused persistent pain in lateral surface of thigh. In four patients, stiffness of hip joint was present.Alyassari et al also used Salvati and Wilson scoring system for final follow up. In their study salvati and Wilson score for hip function was >20 points in 78% of the patients (maximum score is 40 points)[13]. According to Salvati and Wilson score system in our study excellent results were seen in 40 cases, good in 8 cases, fair in 2 cases treated with proximal femoral nail (PFN).

Table No. 5 Comparison with other studies

	Boldin et al[14]	Ekstrom et a[15]1	Menzes et al[16]	Lei-Shang et al [17]	Present study
No. of patients	55	105	155	99	50
Duration of surgery (Min)	68	105	76	46	71.88
Bony union(%)	100	100	99	98	100
Failure of fixation(%)	0	11	2	0	0
Open reduction(%)	10	-	13	34	20
Reoperation rate (%)	10	9	12	-	4

Conclusion

PFN is safe, effective and patient friendly device useful for the treatment of all subtrochanteric fractures irrespective of their comminution. Early mobilization and rehabilitation is possible since it is a closed intramedullary procedure. Weight bearing should be delayed in severely comminuted fractures. It is mandatory to place both proximal screws in the neck, along with distal locking screws for better implant stability in osteoporotic as well as severely comminuted subtrochanteric fractures.

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