

Management of Subtrochanteric Fractures of Femur with Proximal Femoral Nail : A Prospective study

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ABSTRACT

Aim : The study aim was conducted to evaluate the outcome of management of 30 adult patients with sub trochanteric femoral fractures using proximal femoral nail(PFN).

Materials and Methods: This prospective study included 30 patients with sub trochanteric fracture admitted to Osmania General Hyderabad, who underwent intramedullary fixation with PFN from September 2012 to September 2014. Only fresh fractures within one week of injury were included in the study. Pathologic fractures, multiple fractures, fractures in children, old neglected fractures were excluded from the study.

Results: In our study of 30 patients, mostly are of young patients average age is 37.53 years (range from 21-40 years), there were 25 male and 5 female. 73.33% of the patients admitted were road traffic accidents, 16.66% due to fall from height and 10% due to trivial fall with right side being more common side affected. Russell and Taylor type IB fracture accounted for 46.66%, 1A30%, 11A 23.33% of cases. Mean duration of hospital stay was 12.6 days and mean time of full weight bearing was 14 weeks in our patients. All 30 patients, were followed up. Good to excellent results were seen in 83.33% of cases in our study.

Conclusion: PFN is a viable treatment option for sub trochanteric fractures with high rate of fracture union and minimal soft tissue damage. Intra medullary fixation has biological and biomechanical advantages, but the operation is technically demanding. Gradual learning and great patience is needed in order to make this method truly minimally invasive.

Keywords: PFN, Sub trochanteric fractures, russell and taylor

INTRODUCTION

Subtrochanteric fractures of the femur remain some of the most challenging fractures to treat, due to the complications of mal-union, non-union, shortening, angular deformity and rotational mal-union.^[1,2] This fracture is subjected to muscular forces resting in flexion abduction and external rotation of the distal fragment resulting in difficulty in reducing and maintain the reduction by closed methods^[3], hence making operative management the preferred method of treatment.^[4]

The quest for ideal fixation technique and ideal implant resulted in many options available. Subtrochanteric fractures account for 10% to 34% of all hip fractures and

they affect all the age groups.^[5] Subtrochanteric fractures are femoral fractures where the fractures occur below the lesser trochanter to 5 cm distally in the shaft of femur.

It may extend proximally into the intertrochanteric area and distally up to the isthmus of the shaft of the femur.^[6-9] These fractures are due to fall and direct lateral hip trauma, road traffics accidents,^[10] these fractures have bimodal distribution, in young and healthy individuals, due to high-energy trauma, whereas in the elderly population, most of the fractures are osteoporotic, resulting from a fall. also due to pathological fractures and periprosthetic fractures.^[11-13]

The quest for ideal fixation technique and ideal implant resulted in continued understanding of sub trochanteric fracture resulted in various classifications Boyd and Griffin (1949) Fielding and Magliato (1966), Seinsheimer (1978.) The goal of operative treatment is restoration of normal length and angulation to restore adequate tension to the abductors. [13-14, 15]

Closed management fractures poses difficulties in obtaining and maintaining a reduction, making operative management the preferred treatment. [3] The two primary options for treatment of sub trochanteric fractures are intramedullary fixation and extra medullary fixation. Many internal fixation been recommended [18, 19], Earlier anatomical reduction and rigid internal fixation required too much soft tissue dissection and leading to the fragment becoming avascular, better understanding of biology, reduction techniques and biomechanically improved implants like Gamma nail, Russell Taylor nail, Proximal femoral nail allowed for these fractures to be addressed with consistent success. [16-17]

In 1980, the concept of indirect reduction was introduced and significantly improved union rates and reduced the need for bone grafting. Proximal femoral nail (PFN), AO/ASIF (1997) various studies Pugh and Kevin J (1998), Kish B (2000), Christian Boldin et al (2003) proved the efficacy of PFN. The present study is to determine the rate of union, complications, operative risks and functional outcomes in subtrochanteric fractures treated with proximal femoral nail. [21]

MATERIALS AND METHODS

The present study consists of 30 adult patients with subtrochanteric fractures of femur who were treated with PFN in Osmania General Hospital, Hyderabad between September 2012 to September 2014. The fractures were classified according to Russell and Taylor classification. 30 cases were followed at regular intervals.

This study was conducted with due emphasis for clinical observation and analysis of results after surgical management of subtrochanteric fractures of femur with proximal femoral nail. Sub trochanteric fractures in adults are included, fractures. All these 30 patients are subjected to surgical profile and cardiac evaluation, plain X-rays of pelvis including both hips taken, the nail diameter is decided preoperatively by measuring the medullary canal diameter at the level of isthmus, neck shaft angle is decided.

Surgical technique

The patient is placed on fracture table closed reduction of the fracture was done. The unaffected leg was flexed and abducted as far as possible or kept in wide abduction.

The image intensifier was positioned so that anterior-posterior and lateral views of hip and femur could be taken. Open reduction was performed if closed reduction failed. A skin incision made proximal to tip of greater trochanter, tip of greater trochanter was exposed. Under image intensifier, the entry point was selected as tip of greater trochanter, guide wire position was confirmed in the center of the medullary cavity. Proximal femur was reamed for a distance of about 7cms, an appropriate size nail inserted manually by slight twisting movements of the hand until the hole for 8mm screw was at the level of inferior margin of the neck.

A 2.8 mm guide wire was inserted through the drill sleeve after a stab incision, checked under image intensifier. A second 2.8 mm guide wire was inserted through the drill sleeve above the first one. Drilling was done over guide. Neck screw was inserted. Length and position of the screw was confirmed under c-arm image intensifier. Distal locking was usually performed with two cortical screws by free hand technique.

Incision was closed in layers. Suction drain was used in case open reduction cases. Postoperatively, patients were encouraged to sit in the bed after 24 hours following surgery. All the patients were followed up at 4 weeks, 12 weeks and then at every 6 weeks interval there after till fracture union was noted. Patients were serially followed up at 6 months, 9 months and 1 year. At each visit, patient was assessed clinically by using the Harris Hip Scoring System.

RESULTS

In our study maximum age was 70 years and minimum age was 19 years. Most of the patients were between 21-40 years. Mean age was 37.53 years. Male patients were 25 and female were 5. Right side were in 20 cases and left in 10 cases.

The most common mode of injury is road traffic accidents accounting in 20 cases, followed by fall from height in 7 cases and trivial fall in 3 cases. Russell and Taylor type IB are 46.66%, 1A30%, 11A are 23.33%. All the patients were operated at an average interval of 3.75 days from the day of admission. The average hospital stay was 12.6 days ranging from 12-16 days.

Intra operative complications occurred mostly in the earlier part of the study. They were commonly seen in Type IIA subtrochanteric fractures, and obese individuals. Iatrogenic fracture of the lateral cortex of proximal fragment in 2 of 30 cases.

This occurred in initial cases probably due to entry point and osteoporotic bone. 3 of 30 cases, failure to put antirotation screw, 2 cases it could not be accommodated



Figure-1 : Showing right sub trochanteric fracture of femur



Figure-2 : Showing immediate Post operative x-ray

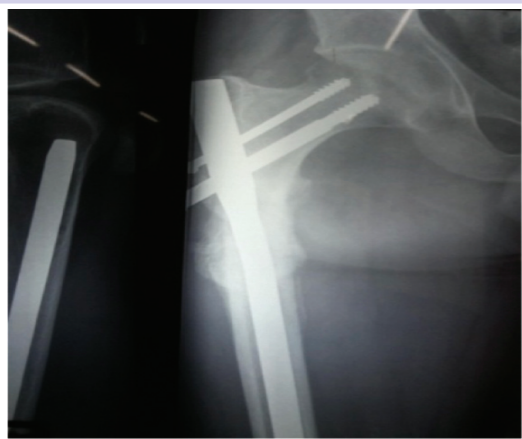


Figure-3 : Showing after 6 months post-operative x-ray



Figure-4 : Showing after 6 months post-operative

in the neck after putting neck screw. 1 of the case antirotation screw had to be removed after inserting as it was penetrating superior cortex of the neck, 1 case failed to lock distally as we used long PFN for which Zig was not available and free hand technique was tried but could not lock. In 3 cases jig mismatching occurred, only 2 cases of post op infection could be treated with antibiotics.

1 case of Malunion in varus, 3 cases of delayed union that required dynamization, 7 (23.33%) cases showed union at 4 months, 13(43.33%) cases at 5 months and 7(23.33%) cases showed union at 6 months duration. 3(10%) cases of delayed union for which dynamization was done and united at average of 7 months. Functional results are scored as per Harri's hip score good to excellent scores are seen in 83.33%of cases, 10% fair results.6.66% poor results.

DISCUSSION

The sub trochanteric region is between 5 cm below the lesser trochanter in the shaft of femur. Sub trochanteric region is usually exposed to high stresses during activities of daily living. Axial loading forces through the hip joint create a large moment arm, with significant lateral stresses and medial compressive loads. In addition to the bending forces, muscle forces at the hip also create torsional effects that lead to significant rotational shear forces.^[20]

During normal activities of daily living, up to 6 times the body weight is transmitted across the sub trochanteric region of the femur.^[21] As a result of these high forces, the bone in this region is a thick cortical bone with less vascularity and results in increased potential for healing disturbances, the muscular forces acting on this region

leads to displacement of distal fragment into flexion, abduction, external rotation, hence sub trochanteric fracture is difficult to manage and associated with many complications.^[22]

This resulted in mandatory surgical treatment of these fractures. The surgical technique needs to address two factors, 1) implant to counter the forces acting at the fracture site., extra medullary load sharing devices like plate fixation or intra medullary load bearing devices like PFN. 2) surgical technique perse, open technique or minimally invasive.

Extra medullary fixation with plating has the potential disadvantages of extensive surgical exposure, severe soft tissue damage and blood loss, thus leading to problems of fracture union and implant failure. In addition, the eccentric plating is prone to fatigue breakage due to their mechanical load-sharing effect. Allowing a minimally open approach, intramedullary nailing is closely linked to "biological internal fixation", in addition to its mechanical benefits over plate fixation.

Intramedullary fixation allows the surgeon to minimize soft tissue dissection thereby reducing surgical trauma, blood loss, infection, and wound complications.^[23] The Proximal femoral nail to reduce the risk of implant related complications. Therefore in addition to the 8 mm load bearing femoral neck screw, the PFN has a 6.5mm antirotation screw to increase the rotational stability of the neck fragment.

An anatomic 60 neck valgus bend in the coronal plane, a narrower distal diameter and distal flexibility of the nail eliminates the need for routine reaming of the femoral shaft and also minimizes stress concentration and tension in the femoral shaft. This should reduce the risk of intra operative and postoperative femoral shaft fractures.

PFN also has all the advantages of an intramedullary device such as decreasing the moment arm, can be inserted by closed technique which retains the fracture hematoma, decreases blood loss, minimizes soft tissue dissection and wound infections. In an experimental study Gotze et al (1998) compared the loadability of osteosynthesis of unstable per and subtrochanteric fractures and found that the PFN could bear the highest loads of all devices.^[25]

Age distribution

Most of patients in present study were from age group of 2nd to 7th decade of life . The average age is 39.2 years. This is significantly lower compared to that quoted by other authors in literature. Boldin et. al ^[24] 73 years, I.B.Schipper Series 82.2 years..

Sex distribution

A significant male preponderance of 83.3% was noted in this study as compared to the female preponderance. It is comparable to the study by Boldin et. al ^[24] (70%) and I.B.Schipper (82%), B.B. Ohari and Hatim Shaikh from Indore (1957) .

Mode of Injury

In 10% of patients fracture is a result of trivial fall and majority of them are elderly age group patients especially females. High velocity injuries like road traffic accidents and fall from heights accounted for 90% of these fractures and most of them were males. In WM. Gadegone's 75% of the fractures were due to domestic falls and this can be explained by the higher mean age group of the patients and vehicular accidents resulted in the remaining 25% of subtrochanteric fractures in their study.

Side of Injury

66.66% of the subtrochanteric fractures involved the right femur in our study as compared to 52% in I.B.Schipper and 33.33% involved the left as compared to 48% in I.B.Schipper.

Types of fracture

Type IB fracture pattern constituted the highest percentage 47% (14) of all fracture patterns.

Time duration between hospital admission and surgery

Admission - operation interval in our study varied from 1 - 10 days. Average time lapse for surgery: 3.75 days, the average was 2 days. In B.Schipper's series the average blood loss occurred during surgery with PFN was 100 ml. Partial weight bearing with PFN 6 weeks and full weight bearing with PFN was 12 weeks.

Complications

Post- operatively 2 patients had (6.66%) had superficial wound infections and this settled with parenteral antibiotics. And no deep infections occurred in this study. It is 4.1% superficial infections and 2.5% deep infection. In I.B. Schipper et al study. Werner et al was the first who introduced the term Z-effect, detected in 5 (7.1%) of 70 cases. The Z-effect phenomenon is referred as a characteristic sliding of the proximal screws to opposite directions during the postoperative weight-bearing period . In present study had Z-effect in two cases (6.66%).

The 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 had 3 cases with Z effect and 2 with reverse Z-effect. The present study had one case with reverse Z-

Table 1 : Mechanical complications

	C.Boldin et al	Dominigo et al	Fogagno et al	Simmermacher et al	Present Study
No of Patients	55	295	46	191	30
Cu out	2	4	5	1	0
Z effect	3	-	-	-	2
Reverse Z effect	2	-	-	-	1
Implant Failure	-	-	2	1	1
Fracture below the tip of Implant	-	1	1	-	-
Reoperation rate.	18%	3%	19%	7%	13.33%

effect (3.3%).

Varus deformity was noted in one case (3.33%) in the present study due to early backing out of screws. In the series by K.D Harrington 1973, out of 72 cases there were 4 cases of coxa vara 5.5%. The average time for radiological union was 3 months in the present study whereas in I.B.Schipper series it was approximately 4 months.

Evaluation of Function by Harris Hip Scoring system

83.3% (25) no or slight pain that did not affect their activities. 86.6% (26) had no or slight limp 83.3% (25) of the patients were mobilized without any walking aids, Cane was required for long walks in 16.6% (5) of patients.86.6% (26) of the patients with PFN can comfortably sit in an ordinary chair for one hour and 6.6% (2) patients can sit on high chair for half an hour and 6.6% (2) patients were unable to sit comfortably.

The range of movements namely flexion, abduction, adduction, external and internal rotation was good in most cases, excellent in a few. In present study the final outcome as calculated by Harris Hip score, the number

Table 2 : Comparative studies

	C.Boldin et al	Ekstrom et al	Menzes et al	Lei sheng et al	Present Study
No of Patients	55	105	155	49	30
Duration of Surgery(minutes)	68	77	76	46	105
Bony Union (months)	4	9	6	6	6
Fixation failure	0%	11%	2%	0%	13.3%
Delayed Union	---	---	0.7%	2%	10%
Open Reduction	10%	---	1.3%	34.6%	26.6%
Re Operation rate	10%	9%	12%		13.3%
Duration Hospital Stay(Days)		12	17		13.4

of PFN patients was excellent to good in 83.3% (25) patients and fair in 10% (3) of patients and poor in 6.6% (2) patients.

The mean Harris Hip score was in our series was 86.6 which was higher than I.B.Schipper series where the mean was 77.6.

CONCLUSION

1. PFN is load sharing device, biomechanically stable, has got high loadability, is indicated in all types of sub trochanteric fractures, irrespective of Communion, osteoporosis.
2. PFN gives rotational stability due to proximal of the two screws in the neck.
3. PFN gives the provision for collapsibility at the fracture site, due to dynamic hole in the nail, can be dynamized if required in delayed union.
4. PFN can be applied by closed methods and biological fixation is done, there by preserving soft tissues and blood supply to the fragments, and the union potential.

CONFLICT OF INTEREST :

The authors declared no conflict of interest

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