



Original Research Article

Outcome of Subtrochanteric Fractures of Femur Managed by Internal Fixation using long Proximal Femoral Nail: A Prospective Study

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Introduction

Fractures of the proximal femur that occur from lesser trochanter to the isthmus of the femoral canal, which is roughly 5 cm distal to the lesser trochanter, are generally termed as subtrochanteric fractures.¹ Previously these fractures were grouped along with complex intertrochanteric fractures.² However, subtrochanteric fractures present with multitude of management and rehabilitation problems. This has prompted the Orthopaedic trauma surgeons to provide special consideration to these fractures. Subtrochanteric fractures tend to have a bimodal age distribution.³ Young patients presenting with subtrochanteric femur fractures tend have high energy trauma as the mode of injury, where as in elderly patients these fractures, most of the times, are osteoporotic.⁴

The subtrochanteric fractures of femur have been classified by various authors, but most of the classifications systems do not have a bearing on

the management and outcome. Seinsheimer classification (Figure 1) is one of the most practical classification systems available for subtrochanteric fractures.⁵ Russel and Taylor classification (Figure 2) is the other commonly used classification for subtrochanteric fractures.

The surgical management of the subtrochanteric fractures is the accepted gold standard.⁶ Two broad categories of the implants for the internal fixation of the subtrochanteric fractures are available, which include extramedullary side plate devices and intramedullary fixation devices. The extramedullary side plate devises include dynamic condylar screw (DCS) and condylar blade plate while as the intramedullary implants include the proximal femoral nail (PFN).

In our study, we studied the functional outcome and complication profile of the long proximal femoral nail for the internal fixation of the subtrochanteric femoral fractures.

Materials and methods

Study Design

This study is a prospective, observational study, which was conducted in the department of Orthopaedics, Government Medical College Jammu, from June 2017 to August 2019. This study included 25 patients with subtrochanteric fractures, which were managed with long proximal femoral nail. Two patients were lost to follow up and were excluded from the study. Hence, the final number of patients with subtrochanteric fractures included in the study was 23.

Inclusion Criteria

- 1) Age >18 years
- 2) Both sexes
- 3) Fracture < 2 weeks old

Exclusion Criteria

- 1) Polytrauma
- 2) Neglected fractures
- 3) Pathological fractures
- 4) Intertrochanteric fractures
- 5) Open fractures

Preoperative assessment

After initial resuscitation according to advanced trauma life support (ATLS) protocol in the emergency department, patients were subjected to detailed history and thorough clinical examination for the assessment of any associated injuries, medical or surgical ailments.

Radiographs of the affected proximal femur (anteroposterior and lateral views) and Pelvis with both hips (anteroposterior view) were taken to determine the type of the fracture which was classified according to the Seinsheimer classification system (Figure 1).

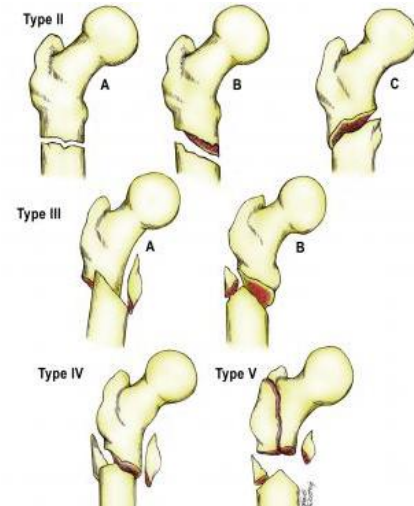


Figure 1: Seinsheimer classification: Type I: Undisplaced or less than 2 mm displacement, Type II: Two part fracture, IIA: Transverse fracture, IIB: Spiral fracture with lesser trochanter attached to proximal fragment, IIC: Spiral fracture with lesser trochanter attached to distal fragment, Type III: Three part fracture, IIIA: Spiral fracture in which lesser trochanter is the third fragment, IIIB: Spiral fracture in which with the third part a butterfly fragment, Type IV: Comminuted with four or more fragments, Type V: Subtrochanteric-Intertrochanteric fracture

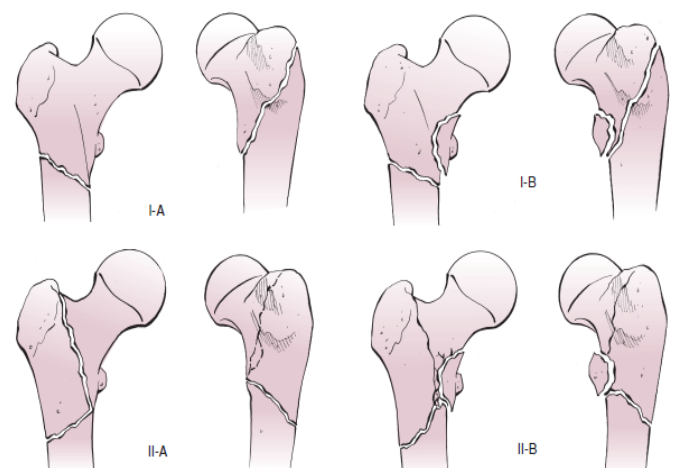


Figure 2: Russell and Taylor classification: Type I: Fractures do not extend into the piriformis fossa, IA: Lesser trochanter is intact, IB: Lesser trochanter is not intact, Type II: Fractures extend into the piriformis fossa, IIA: Lesser trochanter is intact, IIB: Lesser trochanter is not intact.



Figure 3: Long proximal femoral nail

Implant (Figure 3)

The Long PFN is made up of titanium or steel. The length of the nail varies from 320 to 440 mm, with a proximal diameter of 17 mm and the distal part of which is available in 9,10,11 and 12 mm diameter. An anatomical medio-lateral angle of both parts is 6 degrees. Through the proximal part, lower 11 mm load bearing femoral neck screw is placed. The tip should be placed in the

subchondral area of the lower half of the femoral head. An additional 6.5 mm antirotation hip pin is placed through the proximal part of the nail into the upper half of the femoral neck to prevent rotation of head-neck fragment. The tip is specially shaped to reduce stress concentration. Distally, the nail can be locked statically or dynamically by using either the round or oval locking hole.

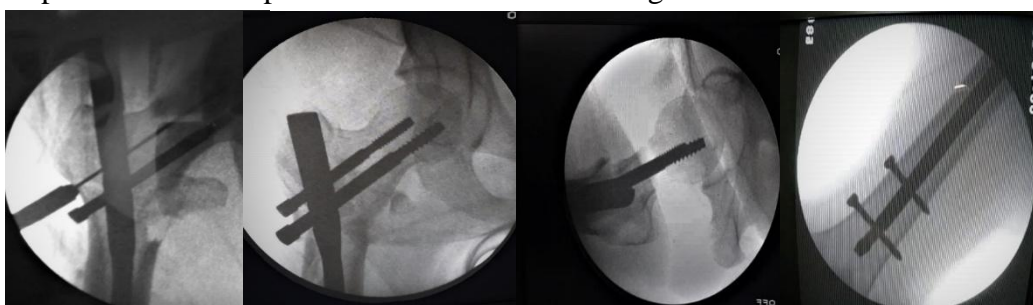


Figure 4: Serial operative steps



Operative technique (Figure 4)

The patient is positioned supine on a fracture table. The unaffected limb is abducted with hip and knees flexed to provide space for C-arm. The hip is flexed 15° on the affected side. Traction is applied on the affected limb through foot holder of the traction table. Closed reduction of the fracture is done under image intensifier control. If closed reduction is not possible, then open reduction is done. The limb is meticulously scrubbed with savlon or spirit and painted with povidone iodine solution. The whole of femur is draped. Palpate the greater trochanter. Make a 5 cm incision approximately 5 to 8 cm proximal from the tip of the greater trochanter. Make a parallel incision in the fascia of the gluteus medius and split the gluteus medius in line with the fibers. Subfascial plane of gluteal muscles is identified and breached to reach piriformis fossa. In the anteroposterior view, the nail insertion point is normally found on the tip or slightly medial to the tip of the greater trochanter. The nail is positioned with convexity medially. A guide wire is inserted laterally at an angle of 6° to the shaft. The guide wire can be inserted either manually with the Universal Chuck or with T-Handle. The central position of the guide wire is confirmed on the lateral view. Femur is reamed over the guide wire by means of various reamers in 1 mm increments. Proximal part of the femur is reamed to adequately accommodate the thick proximal part of the nail. The rest of the femur is reamed to 1 mm greater than the diameter of the nail to be used. The proximal femoral nail of appropriate length and diameter is mounted on a jig and introduced. The proper seating of the nail is checked using C-arm radiographs. Proximal locking is done using the sleeve system provided with the jig. Stab incision is given and the drill sleeves are inserted through the aiming arm to the bone. First, the 2 mm guide wire for femoral neck screw is inserted, then the 2 mm guide wire is introduced for neck pin. The position of the guide wires is checked under C-arm guidance, in both anteroposterior and lateral planes. The

measurements of the neck screw and neck pin is taken by using the same length guide wires. After confirming the proper position, reamer is introduced over the lower guide wire, reaming for the femoral neck screw. The appropriate size of femoral neck screw is introduced. Next reamer is introduced over the upper guide wire, reaming for the femoral neck pin and the appropriate size of femoral neck pin is introduced. Distal locking is done using free hand technique. Wound closure is done in layers. Antiseptic dressing is applied.

Post-operative care

After the surgery, quadriceps muscle strengthening exercises and range of motion exercises were started on first postoperative day. Toe touch crutch walking was started on second post-operative day. Antiseptic dressings were changed on third post-operative day. Stitch removal was done after 2 weeks post-operatively. Radiographs were done post operatively. Depending on patient factors, patients were discharged when stable. Patients were later allowed full weight bearing, depending on clinical and radiological union.

Follow up

Patients were assessed on the 2nd post-operative day, at 2 weeks, at 4 weeks, at 12 weeks and then at 6 months. Healing was judged by both clinical (pain & motion at fracture site) and radiological (bridging callus filling the fracture site or trabeculations across the fracture site) criteria and functional outcome was reviewed according to the Salwati and Wilson hip function scoring system. At each follow up, functional evaluation of the patient was done to note the range of movements, at the hip and knee, ability to walk, any pain, limp, residual shortening, deformities, wound condition and any other complaints. The occurrence of any post-operative complication like thigh pain, knee pain, stiffness, swelling, limb length discrepancy was noted. After 4 weeks, x-rays were taken again to check for position of implant and evidence of radiological union and to rule out development of avascular necrosis of

femoral head. Subsequently, the patients were followed at monthly intervals till 6 months.

Results and Observations

Patients in our study were aged between 21 to 91 years, with a mean age of 53.91 years. Out of the 23 patients 16 (69.56%) were males and only 07 (30.43%) patients were females. Right limb was involved in 13 patients (56.52%) and left limb in 10 patients (43.47%). Out of 23 patients, the mode of injury was road traffic accident in 12 patients (52.17%), domestic fall in 08 patients (34.78%) and fall from height in 03 patients (13.04%). Out of 23 patients, associated comorbidities were present in 11 patients (47.82%). (Table 1)

We used Seinsheimer system to classify the subtrochanteric fractures. We observed 11 patients (47.82%) with type II fractures, 09 patients

(39.13%) with type III fractures, 03 patients with type IV fractures and none of the patients with type I or type V fractures were seen.(Table 2)

The mean operative time was 74.34 minutes. The mean operative blood loss was 261.96 ml. The average duration of union was 16.78 weeks. The mean functional outcome score, as studied using Salwati and Wilson hip scoring system, was 30.52 at 6 months. (Table 1)

21 patients (91.30%) showed excellent to good outcome, 01 patient (4.34%) showed fair and 01 patient (4.34%) showed poor outcome. (Table 3& Figure 5)

The complications studied included wound infection in 2 patients (8.69%), knee stiffness in 2 patients (8.69%), shortening in 2 patients (8.69%) and delayed union in 1 patient (4.47%). (Table 4)

Figure 5: Pie chart depicting functional results (Salwati & Wilson hip scoring system)

	Male	Female	Total
Age in years (Mean ± SD)	51.68 ± 22.42	59.00 ± 16.01	53.91 ± 20.57
Sex	16 (69.56%)	07 (30.43%)	23 (100%)
Mechanism of injury			
Road traffic accident	10/16 (62.50%)	02/07 (28.57%)	12/23 (52.17%)
Domestic fall	04/16 (25.00%)	04/07 (57.14%)	08/23 (34.78%)
Fall from height	02/16 (12.50%)	01/07 (14.28%)	03/23 (13.04%)
Side involved			
Right	10/16 (62.50%)	03/07 (42.85%)	13/23 (56.52%)
Left	06/16 (37.50%)	04/07 (57.14%)	10/23 (43.47%)
Co-morbidities			
Diabetes	02/16 (12.50%)	01/07 (14.28%)	03/23 (13.04%)
Hypertension	03/16 (18.75%)	02/07 (28.57%)	05/23 (21.73%)
Hypothyroidism	01/16 (06.25%)	0/07 (0%)	01/23 (04.34%)
Chronic pulmonary disease	01/16 (06.25%)	0/07 (0%)	01/23 (04.34%)
Schizophrenia	01/16 (06.25%)	0/07 (0%)	01/23 (04.34%)
Operative time in minutes (Mean ± SD)	75.31 ± 8.65	72.14 ± 9.06	74.34 ± 8.70
Operative blood loss (Mean ± SD)	261.25 ± 14.54	263.57 ± 10.29	261.95 ± 13.20
Duration of fracture union in weeks (Mean ± SD)	16.75 ± 2.51	16.85 ± 1.06	16.78 ± 2.15
Salwati& Wilson score at 6 months (Mean ± SD)	30.62 ± 4.77	30.28 ± 4.82	30.52 ± 4.67

Table 2: Classification of fractures

Seinsheimer type of fracture	No. of patients	Percentage (%)
I	00	0
IIA	01	04.34
IIB	05	21.73
IIC	05	21.73
IIIA	04	17.39
IIIB	05	21.73
IV	03	13.04
V	00	0
Total	23	100

Table 3: Functional outcome of patients using Salwati& Wilson hip scoring system

Results	No. of patients	Percentage (%)
Excellent	14	60.86
Good	07	30.43
Fair	01	04.34
Poor	01	04.34
Total	23	100

Table 4: Complications observed

Complications	No. of patients	Percentage (%)
Wound infection	02	08.69
Knee stiffness	02	08.69
Shortening	02	08.69
Delayed union	01	04.47

Discussion

Subtrochanteric fractures of the proximal femur continue to be a challenge to an Orthopaedic surgeon. The specific anatomy, biomechanical stresses and forces acting at the region, make the management difficult.¹ Present consensus is that all the subtrochanteric fractures should be internally fixed, to allow for the early mobilization and hence reduce the associated morbidity.⁶ Currently, two broad categories of internal fixation devices are commonly used for fixation of subtrochanteric fractures. These include, extramedullary side plate implants like dynamic condylar screw (DCS) and intramedullary implants like proximal femoral nail (PFN).

In the present study, we studied 23 patients with subtrochanteric fractures managed with proximal femoral nail, which included 16 males (69.56%) and 7 females (30.43%). The mean age of the patients taken for study was 53.91 years, which is lower than that observed by Radford PJ *et al*, Nungu K *et al* and Emrah KS *et al*.^{7,8,9} This is probably due to the fact that the activity level of the older population in our region is low. Right limb was involved in 13 patients (56.52%) and left limb in 10 patients (43.47%). In our study, road traffic accidents predominated as the cause of trauma which is in contrast to Emrah KS *et al* and other published series in which low velocity

domestic injuries predominate.⁹ We used Seinsheimer system to classify the subtrochanteric fractures. We observed 11 patients (47.82%) with type II fractures, 09 patients (39.13%) with type III fractures, 03 patients with type IV fractures and none of the patients with type I or type V fractures were seen. The mean operative time was 74.34 minutes. The mean operative blood loss was 261.96 ml. The average duration of union was 16.78 weeks. The mean functional outcome score, as studied using Salwati and Wilson hip scoring system, was 30.52 at 6 months.

We achieved excellent results in 14 patients (60.68%), good results in 07 patients (30.43%), fair results in 01patient (4.34%) and poor result in 01 patient (4.34%). The complications observed included wound infection in 2 patients (8.69%), knee stiffness in 2 patients (8.69%), shortening in 2 patients (8.69%) and delayed union in 1 patient (4.47%).Our results are in agreement to the previous studies including Emrah KS *et al* and RKJ Simmermacher *et al*.^{9,10}

Conclusion

We conclude that long proximal femoral nail is an effective implant for the management of subtrochanteric femur fractures in view of promising functional results, minimal soft tissue damage, short surgical time, less operative blood loss and early fracture union rates.

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