

## ORIGINAL RESEARCH

# Subtrochanteric femur fracture treated with long proximal femoral nail and its functional outcome

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### ABSTRACT

**Background and introduction:** Subtrochanteric (ST) femur fractures are defined as fractures of the proximal femur that occur within 5 cm distal to the lesser trochanter. The incidence of fractures of the proximal femur is markedly increasing because of increasing life expectancy and motor vehicle accidents. Subtrochanteric fractures of the femur pose a great problem because of the diversity of fracture patterns and difficulty in attaining anatomical reduction.

**Methods:** Hospital based study of 30 patients with subtrochanteric femur fractures (Russell Taylor type 1) admitted in Navodaya medical college hospital. Patients were operated after pre-operative evaluation. Regular follow ups were done at 4 weeks interval to assess functional outcome using Harris Hip score and Merle D'Aubigne score.

**Results:** Out of 30 cases, majority were from 41-50 years followed by 23.3% from 31-40 years, 20% from 51-60 years and 13.3% each from less than 30 years and above 60 years each. 60% of the patients were male, Right side was affected in 56.7% and Road traffic accidents 90% were the most common mode of injury. Majority of the patients belonged to Russell Taylor type 1B i.e. 60% and remaining were type 1A i.e. 40%. Prevalence of complications in our study was 26.7%. Clinical outcome using Harris hip score showed excellent results in 56.7%, good in 26.7% and fair in 16.7% and outcome according to D'Aubigne score showed very good results in 56.7%, good in 26.7%, medium in 10% and fair in 6.7%.

**Conclusion:** Subtrochanteric fractures of femur are difficult to manage considering the amount of forces acting on the fracture fragments. Deciding between intramedullary and extramedullary fixation depends upon the fracture type and involvement of the piriformis fossa. Long PFN is a reliable implant for subtrochanteric fractures, which yields high union rate with minimal soft tissue damage. In our study the outcome with long PFN treatment showed 56.7% excellent and 26.7% good results with minimum complications. Long PFN fixation has biological and biomechanical advantages, but the operation is technically demanding.

**Key words:** Subtrochanteric fractures, Russell Taylor type 1, Closed reduction, Long PFN, Harris Hip score

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### INTRODUCTION

Subtrochanteric (ST) femur fractures are defined as fractures of the proximal femur that occur within 5 cm distal to the lesser trochanter<sup>[1]</sup>. Overall, the incidence of these fractures globally has been estimated to be approximately 15–20 per 100,000 individuals<sup>[2]</sup>. The age distribution for these fractures has a bimodal distribution: individuals younger than 40 years old account for approximately 20% of ST fractures, while

individuals older than 50 years account for over 66% of ST fractures<sup>[3]</sup>. At younger ages, the incidence of these fractures appears to be nearly equal between male and female; however, with increasing age, the incidence among females increases disproportionately to males<sup>[4]</sup>.

Subtrochanteric femur fracture is defined as a clinically rare fracture with the primary fracture line within 5 cm below the lesser trochanter. In 1949,

Boyd and Griffin [1] first described subtrochanteric femur fractures and distinguished them from intertrochanteric fracture, and they also noted the unsatisfactory postoperative outcomes in many subtrochanteric fracture patients. According to Koch's study [5], the compressive stress on medial cortex was as high as 1100 Newtons, so the subtrochanteric fractures were usually comminuted fractures, which also indicated the necessity of reconstructing the medial cortex.

Once a fracture occurs, the process of healing is relatively slow. Following the fracture, the proximal and distal segments are deformed by forces produced by the surrounding musculature of the lesser and greater trochanters, to be specific, the proximal end is flexed and rotated outwards by the traction of iliopsoas and abducted by the force of hip short abductor muscle, the distal end is adducted by the pulling of the great adductor muscle [6]. High

compressive, tensile forces of muscles separate the fracture segments and make subtrochanteric fracture unstable. So, there are no absolute contraindications for those cases, as long as the patients can tolerate surgery, surgical treatment is the treatment of choice.

The biomechanical characteristics of the area, poor vascularity caused by the predominance of cortical bone and inadequacy of reduction and internal fixation are responsible for malunion, delayed union and mechanical failure of implants used in the treatment [7-14].

In 1996, the Arbeitsgemein-schaft für Osteosynthesefragen AO/ASIF developed the proximal femoral nail (PFN) as an intramedullary device for the treatment of such fractures. With all advantages of an intramedullary nail, it has several other favourable characteristics: it can be dynamically locked, allows early mobilization, has high rotation stability and is done with minimal soft tissue damage

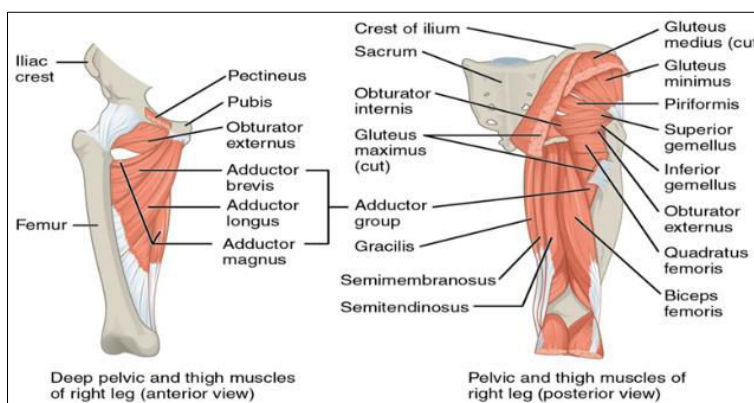


Fig 1: Muscular attachment of femur

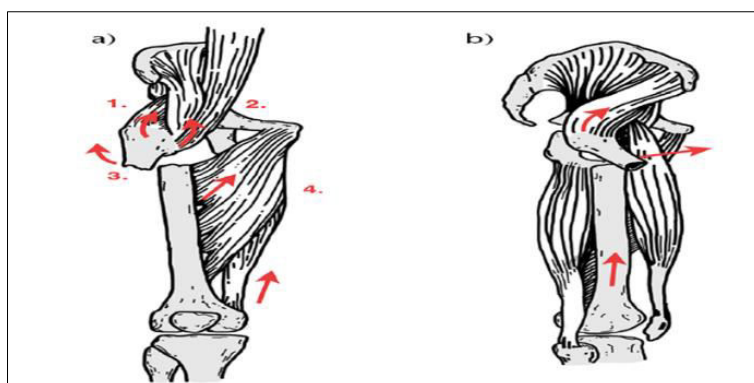


Fig 2: Deforming forces on proximal femur

**Materials and Methods**

Study was carried out in Department of orthopedics, Navodaya medical college hospital and research Centre, Raichur. All Patients with Subtrochanteric fractures satisfying inclusion criteria admitted in Navodaya medical college hospital and research Centre, Raichur were included in the study during the study period of 18 months from January 2021 to July 2022. Ethical clearance was granted from institutional ethical committee, NMCH and RC.

**Inclusion criteria**

Patients within age group 18 to 70 years, All subtrochanteric fracture femur (Russell Taylor type 1, Patients fit for surgery, Patient giving consent for study

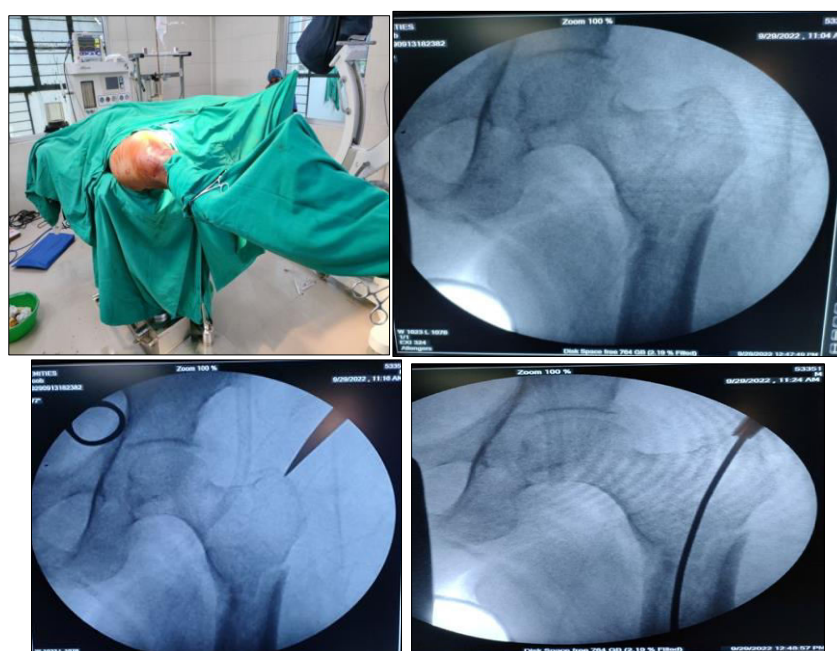
**Exclusion criteria**

Subtrochanteric fractures involving piriformis fossa, Stable intertrochanteric fractures, Open hip fractures, Pathological fractures, Paediatric fractures (before physal closure)

### Surgical procedure

Under Spinal or epidural anesthesia, patient positioned Supine on a standard fracture table. Rest operating foot in a padded foot holder and use a padded perineal post, unaffected limb is kept in hip flexion and abduction over a side support. The pelvis must lie in the horizontal position. Adduct the affected femur to allow access to trochanteric region. Tilt the trunk away from the operating side and strap the arm of the same side across the chest of the patient. Place the uninjured side flexed and abducted to allow unimpeded access to the image intensifier between the legs. Image intensifier is placed opposite to the side being operated. Fractures were reduced with initial closed reduction by longitudinal traction and internal rotation of the foot. In certain cases where reduction was not satisfactory Steinmann pin joystick and clamps were used for proper reduction. The alignment of the medial cortex in AP view and reduction of the proximal fragment and shaft fragment in lateral view is checked. 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 fasciae of the Gluteus medius and split the Gluteus medius in line with its fibres. The point of entry is made on or just medial to the tip of trochanter on antero-posterior view and in line with medullary cavity in lateral view using a curved bone awl. The

guide wire can be inserted either manually with the Universal Chuck with T-Handle or with a power tool with the Quick Coupling for Kirschner Wires. Guide wire passed over a protection sleeve. The position of guide wire is checked in AP and lateral views. The 15 mm cannulated proximal femoral reamer is used to ream the proximal femur for up to 7 cm. Distal reaming of the femoral canal is done with graded cannulated reamers till more than 1 size of the distal diameter of the nail. Nail is mounted on the insertion handle or jig. Under image intensifier insert the nail, first keeping the jig anteriorly advance the nail over guide wire and during the last third of the femur, the jig is turned lateral and advanced either manually or by slight hammering. Lateral stab incision is made for neck screws over the jig, sleeves are passed, guide pins of size 2.5 mm and 2 mm for load bearing cervical lag screw and derotation screws are passed respectively. Guide pins position confirmed under fluoroscopy in both views. Reaming done over guide pins using 6.4mm and 8mm reamers. Lag screw of appropriate length is placed into the subchondral bone 5mm from the articular surface of femoral head. In similar fashion derotation screw is placed. Guide pins are taken out. Distal locking also is done with the aid of distal targeting guide by two 4.9 mm locking bolts after the position of the screws were confirmed with the C-arm.



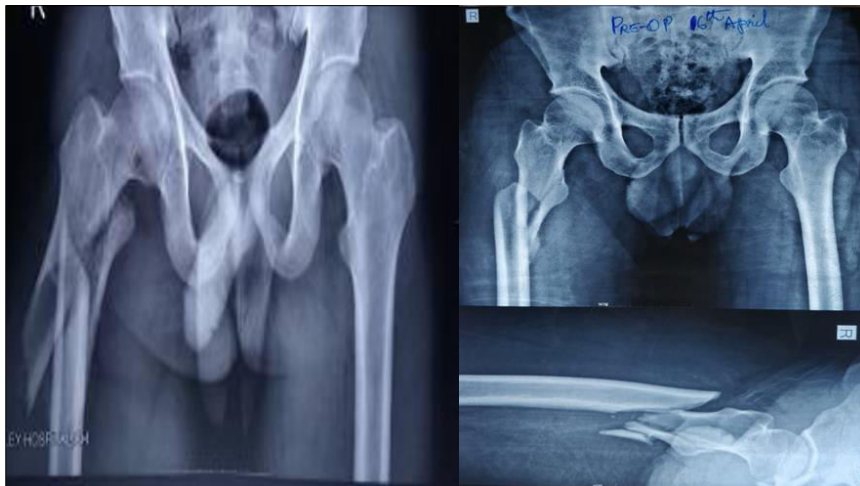


**Fig 3: Intra operative image**

**Follow Up**

Regular follow up of every patient was carried out at every 4-week interval. Following points were noted after clinical and radiological examination, Gait, Pain, Deformity, Shortening, Range of hip and knee motion, Ability to sit cross legged, Ability to squat, whether returned to pre injury occupation.

Radiologically x-ray were taken for-Signs of union, Failure of the fixation, Failure of the implant. Partial weight bearing was started 2 to 4 weeks post operatively. Full weight bearing was allowed after radiological and clinical signs of union. Grading of the patients was done as per D'Aubigne and Postel scale and Harris hip scoring.



**Fig 4: Pre- operative x-ray**



**Fig 5: Post-Operative x-ray**



**Fig 6: 4 month follow up x-ray**



**Fig 7: Functional outcome**

**Results**

We included 30 Patients with subtrochanteric fractures satisfying inclusion criteria admitted in Navodaya medical college hospital and research Centre, Raichur. Out of 30 cases, majority were from 41-50 years, followed by 23.3% from 31-40 years, 20% from 51-60 years and 13.3% each from less than 30 years and above 60 years each (Table 1). In this study out of 30 patients 60% of the patients were males whereas 40% were females (Table 2). In this study out of 30 patients 17 patients i.e. 56.7% had right sided fracture and 13 patients i.e. 43.3% had left sided fracture (Table 3). Mode of injury showed that majority had road traffic accident i.e. 90%, followed by two patients who had accidental fall i.e. 6.7% and

one had fall from height i.e. 3.3% (Table 4). Distribution according to the type of fracture using Russell Taylor Classification, showed that majority of the patients belonged to Type 1B i.e. 60% and remaining were Type 1A i.e. 40% (Table 5). 8 patients out of 30 had experienced complications, hence prevalence of complications in our study was 26.7%. Incidence of superficial infection was 10%, shortening was 10% and ER (external rotation) deformity was 6.7% (Table 6). Distribution according to outcome using Harris hip score showed excellent results in 56.7%, good in 26.7% and fair in 16.7% (Table 7). Clinical outcome according to D'aubigne score showed very good results in 56.7%, good in 26.7%, medium in 10% and fair in 6.7% (Table 8).

**Table 1: Age distribution**

		Frequency	Percent
Age group in years	<30	4	13.3
	31-40	7	23.3
	41-50	9	30.0
	51-60	6	20.0
	>60	4	13.3
	Total	30	100.0

**Table 2: Sex distribution**

		Frequency	Percent
Gender	Male	18	60.0
	Female	12	40.0
	Total	30	100.0

**Table 3: Side distribution**

		Frequency	Percent
Side	Left	13	43.3
	Right	17	56.7
	Total	30	100.0

**Table 4: Mode of injury**

		Frequency	Percent
Mode of injury	Accidental fall	2	6.7
	Fall from height	1	3.3
	RTA	27	90.0
	Total	30	100.0

**Table 5: Type of fracture**

Type of fracture		Frequency	Percent
Russell Taylor Classification	Type 1A	12	40.0
	Type 1B	18	60.0
	Total	30	100.0

**Table 6: Prevalence of complications**

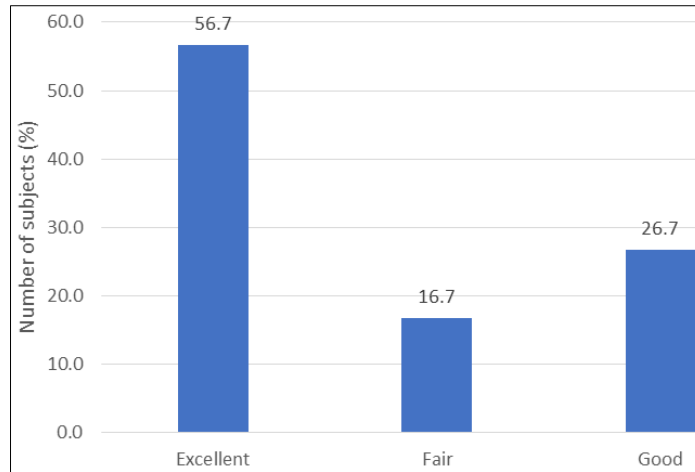
		Frequency	Percent
Complications	ER deformity	2	6.7
	Nil	22	73.3
	Shortening	3	10.0
	Superficial Infection	3	10.0
	Total	30	100.0

**Table 7: Outcome according to HHS**

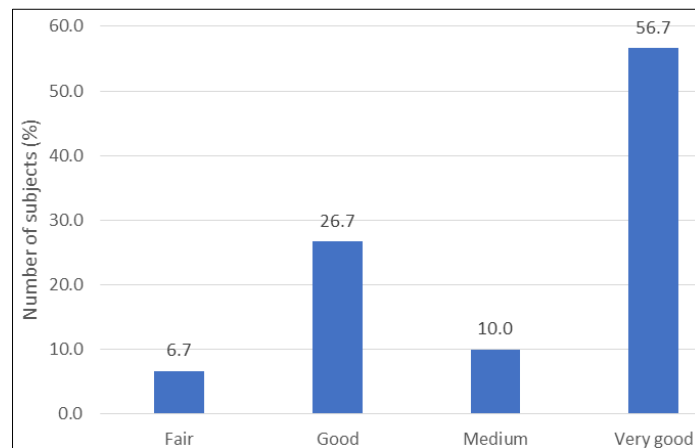
Harris hip score		Frequency	Percent
Outcome	Excellent	17	56.7
	Good	8	26.7
	Fair	5	16.7
	Total	30	100.0

**Table 8: Outcome according to D'aubigne score**

		Frequency	Percent
Clinical outcome according to D' Aubigne score	Fair	2	6.7
	Medium	3	10.0
	Good	8	26.7
	Very good	17	56.7
	Total	30	100.0



**Chart 1: Distribution of outcome according to HHS**



**Chart 2: Distribution of outcome according to D'Aubigne score**

**Discussion**

We included 30 Patients with subtrochanteric fractures satisfying inclusion criteria admitted in Navodaya medical college hospital and research Centre, Raichur. The proximal femoral nail (PFN) is a new intramedullary device designed by AO in 1996 which introduces the benefit of the closed technique to the treatment of subtrochanteric fractures. The Indian versions of PFN are now available and have been used in our study. They are available in two varieties, the standard and the long cannulated. The standard PFN consist of a 240 mm long nail. Its proximal part is 14mm in diameter and distal part available in 9, 10, 11 and 12. Due to increased cases of stress fractures at the distal tip of short PFN in recent past, we preferred long PFN in all our cases. The long PFN comes in lengths of 340, 380,400 and 420 mm and is side specific. Two screws can be inserted through the proximal part, an 8 mm neck screw and a 6.4 mm antirotation screw.

Out of 30 cases, majority were from 41-50 years followed by 23.3% from 31-40 years, 20% from 51-60 years and 13.3% each from less than 30 years and above 60 years each. 60% of the patients were males whereas 40% were females. Mean age of the patients was 45.8±11.9 years. Mode of injury showed that

majority had road traffic accident i.e. 90% followed by two patients who had accidental fall i.e. 6.7% and one had fall from height i.e. 3.3%. Basani V. *et al.* [15] reported that mode of injury was road traffic accident i.e. 27.30% followed by fall from height i.e. 13.6%. Munavalli PP *et al.* [16] reported that 65% of the cases admitted were road traffic accidents, 25% due to fall from height and 10% due to trivial fall with right side being more common side affected.

Distribution according to type of fracture using Russell Taylor Classification showed that majority of the patients belonged to type 1B i.e. 60% and remaining were type 1A i.e. 40%. Shreepad Joshi *et al.* [17] reported that Russell Taylor classification was applied in this series because this classification was based on two variables and it determined the treatment modality, There were 16% type IA subtrochanteric factures, 66% of fractures were type IB, 13% of factures were type II A, 6.6% of fracture were type IIB. Munavalli PP *et al.* [16] reported that Russell and Taylor type IA fracture accounted for 40% of cases and type IB 35% cases. Mean duration of hospital stay was 24 days and mean time of full weight bearing was 14 weeks in our patients.

8 patients out of 30 had experienced complications; hence prevalence of complications in our study was

26.7%. Incidence of superficial infection was 10%, shortening was 10% and External Rotation deformity was 6.7%. One patient went on to get a revision surgery due to shortening. Munavalli PP *et al.*<sup>[16]</sup> in their study of 20 patients concluded that 5 patients encountered complications i.e. 25%. 2 patients had superficial infection i.e. 10%, 1 patient had shortening i.e. 5% and 2 patients i.e. 10% had delayed union. El-Mowafi HM *et al.*<sup>[18]</sup> in their study encountered 20% complications rate, with 5% incidence of deep infection and 15% of patients presented with screw loosening and screw back out. Basani V *et al.*<sup>[15]</sup> in a study of 22 cases reported that the overall complications were seen in 16% of cases with 9% i.e. 2 patients reporting superficial infection, 4% i.e. 1 patient reporting foot drop and 4% i.e. 1 patient reporting lag screw cut-out.

Distribution according to outcome using Harris hip score showed excellent results in 56.7%, good in 26.7% and fair in 16.7%. El-Mowafi HM *et al.*<sup>[18]</sup> in 2013 conducted the study with the objective to evaluate the results of management of 20 adult patients with subtrochanteric femoral fractures using a proximal femoral nail (PFN). Final results were excellent in 25%, good in 40%, fair in 20%, and poor in 15% of patients. Poor results were seen in three cases. Zhou ZB *et al.*<sup>[19]</sup> in their study reported that according to HHS system, 65 cases were considered as excellent in functional recovery, 8 good, 2 fair and 1 poor. The proportion of the patients with excellent and good recovery was 96.05%. Basani V. *et al.*<sup>[15]</sup> reported the outcome as excellent in 42.9%, good in 33.3%, fair in 19% and poor in 4.8% cases. Munavalli PP *et al.*<sup>[16]</sup> reported that Good (35%) to excellent (45%) results were seen in 85% of cases in our study. Subtrochanteric fractures of femur can be successfully treated by ORIF by LPFN resulting in proper anatomical reduction and hence alignment and high rate of bone union. Farhat YA *et al.*<sup>[20]</sup> reported that outcome was Excellent- 37.5%, Good- 33.3%, Fair- 16.7% and Poor- 12.5% using HHS scoring system. Our findings are consistent with the findings of the above-mentioned authors.

### Conclusion

Subtrochanteric fractures of femur are difficult to manage considering the amount of forces acting on the fracture fragments. Deciding between intramedullary and extramedullary fixation depends upon the fracture type and involvement of the piriformis fossa. Long PFN is a reliable implant for subtrochanteric fractures, which yields high union rate with minimal soft tissue damage. In our study the outcome with long PFN treatment showed 56.7% excellent and 26.7% good results with minimum complications. Long PFN fixation has biological and biomechanical advantages, but the operation is technically demanding.

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