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## Assessing the effectiveness of treating high subtrochanteric femur fractures using PFN nailing in elderly subjects: A prospective hospital-based study

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### Abstract

**Background:** Different fractures of the proximal femur are managed using different techniques depending on baseline functional status, patient's age, fracture stability, injury mechanism, morphologic features, and/or fracture location. One such fracture is Subtrochanteric fractures of femur seen below lesser trochanter extending 5cm distally in femur shaft.

**Objectives:** The present study was conducted to assess the functional outcomes of proximal femoral fractures in adult males managed using Long Proximal femoral nails.

**Methods:** The present prospective clinical study was conducted on 150 subjects managed for Subtrochanteric fractures of femur who were managed surgically using Long Proximal femoral nails. After treatment, the subjects were evaluated at 4 weeks, 6 weeks, and 3 months using suitable radiographs and Harris Hip Score, and the results were formulated.

**Results:** 16% (n=24) subjects had no pain, whereas, severe pain was seen in 8% (n=12) subjects. Concerning stair climbing, 32.66% (n=49) subjects were able to climb stair without help and 3% (n=4) subjects were not able to climb stair. 96.66% (n=145) subjects were able to sit comfortably post-surgery. 36.66% (n=55) subjects were able to walk easily and 14% (n=21) subjects could walk only indoors. 36% (n=54) subjects needed no support post-surgery, 58% (n=87) needed canes, and 6% (n=9) needed crutch support. No limping, slight limping, and moderate limping was seen in 34% (n=51), 40.66% (n=61), and 25.33% (n=38) subjects respectively. The functional results for the present study were excellent, good, fair, poor, and not known in 26% (n=39), 46% (n=69), 17.33% (n=26), 6.66% (n=10), and 4% (n=6) study subjects respectively

**Conclusion:** The present study concludes that subtrochanteric femur fractures are effectively managed using the long proximal femoral nail as a reliable implantation method with minimum soft-tissue damage and high bone-union rates. Various biochemical and biological advantages are associated with intramedullary fixation, however, this management strategy is technically demanding and requires patience and learning.

**Keywords:** Boyd and griffin classification, Harris hip score, long proximal femoral nail (PFN), subtrochanteric fractures

### Introduction

Fractures of the femur are usually seen at the junction between cortical bone and trabecular bone, as mechanical stress is highest at this junction of the femur leading to frequent comminution. There is increasing evidence of proximal femur fractures recently owing to high energy trauma caused by automobiles and rapid industrialization seen these days<sup>[1]</sup>. In elderly subjects, proximal femur fracture is the leading cause of mortality and morbidity seen frequently. This has also been confirmed by various biomechanical tests that in the femur, the subtrochanteric region causes significantly high compressive stress and stress in the medial cortex, which is greater than lateral cortex tensile stress<sup>[2]</sup>.

These fractures are very challenging to treat concerning the selection of treatment strategy and achieving acceptable anatomic reduction<sup>[3]</sup>. The management of these fractures conservatively has very high rates of complications including thromboembolism and pneumonia owing to prolonged morbidity and immobilization, which is also associated with high mortality.

Also, other commonly seen complications are shortening of varus deformity, malunion in varus deformity, joint contractures, and Decubitus ulcer [4]. Non-surgical fracture management requires prolonged bed rest and traction as these might lead to various complications as aspiration pneumonitis, Deep vein thrombosis, and bedsores, which are prevalent highly in the elderly subjects. Hence, early mobilization and early fixation are vital factors to be considered while treating these fractures [5, 6, 7].

Early mobilization and internal fixation are highly recommended for treating femur trochanteric fractures, especially in adult subjects, as indicated by various literature studies. This management modality is favored as it reduces mortality and complications associated with management using prolonged immobilization via conservative treatment.<sup>8</sup> Internal fixation and early mobilization are also associated with a lesser risk of malunion and good functional results which are not seen with conservative management.<sup>9</sup> The introduction of Dynamic Hip Screw (DHS) has changed the history of managing unstable fractures. However, the treatment of choice between conservative and surgical management is highly controversial.

Hence, the present study was conducted to assess the functional outcomes of subtrochanteric proximal femoral fractures in adult males managed using Long Proximal femoral nails in intramedullary fixation.

## Materials and Methods

The present prospective clinical study was conducted to assess the functional outcomes of subtrochanteric proximal femoral fractures in adult males managed using Long Proximal femoral nails in intramedullary fixation. The study included a total of 150 subjects managed for Subtrochanteric fractures of the femur surgically. The study was conducted in between May 2020 to October 2021, at Department Of Orthopaedics, Maharajah's Institute Of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh after obtaining clearance from the concerned Ethical committee. The study included a total of 150 subjects from both genders, within the age range of 42-93 years and the mean age of 62.43±6.28 years. The study population was comprised of subjects visiting the Outpatient Department of Orthopaedics with femur fracture in any leg. After explaining the detailed study design, informed consent was taken from all the subjects.

The exclusion criteria for the present study were subjects with acute lower extremity fractures, pathologic fractures, non-ambulatory subjects, subjects with dementia, and the subjects who were not willing to participate in the study.

The fractures in the present study followed the Boyd and Griffin classification [10] which was as follows

- Type I linear intertrochanteric
- Type II with comminution of trochanteric region
- Type III with comminution associated with the subtrochanteric component
- Type IV oblique fracture of the shaft with extension into the subtrochanteric region

After final inclusion, detailed history and demographics of all the subjects were recorded on a structured proforma. The subjects were continuously followed regularly till study completion by planning timely follow-up visits after treatment. All the subjects were surgically treated by single surgeon expertise in the field using a similar procedure.

The procedure uses an incision placed proximal to the trochanter and passed through tensor fascia lata and gluteus

medius till the trochanter tip was palpated which was then entered using the special sleeve and guidewire. This was followed by a distal incision made on the upper thigh lateral aspect which determines the future of guide wires entry to neck and hand for fracture reduction and medial forcing of fracture fragments. Nail length position was determined using C-arm and to achieve fracture reduction. A nail insertion point was determined and a guidewire was inserted. This was followed by internal fixation using drills and bolts and achieving distal locking with a long nail.

All the subjects were recalled at 4 weeks, 6 weeks, and 3 months for follow-up and postoperative assessment. At all recall visits, subjects were evaluated radio graphically using appropriate radiographs and clinically and for functional outcomes using Harris Hip Score. The assessment using Harris Hip scores were excellent: 90-100; good: 80-89; fair: 70-79; and poor: < 70. The collected data were subjected to the statistical evaluation using SPSS software version 21 (Chicago, IL, USA) and one-way ANOVA for results formulation. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at  $p < 0.05$ .

## Results

The present prospective clinical study was conducted to assess the functional outcomes of subtrochanteric proximal femoral fractures in adult males managed using Long Proximal femoral nails in intramedullary fixation. The study included a total of 150 subjects from both genders, within the age range of 42-93 years and the mean age of 62.43±6.28 years. The demographic characteristics of the study subjects are depicted in Table 1. Maximum study subjects were within the age range of 69-93 years with 45.33% (n=68) subjects. There were 60.66% (n=91) males and 39.33% (n=59) females in the present study. There were 42.66% (n=64) fractures of the right femur. Maximum trauma was due to road traffic accidents in 42.66% (n=64) subjects. Maximum study subjects had Boyd and Griffin Classification type IV. Diabetes and hypertension were commonly prevalent associated comorbidity in 20.66% (n=31) and 22.66% (n=34) subjects respectively. In the majority of the study subjects, the mean hospital stay duration was between 11-15 days in 62.66% (n=94) subjects.

On assessing the complications seen in the study subjects, no complications were seen in 44% (n=66) subjects, bedsores in 14% (n=21) subjects, hip stiffness in 12% (n=18) subjects, shortening in 6% (n=9) subjects, infection in 4% (n=6) subjects, non-union in 10% (n=15) subjects, malunion in 4.66% (n=7) subjects, peri-prosthetic fracture and death in 2.66% (n=4) subjects each as shown in Table 2.

The present study also assessed the functional outcomes in the study subjects, it was seen that 16% (n=24) subjects had no pain, whereas, severe pain was seen in 8% (n=12) subjects. Concerning stair climbing, 32.66% (n=49) subjects were able to climb stairs without help and 3% (n=4) subjects were not able to climb the stair. 96.66% (n=145) of subjects were able to sit comfortably post-surgery. 36.66% (n=55) subjects were able to walk easily and 14% (n=21) subjects could walk only indoors. 36% (n=54) subjects needed no support post-surgery, 58% (n=87) needed canes, and 6% (n=9) needed crutch support. No limping, slight limping, and moderate limping was seen in 34% (n=51), 40.66% (n=61), and 25.33% (n=38) subjects respectively as shown in Table 3.

The functional results for the present study were excellent, good, fair, poor, and not known in 26% (n=39), 46% (n=69),

17.33% (n=26), 6.66% (n=10), and 4% (n=6) study subjects respectively (Table 4).

### Discussion

The present prospective clinical study was conducted to assess the functional outcomes of subtrochanteric proximal femoral fractures in adult males managed using Long Proximal femoral nails in intramedullary fixation. The study included a total of 150 subjects from both genders, within the age range of 42-93 years and the mean age of 62.43±6.28 years. On assessing the complications seen in the study subjects, no complications were seen in 44% (n=66) subjects, bedsores in 14% (n=21) subjects, hip stiffness in 12% (n=18) subjects, shortening in 6% (n=9) subjects, infection in 4% (n=6) subjects, non-union in 10% (n=15) subjects, malunion in 4.66% (n=7) subjects, peri-prosthetic fracture and death in 2.66% (n=4) subjects each. These findings were in agreement with the findings by the studies of Kaplan K *et al.* <sup>[11]</sup> in 2008 and Korhan O *et al.* <sup>[12]</sup> in 2011 where similar complications like bedsores, infection, non-union, malunion, and mortality rates were similar as in the present study after managing femur fracture.

The present study also assessed the functional outcomes in the study subjects, it was seen that 16% (n=24) subjects had no

pain, whereas, severe pain was seen in 8% (n=12) subjects. Concerning stair climbing, 32.66% (n=49) subjects were able to climb stairs without help and 3% (n=4) subjects were not able to climb the stair. 96.66% (n=145) of subjects were able to sit comfortably post-surgery. 36.66% (n=55) subjects were able to walk easily and 14% (n=21) subjects could walk only indoors. 36% (n=54) subjects needed no support post-surgery, 58% (n=87) needed canes, and 6% (n=9) needed crutch support. No limping, slight limping, and moderate limping was seen in 34% (n=51), 40.66% (n=61), and 25.33% (n=38) subjects respectively. These results were consistent with the results by the studies of Ekstrom W *et al.* <sup>[13]</sup> in 2007 and Muzaffar N *et al.* <sup>[14]</sup> in 2013 where authors reported comparable functional outcomes after treating femur fracture using proximal femur long nail as in the present study.

The functional results for the present study were excellent, good, fair, poor, and not known in 26% (n=39), 46% (n=69), 17.33% (n=26), 6.66% (n=10), and 4% (n=6) study subjects respectively. These results were comparable to the results seen in the studies of Liu XW *et al.* <sup>[15]</sup> in 2009 and Janardhana A *et al.* <sup>[16]</sup> in 2013 where the results in terms of excellent, good, fair, poor, and not known were comparable and acceptable as in the present study.

**Table 1:** Demographic and disease-related characteristics of the study subjects

Characteristics	Percentage (%)	Number (n)
Mean Age	62.43±6.28	
Age Range	42-93	
42-52	32.66	49
53-62	22	33
63-93	45.33	68
<b>Gender</b>		
Males	60.66	91
Females	39.33	59
<b>Fracture Cause</b>		
Fall from Height	26	39
Road Traffic Accident	42.66	64
Trivial Fall	31.33	47
<b>Fracture Side</b>		
Right	42.66	64
Left	57.33	86
<b>Boyd and Griffin fracture classification</b>		
I	6	9
II	20.66	31
III	24	36
IV	49.33	74
<b>Associated surgical/medical conditions</b>		
Inguinal Hernia	6.66	10
Benign Prostate Hypertrophy	6	9
IHD	4	6
Anemia	4.66	7
CVA	4.66	7
COPD	8.66	13
Diabetes Mellitus	20.66	31
Hypertension	22.66	34
<b>Hospital stays duration (days)</b>		
<10	32	48
11-15	62.66	94
>15	5.33	8

**Table 2:** Postoperative complications as seen in the study subjects

Complications seen	Percentage (%)	Number (n)
None	44	66
Bedsore	14	21
Hip stiffness	12	18
Shortening	6	9
Infection	4	6
Non-union	10	15
Malunion	4.66	7
Peri-prosthetic fracture	2.66	4
Death	2.66	4

**Table 3:** Functional Outcomes are seen postoperatively in the study subjects

Functional Outcomes	Percentage (%)	Number (n)
<b>Pain</b>		
No Pain	16	24
Slight	20.66	31
Mild	18.66	28
Moderate	18	27
Severe	8	12
<b>Stair Climbing</b>		
Unable	3	4
Little	18	27
With railing help	46	69
Without railing help	32.66	49
<b>Sitting</b>		
Able	96.66	145
Unable	3.33	5
<b>Walking</b>		
Easily	36.66	55
Only Indoors	14	21
2-3 blocks	11.33	17
Up to 6 blocks	38	57
<b>Support</b>		
None	36	54
Canes	58	87
Crutch	6	9
<b>Limping</b>		
No Limping	34	51
Slight Limping	40.66	61
Moderate Limping	25.33	38

**Table 4:** Functional results are seen postoperatively in the study subjects

Functional Results	Percentage (%)	Number (n)
Excellent	26	39
Good	46	69
Fair	17.33	26
Poor	6.66	10
Not Known	4	6

### Conclusion

Within its limitations, the present study concludes that long proximal femur nail is a reliable and efficacious implantation technique for treating a subtrochanteric fracture of the femur with minimum damage to soft tissues and high rates of the accurate bone union. The study had few limitations as smaller sample size, short monitoring period, single institutional study, single geographical area, and hence, this study could not depict the overall picture. More prospective clinical trials with a larger sample size and longer monitoring period are required to reach the definitive conclusion.

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