

## Original Research Article

# Study of management of subtrochanteric fractures of femur with reconstruction nail

Shivananda Sundaram, Lokesh Munaiah\*, Radhakrishna A. Mallegowda, Jayaram B. Siddegowda, Jai Aditya Jhamb

Department of Orthopaedics, Kempegowda Institute of Medical Science and Research Center, V. V. Puram, Bangalore, Karnataka, India

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**\*Correspondence:**

Dr. Lokesh Munaiah,

E-mail: [drloky76@yahoo.co.in](mailto:drloky76@yahoo.co.in)

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### ABSTRACT

**Background:** Subtrochanteric fractures of femur are the fractures occurring from the inferior aspect of the lesser trochanter to 5 cm distally. They represent a challenge for surgeons due to the deforming forces acting on the region and the high rates of complications like non-union. This study evaluates the fixation of subtrochanteric fractures of femur with reconstruction nail which is a specialized antegrade intramedullary nail for femur.

**Methods:** A prospective study conducted between October 2017 to May 2019 where 20 cases of subtrochanteric fractures of femur were treated with reconstruction nail and were followed up serially till 24 weeks radiologically and clinically.

**Results:** The average time of union for patients was  $5.15 \pm 1.14$  months with 3 patients whose fractures didn't unite where one went for frank non union, one had a refracture and one patient had reverse z effect. The functional outcome was excellent in 45% patients and good in 30% patients while poor in 3 (15%) patients.

**Conclusions:** Reconstruction nail is a good device for subtrochanteric fractures of femur providing rigid fixation with low complication rates.

**Keywords:** Subtrochanteric fracture of femur, Reconstruction nailing, Modified Harris hip score

### INTRODUCTION

Subtrochanteric fractures are encountered in general population due to a simple fall or after a high-velocity injury involving both direct and indirect forces.<sup>1</sup> Subtrochanteric fractures are defined as fractures occurring in the proximal femur from the inferior aspect of the lesser trochanter to a distance of about 5 cm distally.<sup>2</sup> It can affect any of the age groups and accounts for 10 to 34% of hip fractures.<sup>3,4</sup> Subtrochanteric femur fractures have a bimodal age distribution.<sup>5</sup> Among younger patients, subtrochanteric fracture happens due to a high-energy injury and typically they have associated traumatic injuries such as a car accident or falling from a height.<sup>3,4</sup>

These fractures present a challenge for reduction due to the muscle attachments around the region and are one of the most difficult fractures to treat (Figure 1). Treatment failure is common due to the complications of non-union, shortening, angular deformity and rotational malunion.<sup>6</sup>

Adequate reduction and stable fixation are of utmost importance when treating these fractures to optimize patient outcomes.<sup>7,8</sup>

Early surgical intervention is advocated in majority of these patients to reduce the complications associated with long-term immobilization like deep vein thrombosis, thrombophlebitis, pulmonary embolism, urinary and lung

infections and cubitus ulcers. Various extramedullary and intramedullary implants are being used for these fractures.<sup>9</sup>

Early forms of treatment included casting, splinting and traction. Now, in most cases, the subtrochanteric fractures are best treated surgically. Over a period of time, the treatment has evolved and changed from conservative to operative, from extramedullary devices to intramedullary devices, from open reduction and fixation to newer minimally invasive techniques.<sup>2</sup>

Intramedullary nailing has developed as the best method of subtrochanteric fracture fixation and can lead to reliable reproducible results.<sup>10</sup>

Reconstruction or cephalomedullary nails are specialized, antegrade, femoral, intramedullary nails designed to provide fixation into the femoral head and neck for selected, complex, proximal-femoral fractures.<sup>11</sup>

Reconstruction intramedullary nails are the preferred design because the cephalomedullary component increases device-to-bone contact points in the proximal fracture fragment.<sup>12</sup> Hence, the study was aimed to analyze the role of reconstruction nail in patients having subtrochanteric fracture.

## METHODS

This prospective observational study conducted in Kempegowda Institute of Medical Sciences, Bangalore for the period of 18 months i.e. November 2017 to May 2019.

### *Inclusion criteria*

Total 20 cases, age group >18 yrs and all traumatic fractures of the subtrochanteric region were included.

### *Exclusion criteria*

Compound fractures, pre existing diseases of the affected hip, pathological fractures were excluded.

Patients after meeting the inclusion and exclusion criteria are selected for the study.

Upon the arrival of patients will be assessed clinically and stabilized haemodynamically. They will be subjected for radiographs of pelvis with both hips antero posterior view and full length femur antero posterior and lateral views.

Pre op investigations were done. Fitness for surgery and written informed consent for surgery was taken.

Post operative management was done and patients were mobilized with walker support before discharging the patient. Suture removal will be done on 12th day.

Patients were assessed clinically (using modified Harris hip score) and radiologically X-ray of upper end of femur with hip, at 6 weeks, 12 weeks, 18 weeks, 24 weeks.

### *Surgical procedure*

Intramedullary nailing done in reconstruction mode.

### *Statistical methods*

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. The following assumptions on data are made. Dependent variables should be normally distributed. Samples drawn from the population should be random, cases of the samples should be independent.

Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups, non-parametric setting for qualitative data analysis. Fisher exact test used when cell samples are very small.

+Suggestive significance (p value:  $0.05 < p < 0.10$ ),  
\*Moderately significant (p value:  $0.01 < p \leq 0.05$ ),  
\*\*Strongly significant (p value:  $p \leq 0.01$ ).

### *Statistical software*

The statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data, and Microsoft word and Excel have been used to generate graphs, tables, etc.

### *Ethical approval*

Institutional Ethical Committee approval taken.

## RESULTS

Twenty patients were included in the study, and the observations of these patients were compiled and analysed after the study period where minimum follow up was 6 months and average follow up of 9 months. Twenty two patients were taken initially but 2 patients died before 6 months follow up period due to medical comorbidities. The age wise distribution is mentioned in Table 1. Among the total 20 patients included in the study, 14 (70%) were male and 6 (30%) were female (Table 1).

Of the total 20 patients, 12 (60%) got injured by road traffic accidents, 6 (30%) by means of a trivial fall, 1 (5%) with a fall from height and 1 (5%) got injured with a fall of object on the limb (Table 1).

**Table 1: Age-wise, gender and mode of injury distribution.**

Variable	No. of patients
<b>Age in years</b>	
<40	4
40-50	7
51-60	3
61-70	3
>70	3
Total	20
<b>Mean age±SD (years)</b>	51.75±20.01
<b>Gender</b>	
Male	6
Female	14
Total	20
<b>Mode of injury</b>	
RTA	12
Fall from height	6
Trivial fall	1
Other	1
Total	20

Of the total 20 patients, 12 (60%) got injured on the left side and 8 (40%) on the right side.

**Table 2. Russell Taylor classification and AO classification distribution.**

	No. of patients	%
<b>Russell Taylor classification</b>		
1A	7	35.0
1B	9	45.0
2B	4	20.0
Total	20	100.0
<b>A/O classification</b>		
A	8	40.0
B	10	50.0
C	2	10.0
Total	20	100.0

**Table 5: Association of clinical variables according to functional outcome of patients studied.**

	Functional outcome				Total (n=20)	P value
	Excellent (n=9)	Good (n=6)	Fair (n=2)	Poor (n=3)		
	N (%)	N (%)	N (%)	N (%)		
<b>Russell Taylor classification</b>						
1A	5 (55.6)	0 (0)	0 (0)	2 (66.7)	7 (35)	0.111
1B	3 (33.3)	3 (50)	2 (100)	1 (33.3)	9 (45)	
2B	1 (11.1)	3 (50)	0 (0)	0 (0)	4 (20)	
<b>A/O classification</b>						
A	5 (55.6)	0 (0)	1 (50)	2 (66.7)	8 (40)	0.213
B	3 (33.3)	5 (83.3)	1 (50)	1 (33.3)	10 (50)	
C	1 (11.1)	1 (16.7)	0 (0)	0 (0)	2 (10)	

Continued.

Out of the total number of patients, 7 (35%) were in the category of 1A, 9 (45%) in the category of 1B and 4 (20%) in the category of 2B for Russell Taylor classification (Table 2).

Among the total 20 (100%) patients, 8 (40%) were in the category of A, 10 (50%) in the category of B and 2 (10%) in the category of C for A/O classification (Table 2).

Of the total 20 patients, 17 (85%) patients' fractures were reduced with closed reduction and 3 (15) with open reduction.

Among the total number of patients (100%), 3 (15%) showed nonunion, whereas 1 (5%) showed union in 3 months, 9 (45%) in 4.5 months, 6 (30%) in 6 months and 1 (5%) in 8 months (Table 3).

**Table 3: Union distribution.**

Union in months	No. of patients	%
<b>Nonunion</b>	3	15.0
<b>3 months</b>	1	5.0
<b>4.5 months</b>	9	45.0
<b>6 months</b>	6	30.0
<b>8 months</b>	1	5.0
<b>Total</b>	20	100.0
<b>Mean±SD (months)</b>	5.15±1.14	

**Table 4: MHHS distribution of patients.**

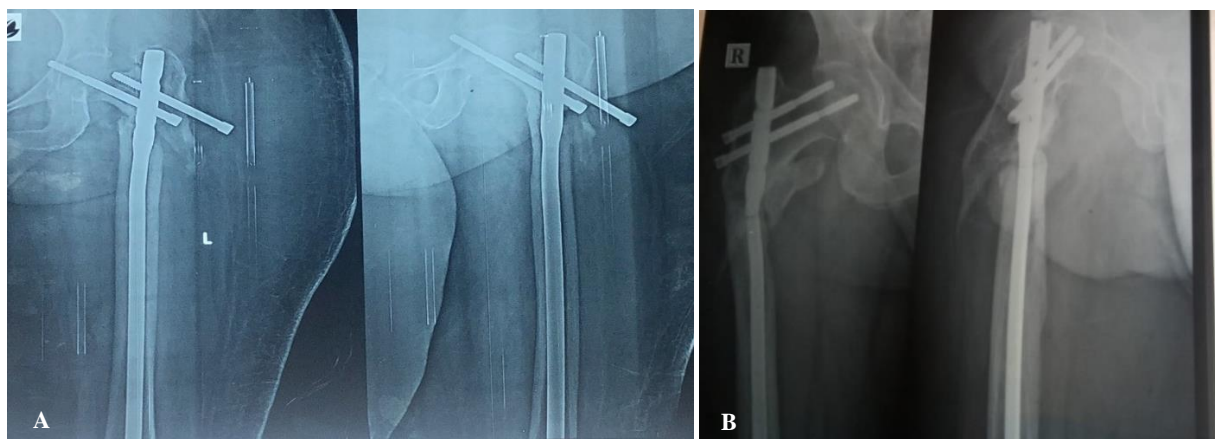
MHHS	No. of patients	%
<b>&lt;80</b>	5	25.0
<b>80-90</b>	6	30.0
<b>&gt;90</b>	9	45.0
<b>Total</b>	20	100.0
<b>Mean±SD</b>	81.40±20.82	

Of the total 20 patients (100%), 5 (25%) had lesser than 80 MHHS (modified Harris hip score), 6 (30%) had 80 to 90 and 9 (45%) had greater than 90 (mean- 81.40±20.82) (Table 4).

	Functional outcome				Total (n=20) N (%)	P value
	Excellent (n=9)	Good (n=6)	Fair (n=2)	Poor (n=3)		
	N (%)	N (%)	N (%)	N (%)		
<b>Method reduction</b>						
Closed	9 (100)	3 (50)	2 (100)	3 (100)	17 (85)	0.055+
Open	0 (0)	3 (50)	0 (0)	0 (0)	3 (15)	
<b>Shortening</b>						
None	8 (88.9)	4 (66.7)	1 (50)	1 (33.3)	14 (70)	0.255
1 cm	1 (11.1)	2 (33.3)	1 (50)	1 (33.3)	5 (25)	
2 cm	0 (0)	0 (0)	0 (0)	1 (33.3)	1 (5)	
<b>Gait</b>						
Normal	9 (100)	4 (66.7)	1 (50)	0 (0)	14 (70)	0.012*
Limp	0 (0)	1 (16.7)	1 (50)	1 (33.3)	3 (15)	
Lurch	0 (0)	1 (16.7)	0 (0)	1 (33.3)	2 (10)	
Unable to walk	0 (0)	0 (0)	0 (0)	1 (33.3)	1 (5)	



**Figure 1: Excellent outcome (A and B) pre op immediate post op, (C and D) 6 weeks 12 weeks, (E and F) 18 weeks 6 months, (G-I) functional outcome sitting cross legged squatting and SLRT.**



**Figure 2: Complications (A) reverse Z effect 6 months (B) non union 9 months nail breakage.**

Among the 20 patients (100%), 9 (45%) had an excellent functional outcome (Figure 1), 6 (30%) had good outcome,

2 (10%) with fair functional outcome and 3 (15%) had a poor functional outcome.



Total of 3 patients faced complications where one patient went for frank non-union and had nail breakage, one patient developed reverse z effect and one patient developed delayed union and had refracture after 9 months of initial surgery (Figure 2).

After statistical analysis there is a statistically significant relation between age and functional outcome. i.e., the older the age the expected functional outcome is less although this can be attributed to the fact that pre operative status of the operated hip is not taken into account. Gait and functional outcome have a statistically significant correlation as the patients with abnormal gait have a tendency to have worse functional outcome. Patients who have undergone open reduction have a better functional outcome in our study but the limitation of a small sample size is evident (Table 5).

## DISCUSSION

In the study conducted by Patel et al, 51 cases of subtrochanteric fractures were operated, out of which 36 were included for the study, 17 were extramedullary fixation and 19 were treated with intramedullary fixation. Mean follow-up of 23.9 months was taken and it was noted that the time for radiological union was more for extramedullary group (16 weeks) whereas in intramedullary group it was 14 weeks, 4 patients in extramedullary required revision surgery whereas 2 required revision surgery in intramedullary group, where 1 patient had Z effect with penetration of proximal screw in hip joint leading to pain and backing out of inferior screw. In our study with intramedullary implant, the mean rate of union was 20.6 weeks with one patient having reverse z effect with proximal migration of distal screw into joint and backing of proximal screw. The functional outcome was assessed with Harris hip score, and mean for intramedullary group in the above study was found to be 81.3 which was similar to our study (81.4).<sup>4</sup>

Raj et al conducted a study - functional and radiological outcome of subtrochanteric fracture treated with proximal femoral nail (PFN). The main advantage of proximal femoral nailing is being a closed technique offering an excellent reduction at the fracture site and sufficient strength for weightbearing even in unstable hip fractures. This intramedullary device is proven to be biomechanically superior to dynamic hip screw (DHS) which is an extramedullary device in the treatment of subtrochanteric fractures. The objective of this study was to analyze the functional and radiological outcome of subtrochanteric fracture treated with PFN. A study population was selected and was carried out with a total of 25 patients (male 20, female 5) treated with PFN from the year 2015-2016. All the patients were selected based on the inclusion criteria such as closed fractures of <3 weeks and age >25. The appropriate selected patients were evaluated both clinically and radiologically at regular intervals of 4 weeks, 8 weeks, 12 weeks, 16 weeks and 20 weeks. The functional outcome was measured using Harris

hip score. Based on the union, 50% of the patients showed full union by 10 to 15 weeks and 35% showed full union by 16 to 20 weeks. 95% of the patients had good anatomical results and 50% of the patients had excellent functional results. PFN like reconstruction nail, being a closed technique for intramedullary fixation allows for early mobilization, rehabilitation and return to function. In our study 50% patients showed full union by 18 weeks follow up and 45% patients achieved excellent functional outcome.<sup>1</sup>

In a study conducted by Chakraborty et al, where 12 cases of subtrochanteric fractures were operated in department of Orthopaedics, Pokhara, Nepal between January 2010 and July 2011 with various methods including PFN, Proximal femoral locking plate, DHS and K nail where they concluded PFN as their choice of implant for subtrochanteric fractures giving best radiological and functional outcome. PFN being a closed intramedullary device the results are comparable to our study.<sup>6</sup>

Gao et al conducted a study named 'a comparative study of long third-generation gamma nail and long PFN antirotation in the treatment of subtrochanteric femoral fracture.' In this study, 66 patients with subtrochanteric femoral fractures received operative treatment and complete follow-up. Thirty one patients were treated with long third-generation gamma nail (LTGN), and 35 patients were treated with long PFN antirotation (LPFNA). Both methods had satisfactory effects. The Harris scoring was excellent, and the rates were 90.32% LTGN and 91.43% LPFNA, respectively. Three cases of nonunion (4.55%), 2 cases were of long third-generation gamma nail and one of LPFNA and 5 cases of varus angulation deformity (7.58%) were detected, which occurred in patients with closed reductions. There were 8 cases (12.12%) of obvious hip pain and 12 cases (18.18%) of obvious side knee-joint pain. The comparison between the difficulty in intraoperative operation and postoperative complications did not reach statistical significance. LTGN and LPFNA were applied to subtrochanteric femoral fractures, and both methods can achieve a satisfactory therapeutic effect. However, the operation time and fluoroscopy time of LPFNA are shorter, with corresponding reductions in blood loss. The proportion of nonunion and malunion for patients suffering from open reduction was smaller than that of patients with closed reduction. Thus, this study finds that applying open reduction with a small incision and intramedullary fixation to treat complex trochanteric fracture is the more appropriate choice. This similar result was seen in our present study since patients having open reduction had a better radiological and functional outcome but the small sample size of our study remained a limitation.<sup>13,14</sup>

In the study conducted by Shah et al, where 51 subtrochanteric fractures of femur were operated with PFN, they observed excellent result in 39 patients, good results in 3 cases and poor results in 5 cases. The poor result in one patient was basically because of pathological

fracture leading to delayed union and low Harris hip score. In two fractures, the related injuries, i.e., tibia fibula fracture and large thigh wound contributed to poor results, whereas implant failure was noted in one case. The mean Harris hip score in the series was 90.1. Additionally, the patient's satisfaction was also evaluated, which has patients satisfied from the study. It was concluded that PFN is a good implant for subtrochanteric femoral fractures. It was discussed that in case of using short PFN for subtrochanteric fractures there was a risk of fracture distal to the implant hence PFN spanning whole femur (long PFN) with proximal and distal locking, an intramedullary load sharing implant, appears to be a satisfactory implant in management of fractures of subtrochanteric femur.<sup>15</sup>

In a study conducted by Kang et al, for management of non union of subtrochanteric fractures, exchange of hardware was compared with retained hardware where bone grafting was done in both groups. The incidence of nonunion in primarily operated cases they noted was 4-20% across various modalities of treatment. In our study 15% non union was noted. They concluded statistically higher rates of union in cases where primary implant exchange was done with bone grafting when compared to retaining the original hardware with bone grafting.<sup>16</sup>

In a study conducted by Ahmad et al, 40 subtrochanteric fractures were operated with long PFN between June 2014 and May 2016 in Govt Medical college Jammu. In their study they used open method of reduction in 13% of cases. In their study at 6 months follow up for range of motion at hip was excellent/good for 80% cases whereas in our study it was 65%. Their patients showed 92.5% union at 18 weeks. In their study majority of patients were started full weight bearing at 18 weeks (87.5%) which was similar protocol followed in our study where 82.5% patients were allowed full weight bearing by 14 weeks.<sup>17</sup>

Choi et al, conducted a study on factors affecting time to bony union of femoral subtrochanteric fractures treated with intramedullary devices to evaluate the factors affecting the bone union time and the occurrence of non-union after intramedullary nailing of subtrochanteric femoral fractures in adults. They retrospectively reviewed data from 31 patients (22 men and 9 women) who had undergone femoral intramedullary nailing at least 1 year post-operatively and analyzed the bone union time, nonunion rates, and factors that affected the bone union time according to the fracture classification (AO and Fielding classifications), comminution of the medial cortex, reduction method, and additional cerclage wiring. The average union time was 26.4 weeks. There were no differences in the bone union time according to the fracture classification, reduction method, or additional cerclage wiring. Significant differences were found in the bone union time between the medial cortex comminution and non-comminution groups. A relatively strong positive correlation was detected between the degree of post-operative displacement and the bone union time hence they

have stressed upon anatomical reduction of the fractures. Non-union occurred in three cases (13.6%) and there was no failure of implants. The bone union time was not affected by the reduction method nor additional cerclage wiring in intramedullary nailing of subtrochanteric femoral fractures. Comminution of the medial cortex and the degree of the postoperative displacement of fractures contributed to the delayed time of union.<sup>18</sup>

## CONCLUSION

Management of subtrochanteric fractures of femur remains to be a challenge due to the deforming forces and the high rates of nonunion and other complications. Long intramedullary devices have emerged as the treatment of choice for these fractures with importance placed on anatomical reduction.

Reconstruction nail is a good device for subtrochanteric fractures of femur providing rigid fixation with low complication rates.

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