

Functional outcome of subtrochanteric femur fracture treated with proximal femoral nailing

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Abstract

Context :Subtrochanteric fractures are femoral fractures where the fractures occur below the lesser trochanter to 5 cm distally in the shaft of femur. **Aims** :The objective of this retrospective study was to assess and document the clinical and functional outcome of subtrochanteric fractures treated with long proximal femoral nailing. **Setting And Design** This retrospective study conducted by department of Orthopaedics from January 2012 and July 2016 with minimum 12 months follow up period at R L Jalappa Hospital attached to Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka. **Materials and methods** Sixty two patients were included in this study. Patient demographics, type of fracture according to Seinsheimer classification, type of nail used, operative details, complications were recorded. Patients were evaluated using Harris hip score for their clinical and functional outcomes. **Statistical analysis used**: The significance of difference in means between the groups were done by Student- t test and difference of proportions /associations by using Chi square test. P value <0.05 was considered as statistically significant. **Results** :Our study was on 62 patients of which 22 (32.3%) were female and 40 (67.7%) were males. Subtrochanteric fracture types 3A2.1, 3A2.2 and 3A2.3 in 14 (22.6), 34 (54.8%) and 14 (22.6%) patients respectively. Functional outcomes were good in 36 (58.1%) and bad in 26 (41.9%) patients respectively. **Conclusion** :The patients in our study had better functional and clinical outcomes with long proximal femoral nail fixation for sub trochanteric fractures with minimal complications.

Keywords:Subtrochanteric fracture, long proximal femoral nailing.

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Introduction

Subtrochanteric fractures are femoral fractures where the fractures occur below the lesser trochanter to 5 cm distally in the shaft of femur[1].These fractures occur typically at the junction between trabecular bone and cortical bone where the mechanical stress across the junction is highest in the femur, which is responsible for their frequent comminution. These fractures account for 10% to 34% of all hip fractures[2].These fractures have bimodal age distribution young male adults involved in high-energy traumas present complex fracture patterns; whereas old patients, predominantly females, generally present spiral fractures.³The subtrochanteric 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 tensile 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. During normal activities of daily living, up to Six times the body weight is transmitted to the sub trochanteric region of the femur[4].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. Hence, sub trochanteric fracture is difficult to manage and associated with many complications.⁵ Due to the predominance of cortical bone, the subtrochanteric region presents a more precarious vascularization than the transtrochanteric region, which makes the consolidation of the fractures difficult. Complex fractures with medial support failure present elevated rates of fixation failure and reoperation[5,6].

Fracture in subtrochanteric region, the unbalanced pull of muscles leads to deforming forces, resulting in fragment displacement. More specifically, the pull of Iliopsoas causes flexion and external rotation of the proximal fragment, whilst gluteus medius causes abduction of the proximal end, whereas the quadriceps mechanism, hamstrings and adductors lead to adduction and shortening of the femoral shaft[3].Closed management of these subtrochanteric fractures thus poses difficulties in obtaining and maintaining a reduction, making operative management the preferred treatment. Currently, the non-surgical treatment of subtrochanteric fractures of the femur is an exception, and must be performed only in patients with extremely serious clinical co-morbidities that counter indicate anaesthetic and/or surgical procedures[3,7]. Although blade plates and proximal femur locking plates had satisfactory outcomes reported by few authors in literature, there are several advantages with use of intramedullary nails for subtrochanteric fracture fixation.⁴Vaishya et al reported use of distal femur locking plate reversed on to proximal femur for nonunited sub trochanteric fractures.⁵ Mattisson et al in their observational study of trochanteric and subtrochanteric hip fractures in Sweden during the years 2014 to 2016 showed with increasing fracture complexity, the proportion of intramedullary nails was increasing, and also the use of long versus short nails. The majority of the patients were operated within 36 h (90%).⁸ There was a higher mortality at 30 days and 1 year for males, and for all those who were delayed to surgery > 36 h. Considering rotational stability, interlocking nails have been more successful and among these cephalomedullary femoral nails have more working length and stability compared to the medullary interlocking nail devices with minimal post-operative complications and better clinical and functional outcomes. The goal of operative treatment is restoration of normal length and angulation to restore adequate tension to the abductors and to start early mobilisation and weight bearing. Hence,

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the purpose of this study was to determine the rate of union, complications, operative risks and functional outcomes in subtrochanteric fractures treated with the proximal femoral nail.³ The objective of this retrospective study was to assess and document the clinical and functional outcome of subtrochanteric fractures treated with long proximal femoral nailing.

Subjects and Methods

This retrospective study conducted by department of Orthopaedics from January 2012 and July 2016 with minimum 12 months follow up period at R L Jalappa Hospital attached to Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka. This study was approved by the institutional ethics committee. The case records were obtained from the medical record section. Sixty two patients were included in this study. All surgeries were done in single hospital setting. Patient demographics, type of fracture according to Seinsheimer classification, type of nail used, operative details, complications were recorded. Patients were evaluated using Harris hip score for their clinical and functional outcomes. The collected data was coded and entered into an excel format. All the quantitative measures were expressed by mean, standard deviation and confidence interval. All the qualitative data were expressed by proportions. The significance of difference in means between the groups were done by Student- t test and difference of proportions /associations by using Chi square test. P value <0.05 was considered as statistically significant.

Results

Our study was on 62 patients of which 22 (32.3%) were female and 40 (67.7%) were males. 27 (43.5%) were left side and 35 (6.5%) were right sided. Age group distribution less than 30 years in 9 (14.5%) and 31- 60 years in 20 (32.3%) and more than 60 years of age in 33 (53.2%) patients. Subtrochanteric fracture types 3A2.1, 3A2.2 and 3A2.3 in 14 (22.6), 34 (54.8%) and 14 (22.6%) patients respectively.

Although several fixation options exist, we prefer to use trochanteric entry, reamed antegrade Intramedullary Nailing for benefits of a shorter moment arm combined with a rigid stiff construct that allows for immediate weight bearing as per surgeon’s recommendations. It is important to emphasize that this technique was primary, where obtaining the reduction and using a slightly more medial starting point will help prevent implant failure, cut-out, and mal-reduction. All our patients were operated within 24 - 72 hours of admission. On post-operative days between 12 - 14 all sutures were removed for all the patients. Mean hospitalization was between 8.2 days. Mean follow- up was 12.7 months. Functional outcomes were good in 36 (58.1%) and bad in 26 (41.9%) patients respectively. Comorbidities present in 17 (27.4%) patients (10 had diabetes mellitus and 7 had systemic hypertension). Post op complications were noted in 15 (24.2%) patients. Limb length discrepancy in 6 (9.7%) patients and 2 (3.2%) patients had implant loosening. Sub trochanteric nonunion was noted in 3 (4.8%) patients. 4 patients had surgical site infection, which was controlled by subsequently after adequate antibiotic administration with third generation cephalosporin for two weeks.

Table 1: Correlation of Functional Outcomes With Variables in Study Population

Variables	Functional Outcomes	
	Good	Fair
Age Groups		
<= 30	7 (77.8%)	2 (22.2%)
31-60	10 (50%)	10 (50%)
>60	19 (57.6%)	14 (42.4%)
Gender		
Male	24 (57.1%)	18 (42.9%)
Female	12 (60%)	8 (40%)
Fracture Types		
3A2.1	10 (71.4%)	4 (28.6%)
3A2.2	20 (58.8%)	14 (41.2%)
3A2.3	6 (42.9%)	8 (57.1%)
Comorbidities		
Present	10 (58.8%)	7 (41.2%)
Absent	26 (57.8%)	19 (42.2%)
Post Operative Complications		
Present	5 (33.3%)	10 (66.7%)
Absent	31 (66%)	16 (34%)



Fig 1: XRAY right femur full length showing right subtrochanteric fracture



Fig 2: XRAY right femur full length showing right subtrochanteric fracture reduced with long proximal femoral nail

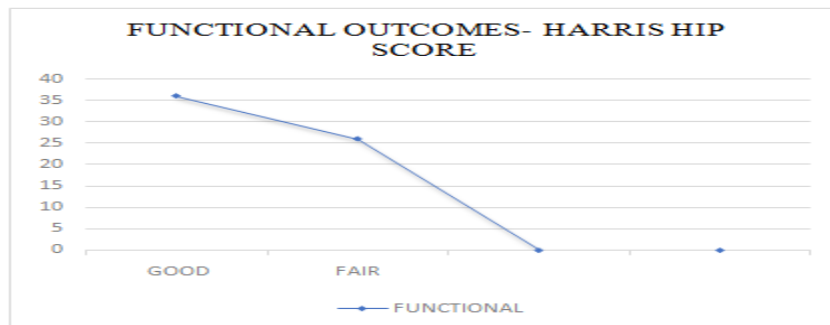


Fig 3: Functional outcomes using harris hip score of our study population.
 Table 1: Correlation of functional outcomes with variables in study population

	Mean	Std. Deviation	N
POST OP 4 WEEKS	71.742	3.7719	62
POST OP 6 WEEKS	73.452	4.2259	62
POST OP 12 WEEKS	76.097	4.5582	62
POST OP 6 MONTHS	77.419	4.5720	62
POST OP 1 YEAR	80.194	4.0604	62

Table 2: Functional Outcomes – Harris Hip Score

	IMPROVE	N	MEAN RANK	SUM OF RANKS
TTS (DAYS)	0	26	33.52	871.50
	1	36	30.04	1081.50
	Total	62		
BL (ML)	0	26	33.96	883.00
	1	36	29.72	1070.00
	Total	62		
ST (MIN)	0	26	36.42	947.00
	1	36	27.94	1006.00
	Total	62		
BTOC(pod days)	0	26	34.81	905.00
	1	36	29.11	1048.00
	Total	62		
CTOW(weeks)	0	26	31.17	810.50
	1	36	31.74	1142.50
	Total	62		

Functional outcomes using HARRIS HIP SCORE was mean score was improving on subsequent follow up using ANOVA.

Table 3: MANN-WHITNEY test showing improvement versus no improvement status of non parametric variables were tabulated

	TTS (DAYS)	BL (ML)	ST (MIN)	BTOC(POD days)	CTOW(Weeks)
Mann-Whitney U	415.500	404.000	340.000	382.000	459.500
Wilcoxon W	1081.500	1070.000	1006.000	1048.000	810.500
Z	-.770	-.991	-1.920	-1.317	-.135
Asymp. Sig. (2-tailed)	.441	.322	.055	.188	.892

Table shows MANN WHITNEY test of studied variables were not statistically significant.

TTS – Time Taken for surgery (days), BL – blood loss (ml),

ST – Surgery Time (days), BTOC – Bed to Chair (Pod days), CTOW – Chair to Walk (weeks).

Discussion

Hip fractures are a major public health problem which can lead to disability, and reduce the quality of life and one of the main reasons for increased morbidity. This condition affects around 1.5 million people per year worldwide. It has been estimated that the number of hip fractures will rise to 2.6 million by 2025 and to 6.25 million in 2050 [1,3]. The subtrochanteric region is a transition zone between cancellous bone (trochanteric region) and predominant cortical bone, leading to an increased blood supply.^{10,11} In case of comminution to the medial cortex, implant should be able to withstand all the forces until the fracture is fully consolidated. All the above factors should be considered for fracture reduction and choosing the implant as it may lead to implant failure and affects the fracture healing [11]. For entry point in the trochanter, the tip of the trochanter leads to the most neutral alignment in spite of the make of nail used. It causes less soft tissue injury and reducing operative time and the tip of the trochanter is generally easier to identify too [14]. But in some cases the lateral entry points of these nails can cause varus mal-alignment. The opening of the lateral cortex of the fracture, with high position of the lag screw which predisposes to cut-out, and the medial points can cause varus mal-alignment in some nails [15]. Previous cadaveric studies of the 'ideal' entry point for a straight nail were placed over the tendinous insertion of the piriformis muscle [16,17]. However this mode of entry point is more technically difficult and it is associated with worsening of the fracture line and the chances of comminution of the proximal fragment, soft tissue injury, neurovascular complications are high. Biomechanically, intramedullary nailing fixation is superior because of its increased rigidity, stiffness, and shorter moment arm which allows for a biomechanically stronger construct with decreased strain. For spanning the entire length of the femur, intramedullary nailing acts as an efficient load sharing device and the deforming forces that occur, primarily, by preventing medialization of the femoral shaft caused by the pull of the adductor muscles [13-15]. Regardless of the type of nail used, the surgeon should know the characteristics of the nail used and pre-operatively plan accordingly to achieve anatomical reduction. Some authors suggested that two smaller diameter screws can overcome the potential weakness at the place of the insertion hole of the nail when compared to a single larger diameter screw with regards to the number of screws locking the nail proximally [17]. The stresses transferred to the nail and screws are considerably reduced in a 2-screw configuration where stresses transferred to the cancellous bone around the screws are increased, and it increases the risk of cut-out theoretically [18]. Fissel B et al. suggested that 3-screw construct had developed increased stiffness when compared to 2-screw constructs for reconstruction nails. Because of that, many surgeons use 2-screw configurations in young patients, whereas in older patients with osteoporotic bone, one large central lag screw is used [8]. In our retrospective study we used the long intramedullary fixation of sub trochanteric fractures as the preferred method of treatment, having several advantages over alternative methods of fixation. The factors

like age, gender, comorbidities and post-operative complications doesn't affect functional outcomes of sub trochanteric fractures treated with proximal femoral nailing in our study. It combines the principles of minimally invasive surgery, with the biomechanical advantages including a shorter lever arm of the fixation, the better load sharing and less bending movement across the fracture site and implant.¹⁸ Several authors' support that intra-medullary implants has reduced operative time, transfusion rate, length of hospital stay and risk of failure when compared to extra-medullary implants [12]. Jiang LS et al [9] in their study done in China suggested that long PFN is a reliable implant for subtrochanteric fractures leading to high rate of union and less soft tissue damage. No complications such as cutout or breakage of the implants were encountered. Limitations of their study was that they did not use an accepted outcome measure instrument scale such as Harris Hip Score. Kumar et al in 2017 [7] in their study showed Harris Hip score, excellent results were noted in 28% and good in 56% cases and fair in 16% cases. And in their study various intraoperative complications were seen in 12% and delayed complications in 26% of cases. In our study Harris Hip score was good in 36 cases and fair in 26 cases and Post operative complications were seen only in 24.1% of cases. Thus we conclude Long PFN fixation has biological and biomechanical advantage but surgery is technically demanding. Treatment of subtrochanteric fractures remain a challenge, but evolution of strategy has allowed for reliable results with low complications. Although several fixation options exist, reamed, antegrade intramedullary nailing has evolved as the standard of care. Cognizant effort to achieve anatomic reduction before intramedullary nailing passage allows for desired outcomes. Surgery as soon as possible without delay should be considered to reduce the mortality rate. The selection of surgical methods depends on the fracture complexity. Superior stiffness is inherent in intramedullary nailing, because of its closed-section design, which yields bending stiffness similar to that of an intact femur. The patients in our study had better functional and clinical outcomes with long proximal femoral nail fixation for sub trochanteric fractures with minimal complications.

LIMITATIONS OF THE STUDY The primary limitation of our study was that it was a retrospective study including small sample size and done at single center. There was no control group in the present study. Large randomized controlled trial are needed to further evaluate outcomes and complications of long proximal femoral nailing for sub trochanteric fractures.

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