

Functional and radiological outcome of long proximal femoral nail in subtrochanteric femur fracture

Singh V, Rathore S S, Patidar A, Jain A, Bhide S, Agrawal A, Jain P

Study performed at Department of Orthopaedics, R. D. Gardi Medical College & C. R. G. Hospital & Associated Charitable Hospital, Ujjain (M.P.)

Abstract

Introduction: Treatment of subtrochanteric fracture is always a challenge for orthopaedic surgeons. Use of proximal femoral nail helps to prevent excessive fracture impaction and consecutive limb shortening in unstable intertrochanteric and subtrochanteric fractures. Our study is aimed to observe the results of Subtrochanteric fractures treated by Long Proximal Femoral Nail.

Material and Method: This observational study was conducted in Department of Orthopaedics of R D Gardi Medical College & associated CRGH, Ujjain during the year July 2016 to June 2018. In this study, 32 cases of fracture subtrochanteric femur (Seinsheimer type I, II, III, IV, V) were admitted and treated by internal fixation using long PFN.

Results: Out of these 32 cases, 1 patient expired and 1 patient was lost in follow up, so our study is aimed at remaining 30 cases. Results were assessed by Modified Harris Hip Score. Modified Harris Hip Score at final follow up (6 months) was Poor in 2 (6%) cases, Fair in 3 (10%) cases, Good in 11 (37%) cases and Excellent in 14 (47%) cases. Mean Modified Harris Hip Score was 87.16.

Conclusion: Our conclusion is that in subtrochanteric fracture, Long PFN helps in achieving good biological reduction, provides stability and prevents excessive collapse & limb shortening. Thus, it helps in achieving overall good functional outcome.

Keyword: long proximal femoral nail, subtrochanteric femur fracture, intertrochanteric fractures, subtrochanteric fractures

Address of correspondence:

Dr Siddharth Singh Rathore, Assistant Professor, Department of Orthopaedics R. D. Gardi Medical College, Ujjain
Email-dr.siddharthrathore31@gmail.com

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Introduction

There has been increase in incidence of subtrochanteric fractures in the last few decades and it will, probably continue in the future due to rising age of the population.[1] The rapid industrialization and changing lifestyle has increased the frequency of road traffic accidents in the world causing significant increase in trauma in general and fracture femur in particular. Trochanteric fractures are one of the common injuries occurring due to low energy trauma in elderly patients with osteoporotic bones.[2]

Lower vascularity along with high biomechanical stress concentration leads to high chances of implant failure and non-union seen in subtrochanteric femur fracture.[6]

Therefore, these fractures need special consideration because defective union of this fracture can lead to high disability levels for an individual [8]. Not much attention was paid to trochanteric fractures till 19th century and the mortality rate of trochanteric fracture was about 80%, those who survived remained morbid due to bed sores, cystitis, joint stiffness, deep vein thrombosis, hypostatic pneumonia, shortening and coxa vara [9]. In early 19th century, Hibbs treated subtrochanteric fractures conservatively in the position of flexion, external rotation and abduction [2]. Couple of years later Sarmiento, Seinsheimer Jc De Lee, T.O.Clanton & C.A.Rockwood and Waddel emphasized the role of traction treatment [7]. Ideal anatomical and functional result could

not be achieved even after improvement and modification in conservative line of treatment. In the 1950s, operative treatment for trochanteric fractures was introduced to improve the union rate and a decrease the complications associated with immobilization and prolonged bed rest.[11]

Several methods of internal fixation were advocated in the treatment of subtrochanteric fractures like Moore-Blount plate, Neufled plate, Lorenzo screw, Kuntcher Cloverleaf Nail, Jewett nail, AO blade plate, Sliding hip screw, Interlocking intramedullary nails, Russel Taylor nail, Gamma nail, Proximal femoral nail and PFNA2 by AO – ASIF GROUP. Nowadays, interest is increasing in intramedullary nailing. Though technical difficulty occurs in intramedullary devices, they have biomechanical advantage over extramedullary devices such as close reduction, less blood loss and less soft tissue dissection.[9]

AO/ASIF group devised proximal femoral nail in 1996 with antirotation hip screw, small diameter, fluting of tip and less valgus angle and it seems to be a promising implant in trochanteric and subtrochanteric fractures.[11] Dynamic Hip Screw (DHS) and Proximal Femoral Nail (PFN) both have their own advantages & disadvantages and various meta-analysis studies conducted to compare both have concluded superiority of PFN over DHS10 in subtrochanteric femur fractures. Use of proximal femoral nail helps to prevent excessive fracture impaction and consecutive limb shortening in unstable intertrochanteric and subtrochanteric fractures.

Material and Method

This observational study was conducted in Department of Orthopaedics of RD Gardi Medical College & associated CRGH, Ujjain during the year July 2016 to June 2018. In this study, 32 cases of fracture subtrochanteric femur (Seinsheimer type I, II, III, IV, V) were admitted and treated by internal fixation using long PFN. Out of these 32 cases, 1 patient expired and 1 patient was lost in follow up. So, our study is aimed at remaining 30 cases. Upon admission, a careful history was elicited from the patient and/or attenders to reveal the mechanism of injury

and the co-morbidities. Ambulatory status and activities of daily living (ADL) before trauma was recorded. The patient's general condition was assessed with the vital signs and systemic examination done. Fractures at other sites were ruled out. All these necessary clinical details were noted on a specially designed proforma prepared for this study. Informed written consent from patient was obtained prior to their inclusion in study.

Inclusion criteria was patients with subtrochanteric femur fractures (Seinsheimer type I, II, III, IV, V) was, all skeletal mature patients (>18years) and patients willing to give consent for surgery. Exclusion criteria was patients of age less than 18 yrs, patient's refusal for the procedure, patients who are medically unfit for surgery, pathological fractures, compound fractures, patient having other fractures in same limb, vertebral fracture and patients with head injury.

All the necessary routine investigations done and patient were operated after written and inform consent. Results were assessed by Modified Harris Hip Score. The youngest patient in our series was 42 years old and the oldest was 84 years. Maximum numbers of patient in this study were of elderly age group and the mean age was 60.38 years. In the present study, it was seen that the incidence of subtrochanteric femur fractures is more in males (19) as compared to females(13) and the ratio is 3:2. Incidence of subtrochanteric fractures was more on right side (18) as compared to left (14). Most common mode of trauma was due to fall (19) and RTA (11). Incidence of type IIA fracture was 12.5%, type IIB was 15.6%, type IIC was 3.1%, type IIIA was 31.3%, type IIIB was 9.4%, type IV was 21.9% and type V was 6.3% according to Seinsheimer classification. Intra operatively reduction of the fracture was achieved through closed means in (28) 87% of cases. Open reduction was performed in only (4)13% cases. Intra operatively reduction of the fracture was good in (29) 90.6% of cases. Reduction was poor in only (3) 9.4% cases. Intra operative complication was ill fitting of jig in 1 case while 7 cases had difficult reduction during intra op period. In the present series, it was seen that 1 case (3.1%)

had superficial wound infection, 1 case (3.1%) had chest infection and 1 case (3.1%) had urinary tract infection while remaining 27 cases had nil complication. Post-op limb length shortening was <1cm in 53.1 % (17) cases, 1cm in 37.5% (12) cases and >1cm in 9.4% (3) cases. Modified Harris Hip Score at 3 months was ≤69 (Poor) in 17% cases, 70 – 79 (Fair) in 33% cases and 80 – 89 (Good) in 50% cases. Mean Modified Harris Hip Score was 78.7. Modified Harris Hip Score at final follow up (6 months) was ≤69 (Poor) in 6% cases, 70 – 79 (Fair) in 10% cases, 80 – 89 (Good) in 37% cases and 90 – 100 (Excellent) in 47% cases. Mean Modified Harris Hip Score was 87.16. In this series, patients <60 years had excellent to good results while older age group patients had relatively good to fair results. Patients of type IIB, IIIA and IV had more proportion of excellent results as compared to others. Average time of union is 14 weeks. It was seen that knee pain and stiffness was present in 13.8% (4) cases, Z effect in 3.4 % (1) cases, Reverse Z effect in 3.4% (1) cases and Screw cutout in 3.4% (1) cases. Mean admission and operation time interval was 6.2 days. Average number of C-arm shoots was 168. Mean duration of operation was 87 minutes. Mean blood loss was 144 milliliters.

Discussion

Various types of implants are available for subtrochanteric fracture but recently techniques of closed intramedullary nailing have gained popularity. Closed intramedullary devices have benefits of minimal surgical exposure, more efficient load transfer through calcar femorale and decreased tensile strain on the implant because of its shorter lever arm. This makes Long Proximal Femoral Nail a good choice of implant for subtrochanteric fractures of the femur. Various studies have considered Long Proximal Femoral Nail as an acceptable minimally invasive implant for subtrochanteric fracture.

Most of patients in our study were from age group of 5th to 7th decade of life, the average age being 60.38 years. Maximum numbers of cases (40.6%) were found in the age group between 61 to 70 years. This was significantly

lower compared to that quoted by other authors in literature.

Velasco and Comfort et al.[17] studied 82 patients and found that 63% of Subtrochanteric fractures occurred in patients from 51 to more than 70 years old. Alyassari et al.[18] studied 70 patients and average age was 84 years showing trochanteric fractures were more common in higher age group. In Boldin et al.[14] study the average age was 73 years while Pavelka T, Kortus J and Linhart M et al.[16] has shown average age was 69 years. In I.B.Schipper Series [15] it was 82.2 years. In our study the average age was 60.38 years.

There was a male preponderance in our patient. The ratio of males to female was 3:2, reflecting the higher incidence of subtrochanteric fractures of femur in male population due to their more active lifestyles. This variation of sex ratio may be due to smaller sample size in present study.

Table.1. Sex distribution

Sex Distribution.	Boldin et al.[14]	I.B.Schipper Series[15]	Pavelka T, Kortus J and Linhart M et al.[16]	Present study
Male (%)	30	18	40.1	59.4
Female (%)	70	82	59.9	40.6

Among 32 patients, 18 were found to have fractures on the right side while 14 on the left side. Side fracture distribution of the present study was comparable to all of the above series.

Table.2- Side distribution

	I.B.Schipper Series[15]	Chopra BL et al.[19]	Ashish Vinod Batra et al.[20]	Present study
Right (%)	52	52	57.5	56.2
Left (%)	48	48	42.5	43.8

In the present study, there were 19 cases (59.4%) due to fall while there were 11 cases (34.4%) due to Road traffic accident (RTA), 1 case (3.1%) was due to hit by cow and 1 case (3.1%) due to assault.

Table.3. Mode of trauma

Mode of trauma	W.M.Gadegone series[30]	Ahmad et al.[21]	Ashish Vinod Batra et al.[20]	Present study
Fall	75	57.5	32.5	59.4
RTA	25	42.5	67.5	34.4
Others	0	0	0	6.2

Keneth J. Koval and Joseph D. Zuckerman (1996) observed that 90% of hip fractures in the elderly result from a simple fall. Hip fractures in young adults were observed to result most often with high energy trauma such as motor vehicular accidents or a fall from height.

Fractures were classified according to Seinsheimer classification. Type IIIA fracture pattern constituted the highest percentage 31.25 % (10 cases) of all fracture patterns. Seinsheimer [7] in his original study also noted high incidence of type III A fracture pattern (38.29%) than other fracture patterns.

Table-4 Seinsheimer Classification-

Seinsheimer type of fracture	Ashish Vinod Batra et al.[20]	S Laxmi Narayana et al.[22]	Tiwari Mukesh et al.[23]	Present study
Type I	0%	0%	0%	0%
Type IIA	12.5%	10%	3.3%	12.5%
Type IIB	20%	20%	26.6%	15.6%
Type IIC	20%	20%	13.3%	3.1%
Type IIIA	32.5%	40%	13.3%	31.3%
Type IIIb	12.5%	10%	6.6%	9.4%
Type IV	2.5%	0%	10%	21.9%
Type V	0	0%	26.6%	6.3%

Admission-operation interval in the study varied from 3-18 days. Mean interval was high in the series. It was 6.2 days which was more when compared to I. B. Schipper series [15] where it was 2 days. Most of the patients with delayed injury-operation interval had preexisting uncontrolled medical problems.

Intra operatively fracture reduction was achieved by closed means in 87.5% (28 cases) of patients and 12.5 % (4 cases) with delayed injury-operation interval required open reduction. In the study, poor reduction was noted in 9.3 % of patients (3 cases) and was associated with poor outcome while in Schipper et al [15] reduction was good and acceptable in 96.2% and poor reduction only in 2.9% of their patients. Intra operative

fracture reduction of the present study was comparable to all of the above series.

Table 5- Fracture reduction

Fracture reduction	Boldin et al.[14]	Alyassar i et al.[18]	Chopra BL et al.[19]	Present study
Closed	90%	87%	97.2%	87.5%
Open	10%	13%	2.8%	12.5%

Mean duration of surgery (skin to skin) was 87 min (range 60-110 min). Operating time in various studies- Wang et al, Ekstrom [24] et al and Menzes [25] et al was 90 min, 105 min & 76 min respectively. In the study duration of surgery was longer in the initial operated cases. With frequent use of proximal femoral nail surgery, the duration decreased.

Table 6- Duration of surgery

Duration of surgery	Domini go et al.[26]	Fogagnolo et al.[27]	Boldin et al.[14]	Present study
No. of patients	105	155	55	32
Duration of surgery(min)	77	76	68	87

Average number of C-arm shoots taken was 168. Mean operative blood loss measured by mop count (each mop was weighed pre operatively and post operatively).

Table 7- Mean intra operative blood loss

Mean blood loss	Zhiyong et al.	Chopra BL et al.[19]	Tiwari Mukesh et al. [23]	Present study
Mean intra operative blood loss (in ml)	100	126	130	144

Patients were discharged after suture removal with instruction of mobilization with support (walker was advised to be purchased for home use).

Table-8- Period of hospitalization

Period of hospitalization	I.B.Schipper series[15]	Fogagnolo et al.[27]	S Laxmi Narayana et al.[22]	Present study
Period of hospitalization (days)	19	17	19.33	18

In this study 1 patient was found to have chest infection, 1 patient had complication of

urinary tract infection (UTI) and 1 patient had superficial wound infection.

I.B.Schipper [15] noted 4.1% superficial infections and 2.5% deep infections. We did not encounter any deep infections in the series.

Werner et al. [28] was the first who introduced the term Z-effect, detected in 5 (7.1%) of 70 cases. The Z-effect phenomenon is referred as a characteristic sliding of the proximal screws to opposite directions during the postoperative weight-bearing period. In our study we had Z-effect in 1 case (3.1%). This complication was noticed when patient came for follow up and this complication was demonstrated on X rays. He was advised surgery and screw was removed.

The reverse Z-effect described by Boldin et al. [14] occurred with movement of the hip pin towards the lateral side, which required early removal. The mechanism was similar, but here the hip pin is sliding back, whereas the neck screw remains impacted to the hole of the nail. In their prospective study of 55 patients with unstable intertrochanteric or subtrochanteric fractures, they had 3 cases with Z effect and 2 with reverse Z effect. The authors in an effort to prevent the Z-effect phenomenon suggest the use of a 'ring' in the lateral side of the hip pin. In our study we had 1 case with reverse Z-effect (3.1%) seen in follow-up and screw was removed by surgery.

Table-9-Mechanical complications of PFN

Mechanical complications	C Boldin et al.[14]	Dominigo et al.[26]	Fogagnolo et al.[27]	Simmermacher et al.[29]	Present study
No. of patients	55	295	46	191	32
Screw Cut out	2	4	5	1	1
Z effect	3	-	-	-	1
Reverse Z effect	2	-	-	-	1

Average time of union in the present of 30 patients was about 13.4 weeks. (Range- 11 to 17 weeks). Assessment of early callus formation at fracture site & its subsequent

progress was done with the help of subsequent radiograph.

Table-10- Average time of fracture union

	I.B.Schipper series[15]	Chopra BL et al.[19]	S Laxmi Narayana et al.[22]	Present study
Average time of fracture union (weeks)	20	20	19.33	14

The functional outcome of patient treated with Proximal Femoral Nail was calculated by the Modified Harris Hip Score. Overall, 47% of patients had excellent results, 37% of patients had good results, 10% of patients had fair results and 6% cases had poor results. The mean Harris Hip score in our series was 87.16.

Table-11- Mean Harris Hip Score

	I.B.Schipper series[15]	Ashish Vinod Batra et al.[20]	S Laxmi Narayana et al.[22]	Present study
Mean Harris Hip Score	77.6	85.7	89.8	87.16

Conclusion

Majority of patients of subtrochanteric femur fracture treated with Long PFN had excellent to good outcome. The mean Harris Hip Scoring System appears to be useful tool for clinical evaluation of patients of subtrochanteric femur fracture. Therefore, it is our conclusion that in Subtrochanteric fracture, Long PFN helps in achieving good biological reduction, provides stability and prevents excessive collapse & limb shortening. Thus, it helps in achieving overall good functional outcome. Almost immediate post operative mobilization does play role, in better rehabilitation. It can be done on a routine basis with minimum complications like knee stiffness, infection, malunion and non-union.

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