



Original Research Article

Subtrochanteric fracture of femur treated with proximal femoral nails – its functional outcome

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ABSTRACT

Background: Using proximal femoral nailing for sub-trochanteric fractures of femur by orthopedicians showed a mixed response in terms of functional outcome such as stability and anchoring and long term studies had also showed that it helps in preventing the recurrence of fractures.

Aim: To assess the operational outcome of subtrochanteric femur fractures those are treated with proximal femoral nails in terms of function.

Methodology: A prospective study was conducted for a period of one year among patients with subtrochanteric hip fracture and a total of 62 patients were included as our study subjects. Proximal femoral nail was inserted through the tip of greater trochanter exactly at the midway between its anterior and posterior extent. Based on the type of fracture distal interlocking was done either statically or dynamically to fix the fracture and the fracture fixation was confirmed through C-arm. Post-operatively all patients were followed up for a period of one year at an interval of 3 months and during each follow-up visit for the functional outcome was assessed in the form of walking, squatting, sitting and rising from chair.

Results: Function outcome was almost 100% at the end of 12 months and for walking for 15 meters nearly 98% was able to perform even at 6 months and 92% performed in 6 weeks post-operatively, whereas for raising from chair and squatting 55-60% of the patients were able to perform at the end of 6 months and for squatting and raising from chair it was 20% and 45% respectively at the end of 6 weeks.

Conclusion: Proximal Femoral Nailing is a good implant technique for patients with subtrochanteric fracture of the femur as it is almost like a closed technique with better stability and early mobilisation.

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1. Introduction

Proximal femur fracture is a common type of fracture frequently reported in the department of orthopedics and among them fracture neck of femur and inter-trochanteric fractures are routinely dealt with by the orthopedicians.¹ One of the most important area in the proximal part of femur is the subtrochanteric region which is located within 5 cms below the lesser trochanter usually experiences high level of stress and if not managed properly results in poor outcome. The overall incidence of this type of fractures as shown by previous studies was 15 – 20/100,000 population

and females aged more than 50 years are most commonly affected.^{2,3} Other added risk factors for subtrochanteric fractures were diabetes mellitus, reduced bone mineral density and patients who were using bisphosphonates as the treatment for osteoporosis for more than 5 years.^{4,5} The subtrochanter region is where the multiple muscular attachments such as lateral hip abductors, medial hip adductors, the iliopsoas, and short external rotators takes place making it to increase the stress around the hip and proximal femur.⁶ In clinical examination of subtrochanteric fractures the classical deformity that occurs is proximal segment abduction, external rotation, and flexion that is due to the pull caused by gluteus medius, gluteus minimus, iliopsoas, gracilis and adductor muscle groups.⁷ The most

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common mode of injury in these type of fractures are either due to injuries resulting from high energy, falling from height or a low mechanism injury such as an accidental fall that commonly occurs in elderly.^{8,9} Diagnosis is confirmed by the x-ray picture that reveals atypical subtrochanteric fractures that include a transverse fracture patterns with a minimal comminution, lateral cortical thickening, and a posteromedial spike.¹⁰ There is no role of non-operative management in sub-trochanteric fractures as it leads to increased morbidity and mortality and the definitive management is early surgical intervention. Over the past two to three decades subtrochanteric fractures are mainly treated with plates and screws such as dynamic hip screws, condylar screws or cephalo-medullary nails.¹¹ Proximal femoral nailing is a newer technique introduced in the year 1997 by an Orthopedic association and after its introduction few studies were conducted to assess its efficacy in terms of stability, anchoring, dynamic locking and option for secondary locking that helps in the prevention of later fractures. Another added advantage of this procedure is, it is a weight sharing implant rather than weight bearing and very few complications such as malunion or non-union were reported.^{12,13} Though few studies have been conducted in assessing the efficacy of proximal femoral nailing but not much had been done in South India and so the present study was conducted to assess the operational outcome of proximal femoral nailing among patients with subtrochanteric fractures.

2. Methodology

A prospective longitudinal study was conducted for a period of one year at a tertiary care hospital in Salem district. The study was started after getting approval from the institutional ethics committee. Patients with subtrochanteric hip fracture admitted in our hospital were included as our study subjects. Patients with open fractures were excluded from the study and a total of 62 patients were taken as our study sample. Proper informed consent was taken from all patients involved in the study. A semi-structured questionnaire was designed to collect the socio-demographic details and the clinical history from all the patients with subtrochanteric fractures. For all patients the operative procedure was done under spinal/epidural anaesthesia. After placing the patient on the fracture table, using longitudinal traction technique the fracture is reduced and the affected limb is slightly adducted in such a way it helps in facilitating the proximal femoral nail insertion through greater trochanter.

A lateral incision of 4-6 cm was made proximally then the gluteus maximus muscle was dissected along with the line of its fibers which paved the way for the entry of proximal femoral nail at the tip of the greater trochanter. After fixing the appropriate sized nail on the insertion device the nail was then slowly introduced manually into the shaft

of femur with a help of guide wire using C-arm. The hip pin was initially introduced just about 25 mm medial to the fracture line, and then the neck screw was inserted according to the size required. Depending on the type of fracture, distal interlocking was done. The stability of the procedure was assessed and wounds were closed in layers after placing a negative suction drain. Post-operatively patients were treated with analgesics and antibiotics and proper wound dressing was applied. Transfusion requirements, adverse events and length of hospital stay were recorded for each patient.

Post-operatively the operated limb was kept in an elevated position in order to reduce swelling and facilitate drainage. Mobilization was initiated based on the patients fracture pattern, in non-comminuted fractures weight bearing was initiated early whereas in comminuted fractures it was delayed till the formation of callus. All the patients were followed up at an interval of three months for a period of one year and in each follow-up visit the functional outcome was assessed in the form of walking, squatting, sitting and rising from chair. Any complication if occurred was also recorded.

All the data were entered and analysed using SPSS version 24. Mean and standard deviation was derived for all parametric variables and percentage was calculated for all frequency variables, chi-square test was used to derive the statistical inference considering $p < .05$ as statistically significant.

3. Results

Most of the study subjects in our study were in the age group between 50 and 70 years with mean age was 56.4 years. Males were slightly more in number than the females with the male: female ratio of 1.23: 1 (Table 1). There was almost equal distribution on the side of injury between left and right. Almost 60% of the patients acquired the fracture through road traffic accidents and the remaining had history of accidental fall. The subtrochanteric femur fracture based on the radiological findings was classified according to Seinsheimer Classification. Based on this classification majority of the patients fell under type 3A (27.4%) fractures followed by type 2C (22.5%) and 2B (20.9%) and only one patient had type 4 fracture (Table 2). The most common comorbid condition reported among our study subjects were either diabetes or hypertension. In majority (64.5%) of the patients the surgery was done in less than 7 days after acquiring the injury and the mean duration between the onset of fracture and the surgery was 5.8 days. Only for two patients the surgery was performed after 2 weeks that is for stabilizing the patient as they had type 4 and type 3B fractures (Table 3). Among the surgeries performed 93% of the patients underwent open reduction and the remaining 7% had a closed reduction and regarding the size of the proximal femoral nail out of 62 patients for 58 patients 9

mm PFN was used and for the remaining 4 patients 10 mm PFN was used. The mean operating time from skin to skin was 90 mins. In our study 70% of the patients had complete fracture union by 14 – 16 weeks and the remaining showed complete union by 12 – 14 weeks with a mean of 14.5 weeks (Table 4). Out of 62 patients 4 patients were lost follow up and so the follow up analysis for functional outcome was made for only 58 patients. The operational outcome was assessed in terms of the patients able to perform the functions like squatting, walking for 15 meters and raising from chair. Three follow-up visits were made at 6 weeks, 6 months and 12 months respectively. It was shown from table 5 that all the patients who had come for regular follow-up was able to perform all the functions at the end of 12 months and for walking for 15 meters nearly 96.5% was able to perform even at 6 months and 93% performed in 6 weeks post-operatively, whereas for raising from chair and squatting 55-60% of the patients were able to perform at the end of 6 months and for squatting and raising from chair it was 22.4% and 43% respectively at the end of 6 weeks (Table 5). Type of fracture does not show a significant association with the functional outcome (Table 6) and similarly age, gender, size of PFN and mode of injury did not show statistical significant association with the outcome. Among the complications reported 2 patients had superficial wound infection which were treated with intravenous antibiotics and wound dressing and two more patients had anesthetic related complications which were managed adequately in the recovery room of anesthesia. Other than that no other serious complications such as malunion, limb length discrepancy or implant related complications were reported. X-ray pictures taken in pre-operative and post-operative period are shown in Figures 1, 2 and 3.

4. Discussion

In Subtrochanteric fractures of femur the commonest mode of injury is because of high energy trauma and due to its complex stress configuration these fractures commonly occurs in the area of least resistance in the proximal femur.¹⁴ Further the unstable fractures occurring at this region impose a significant challenge to the operating surgeon as fixing these fractures becomes technically difficult and improper technique might lead on to primary fixation failure. As quoted in the previous studies the best treatment for these fractures is fixing the fractures with dynamic hip screws (DHS) but still the failure rate was shown as upto 20%.^{15,16} Fracture instability, presence of osteoporosis, lack of anatomic reduction, implant failure, and placing the lag screw in an incorrect position in femoral head were found to be the most common causes for fixation failure.¹⁷ The most common preference among orthopedicians is intramedullary fixation

because of its advantages like minimal soft tissue injury and wound complications. Among the various procedures in intramedullary fixation introducing a proximal femoral nail is a newer technique in which the nail tip is specially shaped to reduce the stress and further it prevents low energy fracture at the tip of the implant, along with this it also reduces the lever arm distance at the time of reactionary forces generated in the hip joint movements.¹⁸ Knowing these advantages the present study was done to assess the operational outcome of patients treated with proximal femoral nails for fractures in the subtrochanteric region of femur.

In the present study the mean age of the patients operated for subtrochanteric fractures was 56 years and it is almost similar to the study done by Sandeep Sharma et al, where he quoted the mean age as 53 years and few other studies done by C.Bouldin et al, I.C.Schipper et al and T.Pavelka et al had mentioned the mean age as more than 70 years and as quoted by previous studies males are more in number than females.^{19–22} In our study the commonest mode of injury was road traffic accidents followed by accidental fall and all the earlier studies had also quoted these two as the major mode of injury with slight variations in the percentage.^{19–22}

In the current study Seinsheimer classification was followed for classifying the subtrochanteric fractures and under this classification type III A was found to be the most common type and a similar results was also shown in the studies done by Sandeep Sharma et al and Seinsheimer et al.^{19,23} In our study the time interval between the onset of injury and the surgery performed was 5.8 days and it is almost in par with the studies done by I.B.Schipper, C.Bouldin and D.M.Rahme.^{20,22,24} The average time taken for the surgery was 90 mins and most of the previously done studies had shown the average time of the procedure varied between 60 and 90 mins as it depends on the skill of the surgeon and certain factors related to patients.^{20,22,24} In the current study the complete union of the fracture was seen in 14.5 weeks, whereas the study done by VivekPradhan et al had shown the mean weeks for complete union as 13.88 weeks and most of the other studies also ranged between 13.5 and 14.5 weeks.²⁵ In our study no serious postoperative complications like malunion or union were reported only superficial wound infection and anesthesia related complications had occurred, whereas a study done by Sandeep et al had shown non-union in 3.5% of the patients and few studies done by D.M.Rahme et al and W.M.Gadegone et al it was 12% and 13% respectively.^{19,24,26} In the present study excellent outcome results was achieved by 12 months in 100% of the patients who had come for follow-up and the outcome was based on their ability to squat, walk for 15 meters and rising up chair, in most of the previously done studies the results was shown that excellent outcome was achieved in almost 90% of the patients in 8 to 12 months.^{19–24}

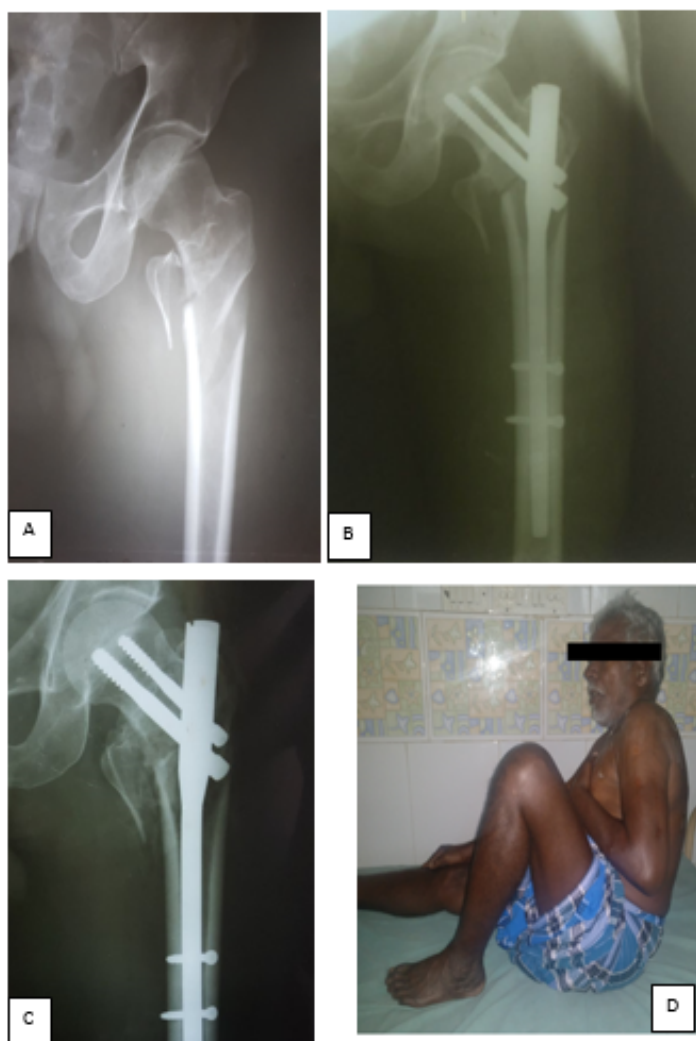


Fig. 1: **A:** Pre-operative X-ray; **B:** Immediate Post-operative X-ray; **C:** X-ray taken at 2 months post-operatively; **D:** Functional outcome at end of 2 month

Table 1: Age and gender wise distribution of the study subjects

Age group	Males	Females	Total
< 30	4 (11.7%)	3 (10.7%)	7 (11.2%)
30 – 50	11 (32.3%)	7 (25%)	18 (29%)
50 – 70	13 (38.2%)	9 (32.1%)	19 (30.6%)
> 70	6 (17.6%)	9 (32.1%)	14 (22.5%)
Total	34 (100%)	28 (100%)	62 (100%)
Mean \pm SD	53.7 \pm 7.2	58.5 \pm 7.8	56.4 \pm 7.4

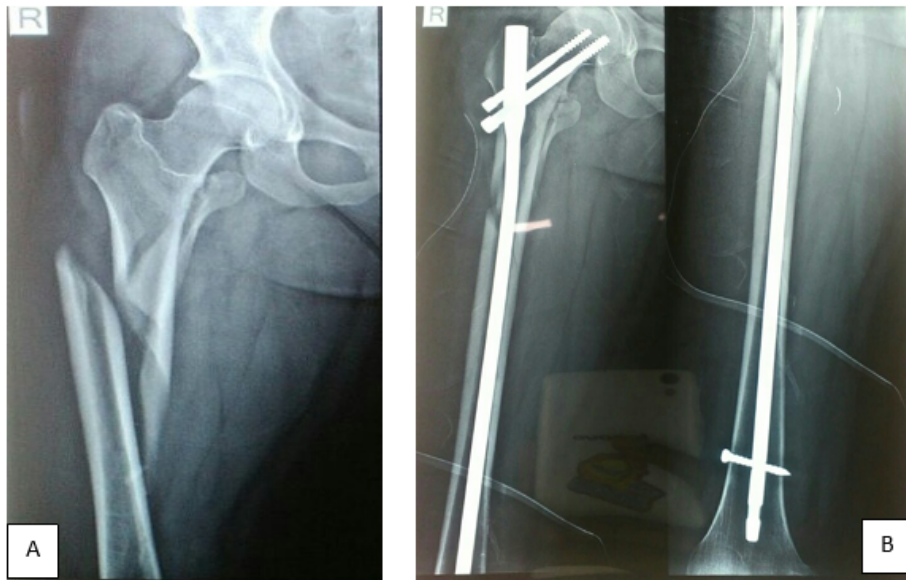


Fig. 2: A: Pre-operative X-ray; B: Post-operative X-ray



Fig. 3: A: Pre-operative X-ray; B: Post-operative X-ray; C: Functional assessment post-operatively at 2 months

Table 2: Distribution of the study subjects based on type of fracture according to Seinsheimer Classification

Fracture Type	No. of cases	Percentage
Two-part transverse fractures (II-A)	10	16.1%
Two-part spiral fractures with lesser trochanter attached to the proximal fragment (II-B)	13	20.9%
Two-part spiral fractures with lesser trochanter not attached to the proximal fragment (II-C)	14	22.5%
Three-part spiral fractures in which the lesser trochanter is part of the third fragment (III-A)	17	27.4%
Three-part spiral fractures of the proximal third of the femur (III-B)	7	11.2%
Comminuted fractures (IV)	1	1.6%
Total	62	100

Table 3: Distribution of the study subjects based on the time interval between fracture and surgery

Time to surgery	No. of cases	Percentage	Mean \pm SD
0 – 7 days	40	64.5%	
1 – 2 weeks	20	32.2%	
> 2 weeks	2	3.2%	
Total	62	100%	5.8 \pm 4.2

Table 4: Distribution of the study subjects based on the duration for fracture union

Time for union	Frequency	Percentage	Mean ± SD
12 – 14 weeks	21	33.8%	
14 – 16 weeks	41	66.1%	14.5 ± 0.88
Total	62	100%	

Table 5: Various functional outcome measured among the study subjects

Functional outcome	6 weeks	6 months	12 months
Squatting (%)	13 (22.4%)	37 (63.7%)	58 (100%)
Walking 15 metres (%)	54 (93.1%)	56 (96.5%)	58 (100%)
Rising from chair (%)	25 (43.1%)	33 (56.8%)	58 (100%)

Table 6: Distribution of the study subjects based on the type of fracture and the functional outcome

Fracture Type	Functional outcome	6 weeks	6 months	12 months
Type 2A (n=10)	Squatting	3 (30%)	6 (60%)	10 (100%)
	Walking 15 metres	6 (60%)	8 (80%)	10 (100%)
	Rising from chair	4 (40%)	7 (70%)	10 (100%)
Type 2B (n=13)	Squatting	5 (38.4%)	8 (61.5%)	13 (100%)
	Walking 15 metres	10 (76.9%)	12 (92.3%)	13 (100%)
	Rising from chair	7 (53.8%)	9 (69.2%)	13 (100%)
Type 2C (n=14) 1 lost follow-up	Squatting	5 (38.4%)	9 (69.2%)	13 (100%)
	Walking 15 metres	10 (76.9%)	11 (84.6%)	13 (100%)
	Rising from chair	7 (53.8%)	9 (69.2%)	13 (100%)
Type 3A (n=17) 2 lost follow-up	Squatting	5 (33.3%)	10 (66.6%)	15 (100%)
	Walking 15 metres	8 (53.3%)	14 (93.3%)	15 (100%)
	Rising from chair	6 (40%)	10 (66.6%)	15 (100%)
Type 3B (n=7) 1 lost follow-up	Squatting	3 (50%)	4 (66.6%)	6 (100%)
	Walking 15 metres	5 (83.3%)	6 (100%)	6 (100%)
	Rising from chair	4 (66.6%)	5 (83.3%)	6 (100%)
Type 4 (n=1)	Squatting	0	0	1(100%)
	Walking 15 metres	0	1 (100%)	1 (100%)
	Rising from chair	0	1(100%)	1(100%)
P value	Squatting		0.591	
	Walking 15 metres		0.784	
	Rising from chair		0.614	

5. Conclusion

Fracture union was observed in almost all the cases with a very good postoperative functional outcome for patients who had regular follow-up. Proximal Femoral Nailing is a good implant technique for patients with subtrochanteric fracture of the femur as it is almost like a closed technique with better stability and early mobilisation. The operation being technically demanding if the operating surgeons are adequately trained it is considered as a truly minimal invasive procedure.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

- Dell RM, Adams AL, Greene DF, Funahashi TT, Silverman SL, Eisemon EO, et al. Incidence of atypical nontraumatic diaphyseal fractures of the femur. *J Bone Miner Res.* 2012;27(12):2544–50.
- Nieves JW, Bilezikian JP, Lane JM, Einhorn TA, Wang Y, Steinbuch M, et al. Fragility fractures of the hip and femur: incidence and patient characteristics. *Osteoporos Int.* 2010;21(3):399–408.
- Streubel PN, Wong AHW, Ricci WM, Gardner MJ. Is There a Standard Trochanteric Entry Site for Nailing of Subtrochanteric Femur Fractures? *J Orthop Trauma.* 2011;25(4):202–7.
- Ng AC, Drake MT, Clarke BL. Trends in subtrochanteric, diaphyseal, and distal femur fractures. *Osteoporos Int.* 1984;23(6):1721–6.
- Abrahamsen B, Eiken P, Eastell R. Subtrochanteric and Diaphyseal Femur Fractures in Patients Treated With Alendronate: A Register-Based National Cohort Study. *J Bone Miner Res.* 2009;24(6):1095–1102.
- Feldman F. Atypical diaphyseal femoral fractures-new aspects. *Skeletal Radiol.* 2012;41(1):75–81.
- Shah A, Shah M. Functional outcomes of subtrochanteric femur fractures treated by intramedullary proximal femur nail. *Int J Orthop.* 2017;3(2):876–81.
- Bumpass DB, Ricci WM, McAndrew CM, Gardner MJ. A Prospective Study of Pain Reduction and Knee Dysfunction Comparing Femoral

- Skeletal Traction and Splinting in Adult Trauma Patients. *J Orthop Trauma*. 2015;29(2):112–8.
9. Grigoryan KV, Javedan H, Rudolph JL. Orthogeriatric Care Models and Outcomes in Hip Fracture Patients. *J Orthop Trauma*. 2014;28(3):e49–e55.
 10. Koval KJ, Rezaie N, Yoon RS. Subtrochanteric Femur Fractures. In: Proximal Femur Fractures. Springer; 2018. p. 101–12.
 11. Robertson R, Tucker M, Jones T. Provisional Plating of Subtrochanteric Femur Fractures Before Intramedullary Nailing in the Lateral Decubitus Position. *J Orthop Trauma*. 2018;32(4):e151–6.
 12. Wiss DA, Brien WW. Subtrochanteric Fractures of the Femur Results of Treatment by Interlocking Nailing. *Clin Orthop Relat Res*. 1992;(283):231–6.
 13. Nicolaou D, Watson JT. Nailing proximal femur fractures: How to choose starting point and proximal screw configuration. *J Orthop Trauma*. 2015;29(4):22–7.
 14. Carter DR, Hayes WC. The compressive behavior of bone as a two-phase porous structure. *J Bone Joint Surg*. 1977;59(7):954–62.
 15. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *J Bone Joint Surg*. 1995;77(7):1058–64.
 16. Sierra RJ, Cabanela ME. Conversion of Failed Hip Hemiarthroplasties After Femoral Neck Fractures. *Clin Orthop Relat Res*. 2002;399:129–39.
 17. Simpson AHRW, Varty K, Dodd CSF. Sliding hip screws: modes of failure. *Inj*. 1989;20(4):227–31.
 18. Halder SC. The Gamma nail for peritrochanteric fractures. *J Bone Joint Surg*. 1992;74-B(3):340–4.
 19. Sharma S, Swamy A, Salgia A, Mohapatra A, Parmar KS. Management of Subtrochanteric Fracture Femur With Proximal Femoral Nail(PFN). *J Pharm Biomed Sci*. 2014;04(03):235–40.
 20. Bouldin C, Seibert FJ, Fankhauser F. The proximal femoral nail (PFN)- a minimal invasive treatment of unstable proximal femoral fractures". *Acta Orthop Scand*. 2003;74(1):53–8.
 21. Schipper IB, Steyerberg EW, Castelein RM, van der Heijden FHW, den Hoed PT, Kerver AJH, et al. Treatment of unstable trochanteric fractures. *J Bone Joint Surg*. 2004;86-B(1):86–94.
 22. Pavelka T, Krotus J, Linhart M. Osteosynthesis of proximal femoral fractures using short proximal femoral nails. *Acta Chir Orthop Traumatol Cech*. 2003;70(1):31–8.
 23. Seinsheimer F. Subtrochanteric fractures of the femur. *J Bone Joint Surg*. 1978;60(3):300–6.
 24. Rahme DM, Harris IA. Intramedullary Nailing versus Fixed Angle Blade Plating for Subtrochanteric Femoral Fractures: A Prospective Randomised Controlled Trial. *Jf Orthop Surg*. 2007;15(3):278–81.
 25. Pradhan V, Jain S, Agrawal S, Sharma SL. Comparative prospective study of proximal femoral nail and locking compression plate in subtrochanteric fractures of femur. *Natl J Clin Orthop*. 2018;2(4):188–94.
 26. Gadegone WM, Salphale YS. Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. *Int Orthop*. 2007;31(3):403–8.

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