



Functional Outcome Of Intertrochanteric Fracture Managed With Proximal Femoral Nailing And Early Weight Bearing

Ajaz Mohammad¹, Shanu Gupta^{2*}, Sandeep Chauhan³

^{1,2,3} Secondary DNB Residents, ³ Senior Consultant

^{1,2,3} Department of Orthopaedics, Artemis Health Institute Haryana, India

***Corresponding Author:**

Shanu Gupta

Department of Orthopaedics, Artemis Health Institute Haryana, India

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Intertrochanteric fractures constitute one of the most common fractures around the hip, occurring mainly in elderly population. The increase in life expectancy in the past few decades has led to a substantial increase in fragility fractures, specially fracture around the hip, this leads to loss of mobility and independency and results in significant socioeconomic consequences. Proximal femoral nail is the latest implant for management of intertrochanteric fractures. This implant has many potential advantages. Being intramedullary, load transfer is more efficient, shorter lever arm results in less transfer of stress and less chances of implant failure, the amount of sliding is limited by intramedullary location and locking screws, therefore less chances of shortening and deformity, besides shorter operative time, less soft tissue dissection and less blood loss. Hence, with proximal femoral nail early mobilization can be achieved after surgery. which results in lesser complications and early recovery. Early weight-bearing also improves bone turnover metabolism and promotes bone growth. The mean Harris hip score at 2, 6- and 12-weeks post op were 36.4 ± 2 , 55.4 ± 4.9 and 81.3 ± 7.5 respectively. which indicates excellent outcome.

Keywords: Intertrochanter Fractures, Proximal femur Nail , early weight bearing

Introduction

Intertrochanteric fractures constitute one of the most common fractures around the hip, occurring mainly in elderly population.(1) The increase in life expectancy in the past few decades has led to a substantial increase in fragility fractures, specially fracture around the hip , this leads to loss of mobility and independency and results in significant socioeconomic consequences.(2)

Intertrochanteric fractures are seen with increasing frequency and severity as the life expectancy of our population increases.(3) Intertrochanteric fractures usually occur in older patients with decreased bone strength and density. Nowadays these fractures are also commonly seen in younger age group(4)

resulting from high energy trauma and often are associated with other fractures.

These fractures are not prone to nonunion or femoral head necrosis as the blood supply of the metaphyseal fracture fragments is in general much better than in cervical fractures. Hip fractures are associated with the most severe morbidity and mortality of all the osteoporotic or age-related fractures. For the majority of these patients, sustaining a hip fracture means the temporary or permanent loss of previous degree of independence and a burden on the socioeconomic system.(5)

Prophylactic interventions³ to decrease the risk of falls and aggressive screening and treatment of osteoporotic patients with high risk of fragility fracture are very important. Early postoperative

rehabilitation care is more crucial. The overall aim in the management of hip fractures is to bring the patient to pre morbid functional status.

Proximal femoral nail is the latest implant for management of intertrochanteric fractures. This implant has many potential advantages. Being intramedullary, load transfer is more efficient, shorter lever arm results in less transfer of stress and less chances of implant failure, the amount of sliding is limited by intramedullary location and locking screws, therefore less chances of shortening and deformity, besides shorter operative time, less soft tissue dissection and less blood loss. Hence, with proximal femoral nail early mobilization can be achieved after surgery(6) which results in lesser complications and early recovery.(7)

Early post-operative mobilization (weight bearing as tolerated with walker support on post-operative day one) has a significant impact on short-term results, such as low complication rates and shorter length of stay, and also results in better long-term outcomes.(8) Early weight-bearing also improves bone turnover metabolism and promotes bone growth. In a similar perspective, prolonged non weight-bearing is associated with the occurrence of delayed bony union and worse functional recovery.(9)

Early weight bearing is also very important to activate osteoblasts and other cells responsible for bone healing. (10)

Patients with hip fractures often present with comorbidities and frequently suffer complications during their hospital stay.(11) They frequently have associated medical problems most commonly diabetes, hypertension, renal failure, coronary artery disease, chronic lung disease, Parkinsonism and others.(12) Post operatively, early mobilization of these elderly patients reduces the morbidity and mortality rate.

Non operative methods consists of prolonged bed rest in traction until fracture union (10 – 12 weeks). This is followed by a lengthy program of walking training. In elderly people, this was associated with high complications including mal-union, nonunion, decubitus ulcers, urinary tract infection, joint contractures, pneumonia and thromboembolic complications, resulting in a high mortality rate. For these reasons, the treatment of intertrochanteric

fracture by reduction and internal fixation has become the standard method of choice.(13) Hence, conservative method is only indicated in conditions such as age related chronic medical conditions unfit for surgery and for nonambulatory patients before sustaining fracture.(14)

Other operative management for intertrochanteric fractures includes extramedullary (dynamic hip screw and its variants). Dynamic hip screw is the most commonly used device for fixation of intertrochanteric fractures. However, the disadvantages such as large skin incision and more soft tissue dissection with greater blood loss replaced its use with proximal femoral nail.(15)

In view of these conditions, this study has been taken up to study the management, outcome and related complications associated with treatment of intertrochanteric fractures by using proximal femoral nailing and post-operative early weight bearing.

Materials And Method

Study setting:The present study was carried out in the Department of Orthopedics, Artemis Health Institute, Gurgaon, Haryana, a tertiary care teaching institute in North India.

Study Population:Adult patients of either sex presenting to the study hospital with intertrochanteric fractures comprised the study population.

Study design:The present study was undertaken as a prospective, observational study.

Study sample:30 patients who under proximal femoral nailing for intertrochanteric fractures in the study hospital comprised the study sample.

Sample Size estimation:The minimum required sample size was calculated to be 25, however, 30 patients were included in the study.**Study Period:**The study was carried out during the period starting from November 2020 to June 2021.

Inclusion Criteria:All patients scheduled to undergo proximal femoral nailing.

Exclusion Criteria:

1. Patients with fracture in any other part of the body and polytrauma patient, who can not be allowed for early weight bearing.
2. Patients who were in non-ambulatory state before fracture.

3. 3.All patient with pathological trochanteric fractures.
4. 4.Patients with neuromuscular disorders like Polio (post-polio residual paralysis), neurological disorders like Seizure disorders, epilepsy, Parkinson’s disease

Brief Procedure:

Patients were selected on the basis of inclusion and exclusion criteria for the study. Enrolled patients underwent all routine hematological and Radiological investigations and patients who are found fit for surgery in pre-anesthetic checkup, were included in the study. Patient’sdemographical data was collected for record. All patients underwent close/open reduction and internal fixation with proximal femoral nail through similar approach. All operations were performed by two senior orthopedic surgeons, within the Artemis Health institute. All patient were provided adequate post-operative analgesic medications including epidural analgesics as per hospital protocol. X- Ray was taken on post-operative day 1 of all the patients included in study. All eligible patient have been started with early weight bearing, as tolerable, with walker support on post-operative day 1.All patient underwent similar physiotherapy rehabilitation program. At the end of 1st week, 50% weight bearing on operated limb was targeted and walker assisted mobilization was continued till 4th to 6th week post operatively. At the end of 12th week 100 % weight bearing over operated limb was targeted without walker support. Assessment and scoring was done as per Harris hip score on post-operative day 1 (when the weight bearing was started), and on follow up on 2nd week, 6th week and 12th week from the date of surgery. Harris hip score was recorded in terms of pain , limp on walking , taking support while walking, total walking distance , ability to sit on a chair, ability to enter in a public transport , ability to put on socks and shoes without help , absence of any deformity and range of motion of hip joint.

Maximum score is 100.Harris hip score is graded as under

1. Less than 70 – poor
2. 70 to 79 - fair
3. 80 to 89 - good
4. 90 to 100- excellent

Outcome Measures:Physical examination as per Harris hip score was done and scoring was recorded for the study. Post-operative x rays were recorded on post-operative day 1, and on follow up on 6th week and 12th week.

Statistical analysis:Data entry was done in MS Excel 2013 and data analysis was carried out using SPSS version 22.0. Continuous and categorical variables were expressed as means and proportions respectively. Difference in proportions were tested for statistical significance using chi square test. A p value <0.05 was considered statistically significant.

Ethical Considerations:Institute ethical committee clearance certificate was sought and obtained before the study was begun. Informed written consent was obtained from all the study participants before including them in the study.

Results

Majority of the study participants had a fair and good functional outcome with 40.0% in each.

The mean harris hip score at 2, 6 and 12 weeks post op were 36.4±2, 55.4±4.9 and 81.3±7.5 respectively. Higher proportion of patients with good functional outcome were in more than 75 years age group. The association was not found to be statistically significant (p value – 0.872).No significant association was observed between gender of the participants and functional outcome.Higher proportion of patients having good functional outcome with type II (45.5%) and fair outcome with type III (62.5%) by Boyed and Griffin classification and the association was not found to be statistically significant (p value – 0.316).

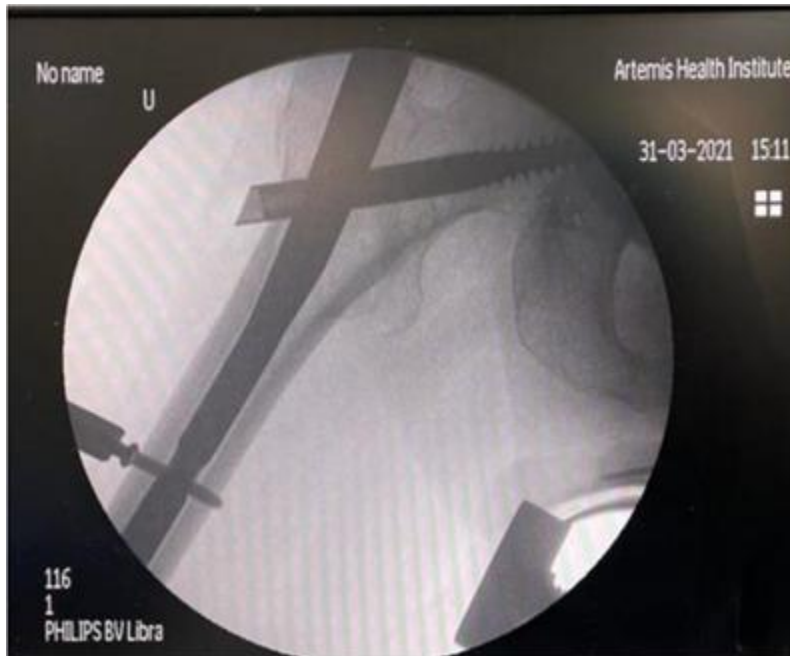
Study	Harris Hip score			
	Excellent and good results	Excellent	Good	Mean Score

Krishan VM et al(68)	88%	34%	54%	
Purohit A et al(67)	96%	6%	90%	87.37
Manjunath J et al(66)	76.7%	56.16%	20.54%	
Murugesan AK et al(65)	88%	80%	8%	
Kapila R et al(64)	80%	24%	56%	
Khairnar A et al(63)	82.8%	51.42%	31.42%	
Mudgal CV et al(62)	54%	7 %	47 %	
Rathore LP et al(61)	73%	31%	42%	
Mandice1 CM et al(59)	91.7%	50%	41.7%	88.75
Prajapati P et al(57)	82.66%	57.33%	25.33%	
Nandakumar R et al(56)			35%	81.7
Present study	80%	40%	40%	81.3

X ray Image of patient at the time of Presentation in Emergency Room



C Arm Image From Operating Room during fixation of IT Fracture with PFN



Post - Operative X ray of same patient on Post op day 2



Discussion

This is a prospective observational study conducted on 30 patients to assess the functional outcome of intertrochanteric fracture managed with proximal femoral nailing and early weight bearing at a tertiary care teaching institute in North India. Maximum of the study participants were in the age group of >75 years (50.0%), followed by 61-75 years (36.7%). The mean age of the study participants was 73.6 ± 11.3 and the minimum age was 49 years. Majority of the study participants were females (53.3%), had slip and fall (40.0%) as a mode of injury, were in type II (73.3%) Boyed and Griffin classification, had injury on right side (56.7%), and two days interval between injury and surgery (60%). Majority of study participants had a nail size of 10 mm (50.0%) followed by 11mm (diameter) (36.7%), and 56.7% had up to 100 ml of blood loss. Majority of the study participants had a Harris hip score of 70 – 79 (40%) and 80 – 89 (40%) at 12 weeks. The mean Harris hip score at 2, 6 and 12 weeks post op were 36.4 ± 2 , 55.4 ± 4.9 and 81.3 ± 7.5 respectively. No statistically significant association was observed between age, gender, classification of fracture, side of injury, time to surgery, duration of

surgery, blood loss and functional outcome. Demographic pattern of study population varied to certain extent amongst different studies conducted in different parts of the country. This could be because of difference in characteristics of the study population where the concerned study was conducted. However, in common it was observed that mean age was around 70-75 years in most cases and male preponderance was noticed. There were 26 males and 22 females of age 35-85 years with an average of 60 years in the study by Krishan VM et al.(68) Also, Purohit A et al(67) reported in their study results that majority of the patient were between 61-80 years with a mean age of 74.46 ± 12.04 years. About 52 percent of the patients were female and 48 percent male. Murugesan AK et al(65) observed in their research work that of the 24 patients, 10 males, 14 females with mean age of 75.77 years (range: 60-82 years). These observations were similar to that of the present study findings. Kapila R et al(64) study of 25 cases, 19 were males and 6 were females, in the age group of 21-78 years with the mean age of 49.24 years, this was considerably lower than the present study, which

could be because, the above study included more younger patients in the inclusion criteria.

Fall at home was the most common mode of injury and Right hip was involved in 48% in the study by Purohit A et al,(67) identical proportions were observed in the present study also. In Kumar M et al(69) series RTA was the major cause of proximal femur fractures(86%). Different studies have reported different type of injury being the most common cause, this could be because of the fact that all the studies are hospital research work and the location of hospital may have considerably influenced the type of patient it usually receives.

Khairnar A et al(63) documented in their study that For PFN minimum duration was 40 minutes and maximum duration was 150 minutes and mean duration was 80 minutes. Purohit A et al(67) reported an average time for operation as 42.30 ± 10.01 minutes. These observations were comparable to that of the present study observation where maximum (46.6%) of the study participants had duration of surgery ranging between 60-90 minutes.

Stable operative fixation allows early mobilization and also prevents from other medical complications. The successful treatment of Intertrochanteric fractures with PFN depends on many factors such as the general health of the patient, time from fracture to treatment, adequacy and stability of the fixation. Harris Hip score was the most commonly involved tool for evaluation of functional outcome post PFN surgery for inter trochanteric features among the studies reviewed. In general most of the studies in the past have reported a Harris hip score postsurgery ranging from 75-95% for excellent and good outcomes considered together. This is comparable to that of the present study observations. Also, it has to be interpreted with caution as duration at which the outcome was measured is different for different studies, which would apparently affect the score reported. None of the 30 operated patients in the present study had any complications. Various studies have documented different levels of complication rate in their research works. Purohit A et al(67) reported the rates of complications in their study as revision surgery (4.0%) patients, superficial infection (4.0%), Z effect (2.0%) patient, inadequate reduction (2.0%) patient, difficulty in distal locking (2.0%) and varus(2.0% }

Conclusion

Proximal femoral nailing and early weight bearing for inter trochanteric fractures has resulted in good functional outcomes, as evaluated by Harris Hip Score with no considerable procedure related complications amongst adults aged more than 45 years of both sexes.

Proximal femoral nailing and early weight bearing for inter trochanteric fractures has resulted in good functional outcomes, as evaluated by Harris Hip Score with no considerable procedure related complications amongst adults aged more than 45 years of both sexes.

References

1. Yang YH, Wang YR, Jiang SD, Jiang LS. Proximal femoral nail antirotation and thirdgeneration Gamma nail: which is a better device for the treatment of intertrochanteric fractures? Singapore medical journal 2013;54 (8):446-50.
2. Murphy NM, Carroll P. The effect of physical activity and its interaction with nutrition on bone health. The Proceedings of the Nutrition Society 2003;62 (4):829-38.
3. Vivek Trikha, Shishir Rastogi M. Epidemiology and Rehabilitation of Hip Fractures in the Geriatric Population. IJPMR 2005;16 (1):16-9.
4. Robinson CM, Court-Brown CM, McQueen MM, Christie J. Hip fractures in adults younger than 50 years of age. Epidemiology and results. Clinical orthopaedics and related research 1995(312):238-46.
5. Braithwaite RS, Col NF, Wong JB. Estimating hip fracture morbidity, mortality and costs. Journal of the American Geriatrics Society 2003;51 (3):364-70.
6. Lim JY, Park WB, Oh MK, Kang EK, Paik NJ. Falls in a proportional region population in Korean elderly: incidence, consequences, and risk factors. Journal of the Korean Geriatrics Society 2010;14 (1):8-17.
7. JW B. Orthopaedics and rheumatology. editors. . 2nd ed. ed: William & Wilkins, ; 1990.
8. Laflamme GY, Rouleau DM, Leduc S, Roy L, Beaumont E. The Timed Up and Go test is an early predictor of functional outcome after hemiarthroplasty for femoral neck fracture. The

- Journal of bone and joint surgery American volume 2012;94 (13):1175-9.
9. Alexiou KI, Roushias A, Varitimidis SE, Malizos KN. Quality of life and psychological consequences in elderly patients after a hip fracture: a review. *Clinical interventions in aging* 2018;13:143-50.
 10. Pareja Sierra T, Bartolomé Martín I, Rodríguez Solís J, et al. Predictive factors of hospital stay, mortality and functional recovery after surgery for hip fracture in elderly patients. *Revista española de cirugía ortopédica y traumatología* 2017;61 (6):427-35.
 11. Ariza-Vega P, Kristensen MT, Martín-Martín L, Jiménez-Moleón JJ. Predictors of long-term mortality in older people with hip fracture. *Archives of physical medicine and rehabilitation* 2015;96 (7):1215-21.
 12. Pashikanti L, Von Ah D. Impact of early mobilization protocol on the medical-surgical inpatient population: an integrated review of literature. *Clinical nurse specialist CNS* 2012;26 (2):87-94.
 13. Chong CP, Savige JA, Lim WK. Medical problems in hip fracture patients. *Archives of orthopaedic and trauma surgery* 2010;130 (11):1355-61.
 14. Lee YS, Huang HL, Lo TY, Huang CR. Dynamic hip screw in the treatment of intertrochanteric fractures: a comparison of two fixation methods. *International orthopaedics* 2007;31 (5):683-8.
 15. Chowdary SD, Kiran CR, Lalki C. Comparative study of management of
 16. intertrochanteric fractures (Type 3 and 4 Boyd and Griffin Classification) by dynamic hip screw or proximal femoral nail. *J Evid Based Med Healthc* 2017;4 (47):2876-83.
 17. Thompson JC. *Netter's Concise Orthopaedic Anatomy E-Book*: Elsevier Health Sciences; 2015.
 18. Heckman JD, McKee M, McQueen MM, Ricci W, Tornetta III P. *Rockwood and Green's fractures in adults*: Lippincott Williams & Wilkins; 2014.
 19. Gilligan I, Chandraphak S, Mahakkanukrauh P. Femoral neck-shaft angle in humans: variation relating to climate, clothing, lifestyle, sex, age and side. *Journal of anatomy* 2013;223 (2):133-51.
 20. 2013;223 (2):133-51.
 21. Collin PG, D'Antoni AV, Loukas M, Oskouian RJ, Tubbs RS. Hip fractures in the elderly-: A *Clinical Anatomy Review*. 2017;30 (1):89-97.
 22. Shivji FS, Green VL, Forward DP. Anatomy, classification and treatment of intracapsular hip fractures. *British journal of hospital medicine (London, England : 2005)* 2015;76 (5):290-5.
 23. Lu Y, Wang L, Hao Y, Wang Z, Wang M, Ge S. Analysis of trabecular distribution of the proximal femur in patients with fragility fractures. *BMC musculoskeletal disorders* 2013;14:130.
 24. Solomon LB, Lee YC, Callary SA, Beck M, Howie DW. Anatomy of piriformis, obturator internus and obturator externus: implications for the posterior surgical approach to the hip. *The Journal of bone and joint surgery British volume* 2010;92 (9):1317-24.
 25. Kalhor M, Horowitz K, Gharehdaghi J, Beck M, Ganz R. Anatomic variations in femoral head circulation. *Hip international : the journal of clinical and experimental research on hip pathology and therapy* 2012;22 (3):307-12.
 26. Zlotorowicz M, Szczodry M, Czubak J, Ciszek B. Anatomy of the medial femoral circumflex artery with respect to the vascularity of the femoral head. *The Journal of bone and joint surgery British volume* 2011;93 (11):1471-4.
 27. Kalhor M, Beck M, Huff TW, Ganz R. Capsular and pericapsular contributions to acetabular and femoral head perfusion. *The Journal of bone and joint surgery American volume* 2009;91 (2):409-18.
 28. Xiao J, Yang XJ, Xiao XS. DSA observation of hemodynamic response of femoral head with femoral neck fracture during traction: a pilot study. *Journal of orthopaedic trauma* 2012;26 (7):407-13.
 29. 2012;26 (7):407-13.
 30. Crawford EJ, Emery RJ, Hansell DM, Phelan M, Andrews BG. Capsular distension and intracapsular pressure in subcapital fractures of the femur. *The Journal of bone and joint surgery British volume* 1988;70 (2):195-8.
 31. Bonnaire F, Schaefer DJ, Kuner EH. Hemarthrosis and hip joint pressure in femoral neck fractures. *Clinical orthopaedics and related research* 1998(353):148-55.

32. Kregor PJ. The effect of femoral neck fractures on femoral head blood flow. *Orthopedics* 1996;19 (12):1031-6; quiz 7-8.
33. Claffey TJ. Avascular necrosis of the femoral head. An anatomical study. *The Journal of bone and joint surgery British volume* 1960;42-b:802-9.
34. Trueta J, Harrison MH. The normal vascular anatomy of the femoral head in adult man. *The Journal of bone and joint surgery British volume* 1953;35-b (3):442-61.
35. Sevitt S, Thompson RG. The distribution and anastomoses of arteries supplying the head and neck of the femur. *The Journal of bone and joint surgery British volume* 1965;47:560-73.
36. Pokorný D, Jahoda D, Veigl D, Pinskerová V, Sosna A. Topographic variations of the relationship of the sciatic nerve and the piriformis muscle and its relevance to palsy after total hip arthroplasty. *Surgical and radiologic anatomy : SRA* 2006;28 (1):88-91.
37. Kaufer H, Matthews LS, Sonstegard D. Stable fixation of intertrochanteric fractures: A biomechanical evaluation. *JBJS* 1974;56 (5):899-907.
38. Boyd HB, GRIFFIN LL. Classification and treatment of trochanteric fractures.
39. *Archives of Surgery* 1949;58 (6):853-66.
40. Evans EM. Trochanteric fractures; a review of 110 cases treated by nail-plate fixation. *The Journal of bone and joint surgery British volume* 1951;33b (2):192-204.
41. Chapman MW, Szabo RM, Marder RA. *Chapman's orthopaedic surgery: Lippincott*
42. *Williams & Wilkins Philadelphia; 2001.*
43. De Boeck H. Classification of hip fractures. *Acta orthopaedica Belgica* 1994;60 Suppl 1:106-9.
44. Müller ME. [Classification and international AO-documentation of femur fractures]. *Unfallheilkunde* 1980;83 (5):251-9.
45. Cheng K, Montgomery S, Housley S, Wheelwright E. Clinical Risk Factors for Hip Fracture in Young Adults Under 50 Years Old. *European journal of trauma and emergency surgery : official publication of the European Trauma Society* 2009;35 (1):40-2.
46. Al-Ani AN, Neander G, Samuelsson B, Blomfeldt R, Ekström W, Hedström M. Risk factors for osteoporosis are common in young and middle-aged patients with femoral neck fractures regardless of trauma mechanism. *Acta orthopaedica* 2013;84 (1):54-9.
47. Davidovitch RI, Jordan CJ, Egol KA, Vrahas MS. Challenges in the treatment of femoral neck fractures in the nonelderly adult. *The Journal of trauma* 2010;68 (1):236-
48. 42.
49. Eiff M, Hatch R, Calmbach W. *Femur and pelvis fractures. Fracture Management for Primary Care, 2nd, Saunders, Philadelphia 2003.*
50. Al-Ani AN, Samuelsson B, Tidermark J, et al. Early operation on patients with a hip fracture improved the ability to return to independent living. A prospective study of 850 patients. *The Journal of bone and joint surgery American volume* 2008;90 (7):1436-42.
51. Holt G, Smith R, Duncan K, McKeown D. Does delay to theatre for medical reasons affect the peri-operative mortality in patients with a fracture of the hip? *The Journal of bone and joint surgery British volume* 2010;92 (6):835-41.
52. Simmermacher RK, Bosch AM, Van der Werken C. The AO/ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures.
53. *Injury* 1999;30 (5):327-32.
54. Banan H, Al-Sabti A, Jimulia T, Hart AJ. The treatment of unstable, extracapsular hip fractures with the AO/ASIF proximal femoral nail (PFN)--our first 60 cases. *Injury* 2002;33 (5):401-5.
55. Domingo LJ, Cecilia D, Herrera A, Resines C. Trochanteric fractures treated with a proximal femoral nail. *International orthopaedics* 2001;25 (5):298-301.
56. Boldin C, Seibert FJ, Fankhauser F, Peicha G, Grechenig W, Szyszkowitz R. The proximal femoral nail (PFN)--a minimal invasive treatment of unstable proximal femoral fractures: a prospective study of 55 patients with a follow-up of 15 months. *Acta orthopaedica Scandinavica* 2003;74 (1):53-8.
57. Schipper IB, Bresina S, Wahl D, Linke B, Van Vugt AB, Schneider E. Biomechanical evaluation of the proximal femoral nail. *Clinical orthopaedics and related research* 2002(405):277-86.
58. Helwig P, Faust G, Hindenlang U, et al. Finite element analysis of four different implants

- inserted in different positions to stabilize an idealized trochanteric femoral fracture. *Injury* 2009;40 (3):288-95.
59. Pajarinen J, Lindahl J, Savolainen V, Michelsson O, Hirvensalo E. Femoral shaft medialisation and neck-shaft angle in unstable pertrochanteric femoral fractures. *International orthopaedics* 2004;28 (6):347-53.
 60. Gupta RK, Sangwan K, Kamboj P, Punia SS, Walecha P. Unstable trochanteric fractures: the role of lateral wall reconstruction. *International orthopaedics* 2010;34 (1):125-9.
 61. Werner-Tutschku W, Lajtai G, Schmiedhuber G, Lang T, Pirkl C, Orthner E. [Intra- and perioperative complications in the stabilization of per- and subtrochanteric femoral fractures by means of PFN]. *Der Unfallchirurg* 2002;105 (10):881-5.
 62. Kumar GK, Sharma G, Khatri K, et al. Treatment of unstable intertrochanteric fractures with proximal femoral nail antirotation II: our experience in Indian patients. *The open orthopaedics journal* 2015;9:456.
 63. Nandakumar R VTA, Prabhakaran A , Chandrasekaran M , Swagat Mahapatra. Early Weight Bearing Following Intertrochanteric Fractures Managed With Proximal Femoral Nail; Are We Obsessed With Complications? *International Journal of Orthopaedics Traumatology & Surgical Sciences* 2016;2 (1):255-8.
 64. Prajapati P, Prajapati V, Pate P, Kakani K, Patil S. Functional outcome of unstable intertrochanteric femur fracture treated with intramedullary nailing. *J Res Medical Dental Sci* 2016;4 (3):3.
 65. Punit J. Tank RAS, Harshadkumar A Patel, Nirav Rathi, Janak Mistry, Hiren B.
 66. Bhabhor. Results of Proximal Femoral Nail in Intertrochanteric Fracture of Femur. *IOSR Journal of Dental and Medical Sciences* 2016;15 (4):17-24.
 67. Mandice CJ, Khan R, Anandan H. Functional outcome of unstable intertrochanteric fractures managed with proximal femoral nail: a prospective analysis. *International Journal of Research in Orthopaedics* 2018;4 (6):945.
 68. Kammar S, Bhasme V, Hosthota A. Functional outcome of proximal femur fracture managed surgically using proximal femoral nail (PFN). *Journal of Karnataka Orthopaedic Association* February 2017;5 (1):41.
 69. Rathore LP, Gupta L, Thakur S, Vaidya S, Sharma D, Sharma A. Treatment of stable and unstable intertrochanteric fractures using proximal femoral nail and their functional assessment using modified Harris hip score. *International Journal of Research in Orthopaedics* 2019;5 (1):162.
 70. Mudgal C, Madhuchandra R, Dhananjayan D. A Study On Surgical Management Of Unstable Intertrochanteric Fractures Using Proximal Femoral Nail. *BMH Medical Journal- ISSN 2348–392X* 2018;5 (3):67-73.
 71. Patil AKaL. A study of functional outcome in intertrochanteric femur fractures treated by proximal femoral nailing. *Int J Med Res Rev* 2018;6 (6):335-40.
 72. Rajesh Kapila PS, Sunil Mahajan. Functional Outcome of Proximal Femoral Nail (P.F.N) in the Management of Intertrochanteric and Subtrochanteric Fractures Femur. *Journal of Medical Science and Clinical Research* 2018;6 (2):682-7.
 73. Murugesan AK, Govindasamy R, Ismail PY. Functional outcome of intertrochanteric fractures in elderly patients with proximal femoral nail: retrospective study. *International Journal of Research in Orthopaedics* 2019;5 (4):619.
 74. Manjunath J, Venkataramana Rao M, Srinath S, Kiran G, Shashidhara H, Druva V.
 75. Clinico-radiological and Functional outcome of Unstable Intertrochanteric Fractures by Proximal Femoral Nail Antirotation-2 (PFN-A2). 2019.
 76. Arnik Purohit PC, Shreesh Phatak. A Prospective Study of the Functional Outcome of Intertrochanteric Femoral Fracture Managed with Short Proximal Femoral Nail. *International Journal of Contemporary Medical Research* 2020;7 (2):B9-B16.
 77. Krishna CVM, Kare SK, Archana R, Nethajee P, Chakravarthy AK. Functional outcome of intertrochanteric fracture neck of femur treated with proximal femoral nail. *International Journal of Health and Clinical Research* 2021;4 (1):150-4.

86. Manoj Kumar HV, Krishna Murthy T , Ankith NV , Somashekar D. A Prospective Study of Clinikoradiological Outcome Assessment in Proximal Femoral Fractures
87. Treated with Proximal Femoral Nail. International Journal of Contemporary Medical Research 2016;3 (5):1343-6.