ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 01 | January - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSESSMENT OF EARLY MECHANICAL COMPLICATION FOLLOWING EARLY WEIGHT BEARING IN UNSTABLE TROCHANTERIC FRACTURE FOLLOWING TFN FIXATION

Orthopaedics

Dr. Prabhat Kumar Verma JR Department Of Orthopedics B. R. D. Medical College Gorakhpur

Dr. Pavan Pradhan MS, Department Of Orthopedics B. R. D. Medical College Gorakhpur

Dr. Surendra Kumar MS, Department Of Orthopedics B. R. D. Medical College Gorakhpur

Dr. Atil Lal MS, Department Of Orthopedics B. R. D. Medical College Gorakhpur

ABSTRACT

Background: Trochanteric fractures, first described by Astley Cooper in 1851, are significant in older populations due to high morbidity and mortality rates. Surgical fixation, especially with the trochanteric femoral nail (TFN), is common. **Objectives:** To evaluate the incidence of early mechanical complications and assess functional outcomes and patient satisfaction in patients who underwent early weight-bearing following TFN fixation for unstable trochanteric fractures. **Methods:** This hospital-based prospective observational study was conducted at BRD Medical College, Gorakhpur, over 18 months in the Orthopaedic Emergency and Outdoor Department. The study included patients aged 50 years or older with unstable intertrochanteric fractures, excluding those with pathological fractures, previous hip surgeries, or significant comorbidities. **Results:** The study of 94 patients with unstable intertrochanteric fractures, predominantly aged 50-60 years, showed that 56.4% were male. All patients underwent TFN fixation surgery with early weight-bearing. Mechanical complications were observed in 12.8%, and 3.2% developed infections. Harris Hip Scores significantly improved from an initial mean of 19.2 to 83.1 at three months. Overall, 97.9% were satisfied with the surgical outcome. **Conclusion:** Our study highlights that Trochanteric Femoral Nail (TFN) is highly effective for intertrochanteric fractures, offering excellent outcomes with high bone union rates, minimal soft tissue damage, and superior functional results.

KEYWORDS

Trochanteric Femoral Nail (TFN); Intertrochanteric fractures; Bone union; Surgical technique; Functional outcomes

INTRODUCTION

Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly. The incidence of intertrochanteric fracture is rising because of the increasing life expectancy superadded with osteoporosis. These fractures are three to four times more common in women and the mechanism of injury is usually due to low-energy trauma like a simple fall. Among all age groups, hip fractures are the most severe orthopaedic injuries; among those over 50, hip fractures account for 90.0% of occurrences. Proximal femur fractures are more prevalent as a result of increased total life expectancy and an increase in traffic-related events. The elderly patients who sustain these fractures have significant morbidity and death rates associated with them, ranging from 15.0% to 20.0% within a year following the fracture. Sub-trochanteric fractures, which make up 10.0% of proximal femur fractures, are more common in people over 60 and in those between the ages of 20 and 40. Extra-capsular fractures mostly impact the cortical and compact cancellous bone (intertrochanteric and subtrochanteric fractures). Fractures in this area occur via the proximal femur following the route of least resistance due to the nonhomogeneous osseous structure and complex load distribution.

Trochanteric (pertrochanteric/intertrochanteric) and subtrochanteric fractures are within the group of proximal femoral fractures, sometimes known as hip fractures. Femoral neck injuries are subordinated to this group as well. Of all hip fractures, femoral neck fractures account for 51.0%, trochanteric fractures for 38.0%, and subtrochanteric fractures for 8.0%. Just 3.0% of hip fractures are basocervical fractures, which are uncommon fractures in the area where the trochanteric region and femoral neck meet. According to Gullberg B et al estimates, Global hip fracture rates are expected to rise to 2.6 million in 2025 and 4.5 million in 2050. Men will have a higher percentage gain (310.0%) than women (240.0%). Asia accounted for 26.0% of all hip fractures in 1990; by 2025, that percentage might increase to 37.0% and perhaps 45.0%. Hagino and associates. According to reports, the lifetime risk of hip fractures is 5.6% for men and 20.0% for women over the age of 50.

An intertrochanteric fracture, which is more common in elderly adults with osteoporotic bones, is one of the most common hip fractures. If treatment is not received, the fractures have a very high morbidity and fatality rate. Therefore, the best course of therapy for these fractures is surgery. It is projected that by 2020, about twenty percent of Indians would be over sixty, and six million hip fractures will occur annually. Ninety percent of intertrochanteric fractures from low-energy trauma occur in patients over 65. Data from epidemiological surveys showed that in 1990, there were 1.66 million hip fracture patients globally as a result of osteoporosis; by 2050, that number is predicted to rise to 6.26 million.

Prior to the development of appropriate fixation devices, conservative therapy was the norm; however, due to the high risk of complications, this strategy is no longer widely used. The high death rate is a result of common issues associated with extended immobility, such as UTIs, decubitus ulcers, pneumonia, joint contractures, and thromboembolism. Because varus deformity and shortening are more common and lead to poor function, surgical therapy is the recommended course of treatment. In the 1950s, surgical therapy for hip fractures was established with the goal of reducing complications and improving functional results. Many therapeutic alternatives, including extramedullary, intramedullary, external fixator, and arthroplasty, have developed since then. While internal therapy has gained widespread acceptance for these fractures, problems with infection after surgical repair, non-union, malunion, and implant failure have prompted continued research into new devices and treatment strategies.

Early mobilization and internal fixation are the current standards of treatment. “These fractures can be treated with a variety of implant types, including the gamma nail, blade plate, proximal femoral locking plate, dynamic hip screw (DHS), proximal femoral nail (PFN), and proximal femoral nail anti-rotation” Asia (PFNA2). In general, implants fall into one of two categories: extramedullary or intramedullary devices. Examples “of extramedullary devices are the DHS, the blade plate, and the proximal femoral locking plate”.

For orthopaedic surgeons, unstable intertrochanteric fractures including postero-medial instability and reverse obliquity provide a significant problem. Throughout history, a variety of implants have been introduced to the surgeon's toolset, including the Jewett nail, Ken-Pugh nail, Holt nail, “Massie nail, sliding hip screw devices, and cephalo-medullary nails. But none of them are entirely successful”.

The trochanteric femoral nail (TFN) combines “the advantages of semi-closed intramedullary nailing, a dynamic femoral neck screw, and early post-operative weight-bearing” by “combining the features of an unreamed intramedullary femoral nail with a sliding, load-bearing femoral neck screw. This enhances the proximal fracture fragment's rotational stability.” its introduction in year 1997, numerous

clinical studies demonstrated positive outcomes with few intraoperative issues and a low incidence of complications. It is yet unknown how clinically significant the decreased complication rates and assumed benefits would be".

In the older population, trochanteric fractures are frequently unstable and can result in severe morbidity and death even after they have healed. In many cases, surgical fixation is required to return the damaged limb's function and range of motion. Because of the trochanteric fixation nail (TFN) system's alleged high effectiveness and low complication rates, it has recently gained popularity as a therapy for trochanteric fractures. The best postoperative rehabilitation regimen is still up for debate, though, particularly when it comes to weight-bearing.[1] Although early mobilization and weight-bearing have been shown to improve outcomes and reduce complications in orthopaedic patients, there is insufficient data to evaluate if it is safe to do so after TFN fixation for unstable trochanteric fractures.

Numerous studies have examined the prevalence of early mechanical issues in patients who experienced "early weight-bearing following TFN fixation for unstable trochanteric fractures".[2] The primary objective of these studies is to identify risk variables for fracture displacement and implant failure in patients who underwent early weight-bearing. These studies also intend to assess the frequency of early mechanical problems between individuals undergoing delayed weight-bearing following TFN fixation and those undergoing early weight-bearing.[3]

This study was aimed to assess the incidence of early mechanical complications following early weight-bearing in unstable trochanteric fractures following TFN fixation.

MATERIAL AND METHODS

This study was a prospective observational hospital-based study carried out on 94 patients of above 50 years older and presented with an unstable trochanteric fracture requiring surgical intervention; at the orthopaedic emergency department of BRD Medical College, Gorakhpur. The patients with Unstable intertrochanteric fracture as per AO/OTA and Evan's classification and without any other associated fracture/ injury were enrolled in this study. The patients with pathological fractures, Previous surgery or injury to the affected hip, Known allergy to any of the implant components, Cognitive impairment or inability to provide informed consent and Fracture more than 1 month old was excluded from the study.

All potentially eligible individuals were asked for their written agreement before being removed from the research if their answers did not meet the inclusion criteria. A thorough medical history, a clinical diagnosis of an intertrochanteric fracture, a history of trauma, and the limb in external rotation were all taken into consideration. Analgesics were administered as emergency care. Investigations on haematology were also conducted.

Once the patient was deemed surgically fit, the same surgeon performed all of the procedures while the patient was under regional anesthesia. Antero-posterior view radiographs of the unaffected side were used to compute the neck-shaft angle and side plate length. The femur's diameter at the isthmus level was used to calculate the diameter for TFN. Using an AP X-ray, the neck-shaft angle for TFN was assessed on the unaffected side. Every time, a TFN with a standard length of 180 mm was employed. The Brecher et al. approach was used to calculate the average blood loss.

The patient is placed supine on a fracture table with traction, and fracture reduction is performed under an image intensifier. A lateral incision is made that is 3 cm long and 2 cm above the greater trochanter. Following the incision, the greater trochanter tip is located, and the insertion location is 2 mm lateral to the tip in both the AP and lateral views. However, in cases of severe community fractures, the fracture site is used for insertion. Awl entrance is made over that location, a guide wire is put into the femoral canal over that entry site, a reamer is used to reamer the entry site, and a nail is placed into the bone before measuring the femoral neck angle and choosing a nail. Next, image intensifier-guided guide wires are inserted into the head and neck to facilitate the positioning of the compression and de-rotation screws. One by one, the two guide wires are reamed for the rotation screw first, and it is secured using a measurement on the reamer before being fastened with a compression screw that is around 10 mm bigger than the rotation screw tip because it is in the subchondral bone. Next, using the zag, both distal lock blots are positioned.

The approach for postoperative restoration was consistent. Immediately following surgery, exercises for strengthening the abductor muscles, knee bending, and isometric quadriceps were recommended. Depending on the patient's overall health and pain threshold, early weight bearing (EWB) was allowed starting on the second or third postoperative day with the use of a walker or axillary crutches. After 5-7 days from the operation, the patients were released with instructions on how to walk EWB with the use of a walker or axillary crutches. The subjects had follow-ups at 15, 1, and 3 months.

Union was determined by bridging the callus to obliterate the fracture line and permit unprotected limb function. The patients underwent radiographic evaluation in the form of lateral and anteroposterior X-rays of the operative hip in addition to functional assessment using the Harris Hip Score. After each follow-up visit (three months), postoperative pain was evaluated using the Harris Hip Score criteria, and postoperative gait was evaluated at the same time.

Following surgery, all patients were permitted to bear weight as tolerated. Patients were advised not to bear too much weight during the first two weeks and to use a walker or crutches for support. Patients were evaluated for clinical and radiographic evidence of implant failure or fracture displacement at the 2-week postoperative visit. Over the following two weeks, patients were permitted to progressively raise their weight-bearing to full weight if there were no indications of complications. Additionally, patients were advised to refrain from intense activities for the first six weeks and to conduct daily range-of-motion exercises.

Outcome Measures

Functional evaluation will be done according to HARRIS HIP SCORE based on following points:

1. Pain
2. Limp
3. Support
4. Distance Walked
5. Sitting
6. Climbing Stairs
7. Enter Public Transportation
8. Absence of Deformity
9. Put on Shoes & Socks
10. Range of Motion

RESULTS

The study included 94 patients, with the majority 35 patients (37.2%) aged between 50-60 years. This was followed by 26 patients (27.7%) in the 61-70 years age range, and 24 patients (25.5%) aged 71-80 years, and 9 patients (9.6%) who were over 80 years old. The patient's average age was 66.34 +/- 10.34 years. 41 (43.6%) and 53 (56.4%) of the 94 patients were female and male respectively.

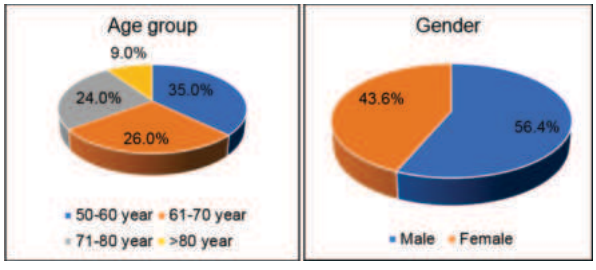


Figure 1: Distribution of the studied patients based on Age and sex

The average height of the 94 individuals in the research was 163.3 cm, with a 4.6 cm standard deviation. With a standard deviation of 6.5 kg, the weight was found to be 60.7 kg on average. Furthermore, there was a standard deviation of 2.7 kg/m² and an average Body Mass Index (BMI) of 22.8 kg/m²

Table 1: Details of the studied patients based on age and anthropometry

Anthropometry	Mean±SD (n=94)	Range
Age (Years)	66.34±10.34	50 to 88

Height (cm)	163.3±.6	152 to 172
Weight (kg)	60.7±6.5	48 to 75
BMI (kg/m^2)	22.8±2.7	17 to 28.8

In our study patients, 15 patients (16.0%) had hypertension and 22 patients (23.4%) had a history of diabetes and diabetes with hypertension had 10 (10.6%) out of 94 patients. 47 (50.0%) of the individuals had no chronic medical issues.

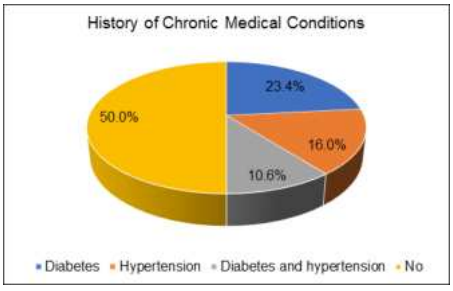


Figure 2: Distribution of the studied patients based on history of chronic medical conditions

In this study, 41 (43.6%) had a two-part fracture with a broken lateral wall (3A2.2), while 27 patients (28.7%) had a two-part fracture with a comminuted lateral wall (3A2.3). Additionally, 26 patients (27.7%) had a two-part fracture with a lesser trochanter fracture (3A2.1).

Table 2: Distribution of the studied patients based on AO/OTA classification

AO/OTA classification	Number of patients (n=94)	Percentage
Two Part fracture with broken lateral wall fracture (3A2.2)	41	43.6
Two Part fracture with comminuted lateral wall fracture (3A2.3)	27	28.7
Two-part fracture with lesser trochanter fracture (3A2.1)	26	27.7

There were mechanical complications in some cases. Specifically, implant failure (screw back out) occurred in 9 patients, representing 9.6% of the total, while 85 patients, or 90.4%, did not experience implant failure. Additionally, fracture displacement was observed in 3 patients, accounting for 3.2%, whereas 91 patients, or 96.8%, did not have fracture displacement. 3 (3.2%) developed an infection, while 91 patients (96.8%) did not experience any infection.

Table 3: Distribution Of The Studied Patients Based On Complications

Complications	Yes	No
Implant Failure (Screw back out)	9 (9.6%)	85 (90.4%)
Fracture Displacement	3 (3.2%)	91 (96.8%)
Infection	3 (3.2%)	91 (96.8%)

At 1st month follow-up, 12 (13.7%) reported good satisfaction with Harris Hip scores between 80 to 89. A larger group of 39 patients (44.82%) had fair satisfaction with scores ranging from 70 to 89. Meanwhile, 36 patients (41.37%) expressed poor satisfaction with scores below 70. While Harris hip score after 3 months was 14 cases (16.0%) were rated as excellent, 52 cases (59.8%) were rated as good, and 12 cases (13.8%) were rated as fair, and 9 cases (10.34) were rated as poor.

Table 4: Distribution of the studied patients based on functional assessment using after 1 month and 3 months.

Harris Hip Score	No. of cases (n=94)	No. of cases (n=87)	P value*
Excellent	0 (0.00%)	14 (16.0%)	<0.001
Good	12 (13.7%)	52 (59.8%)	
Fair	39 (44.82%)	12 (13.8%)	
Poor	36 (41.37%)	9 (10.34%)	

*Chi-Square test

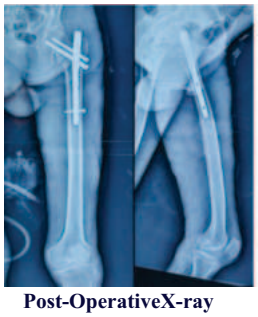
For two-part fractures with a broken lateral wall (3A2.2), 2.4% (1 out of 41) experienced implant failure, while 97.6% (40 out of 41) did not. For two-part fractures with a comminuted lateral wall (3A2.3), 22.2% (6 out of 27) experienced implant failure, while 77.8% (21 out of 27) did not. For two-part fractures with a lesser trochanter fracture (3A2.1), 7.7% (2 out of 26) experienced implant failure, while 92.3% (24 out of 26) did not. The p-value was 0.023, indicating a statistically significant difference in implant failure rates among the different fracture types.

Table 5: Comparison of AO/OTA classification with Implant failure

Implant Failure (Screw back out)	AO/OTA classification			p-value*
	Two Part fracture with broken lateral wall fracture (3A2.2)	Two Part fracture with comminuted lateral wall fracture (3A2.3)	Two-part fracture with lesser trochanter fracture (3A2.1)	
Yes	1 (2.4%)	6 (22.2%)	2 (7.7%)	0.023
No	40 (97.6%)	21 (77.8%)	24 (92.3%)	

*Chi-Square test

55 Year Male Pre-Operative x-ray AP and Lateral View



Post-OperativeX-ray

15 day follow-up

1 Months Follow up

3 Months Follow up

DISCUSSION

This study included 94 patients, with the majority 37.2% aged between 50-60 years. This was followed by 27.7% in the 61-70 years age range, 25.5% aged 71-80 years, and 9.6% who were over 80 years old. The patient's average age was 66.34 +/- 10.34 years.

In our study population, 56.4% were male, while 43.6% were female cases. In a similar study, **Mishra A et al**[1] revealed that of the 64 patients, 28 were female and 36 were male. In this group, the male-to-female ratio was 1.3:1. This was a clear reflection of the highly active lifestyle that Indian men lead. The outcome differed from the research conducted by **Dean GL et al** who discovered that the ratio of women to

men was 3:1 and that trochanteric fractures were more prevalent in women, but **Gadegone WM & Salphale YS** 62% of the participants in the research were men, and 38% were women.

We found that, in this investigation, the average weight was 60.7 kg, with a 6.5 kg standard deviation. Furthermore, there was a standard deviation of 2.7 kg/m² and an average Body Mass Index (BMI) of 22.8 kg/m². In our study, 23.4% of patients had a history of diabetes, while 16.0% of patients had hypertension. The majority of the patients, (60.6%), did not have any chronic medical conditions. "

The research cases' surgical features included the fact that every patient had TFN fixation using an implant designed for TFN fixation. Numerous individuals had early weight-bearing status and an unstable trochanteric fracture. The two-part fractures with fractured lateral walls (3A2.2) accounted for 43.6% of the patients in our research, whereas the two-part fractures with comminuted lateral walls (3A2.3) accounted for 28.7% of the patients. Additionally, 27.7% had a two-part fracture with a lesser trochanter fracture (3A2.1). In a similar study, **Mishra A et al**[1] found that the distribution of fracture types revealed a high number of type 31-A2 fractures, 42 (65.6%), followed by type 31-A1 fractures in 14 patients and type 31-A3 fractures in 8 patients. **Morihara et al** found that 88.2% of patients had fractures of the 31-A2 type, while the remaining 11.7% had fractures of the 31-A3 type.

In our studied cases implant failure (screw back out) occurred in 9.6% of patients and fracture displacement was observed in 3.2% of patients. While 87.2% of others did not experience implant failure and fracture displacement. In our studied population only 3.2% of patients developed infection while 91 patients (96.8%) did not experience any infection. There is a significant rate of problems when using trochanteric femoral nails (TFNs) for unstable intertrochanteric fractures, according to studies. The largest series in the literature that compares the two approaches was conducted by **Peifu Tang et al** "with 303 instances. Infection, non-union, screw breakage, dislocations, and screw cutouts are among the issues he mentioned. Other studies include studies done by **Jun Shen et al** and **Kim et al** with 124 and 58 patients respectively. **Mandal S et al** revealed that 12% of cases had difficulties overall, some of which were attributable to implants. **Choudhari P et al** revealed that in three patients, the femoral neck screws had broken through; two of them needed to have them removed. One inpatient patient had a hematoma, and there was a superficial wound infection. One patient, and one patient's delayed wound healing Using the Salvati and Wilson hip function rating method, 88% of the patients at the last follow-up scored more than 20 points (out of a possible 40). Therefore, in situations involving comminution, osteoporosis, or inadequate screw fixation, it is preferable to avoid early mobilization for internal fixation.

Our study noted that for two-part fractures with a broken lateral wall (3A2.2), 2.4% (1 out of 41) experienced implant failure, for two-part fractures with a comminuted lateral wall (3A2.3), 22.2% (6 out of 27) experienced implant failure, and for two-part fractures with a lesser trochanter fracture (3A2.1), 7.7% (2 out of 26) experienced implant failure, while 92.3% (24 out of 26) did not. A statistically significant variation in implant failure rates across the various fracture types was shown by the p-value of 0.023. **Liu W et al**[23] All kinds of failure ($p<0.05$) were shown to be significantly predicted by the observed quality of calcar reduction, except femoral shaft fracture at the nail tip.

In our study after the 1st-month follow-up, 12 (13.7%) reported good satisfaction with Harris Hip scores between 80 to 89. A larger group of 39 patients (44.82%) had fair satisfaction with scores ranging from 70 to 89. Meanwhile, 36 patients (41.3%) expressed poor satisfaction with scores below 70. Out of 94 cases, 7 patients unfortunately expired before three months of follow-up. Based on functional assessment using the Harris hip score our study noted that 16 cases (18.4%) were rated as excellent, 52 cases (59.8%) were rated as good, 12 cases (13.8%) were rated as fair, and 7 cases (8.0) were rated as poor functional outcome. In a similar study, **Mishra A et al**[1] found that 42 patients had good scores, 4 had acceptable scores, and 4 had low scores, with 14 having great scores. Hence, 12.5% of instances had fair to poor results, whereas 87.5% of cases had good to exceptional results. **Theja SJS et al** revealed that, during the 6-month follow-up, 73.3% of patients treated with trochanteric femoral nails and 56.7% of patients treated with dynamic hip screws had outstanding outcomes. **Das S et al** revealed that of the 25 patients who had TFN surgery, one had great outcomes, eight had acceptable results, ten had medium results, and six had bad results. **Mahale YJ et al** revealed that there were 10 cases with great outcomes, 27 with good results, 3 with acceptable results, and 0 with bad results. **Ibrahim M et al** discovered that the hip score after the six-month period was 50% outstanding, 25% good, 20% fair, and 5% bad. **Choudhari P et al**[38] revealed that 80% of patients had function levels comparable to those before their injuries, and 94% of patients had outcomes rated as satisfactory or very good. **Kumar ST et al** said that the key factors influencing the choice of implants and initial fixation of intertrochanteric fractures are the surgeon's experience and the fracture pattern. This allows for an early return to everyday activities and rehabilitation.

Limitations:

The present study with small sample size may not accurately represent the broader population, and the short follow-up period may not capture long-term outcomes. Additionally, being a single-center study limits its generalizability to other settings. The absence of a control group prevents comparisons with alternative treatments. Furthermore, the outcomes of the Transforaminal Nucleoplasty (TFN) procedure may be influenced by operator dependence, highlighting the importance of surgeon expertise and skill level. These limitations underscore the need for larger, multicentre studies with longer follow-up periods and control groups to validate and expand upon these findings.

CONCLUSION:

Our study shows that when paired with careful patient selection, sophisticated instruments, image intensifier guidance, and exact surgical technique, trochanteric femoral nail (TFN) is a very successful treatment option for intertrochanteric fractures. Outstanding results are obtained with this method, such as a high rate of bone union, good functional outcomes, and less soft tissue injury. By optimizing these factors, healthcare professionals can confidently consider TFN as a primary treatment choice for suitable patients, leading to improved patient care and outcomes. Future research should focus on addressing the shortcomings of this study by doing comparison studies with alternative treatment choices, longer follow-up periods, and bigger sample numbers. Professional associations and societies want to think about creating recommendations that include TFN as a feasible therapeutic option for the management of intertrochanteric fractures. We suggest TFN as the preferred treatment option for intertrochanteric fractures in individuals who meet the study's criteria. We recommend standardized training programs for surgeons and the use of high-quality instrumentation to ensure consistency in TFN technique.

REFERENCES

1. Mishra A, Sinha AK, Yadav A, Pandey D, Surendra K, et al. Clinical study of functional outcome of intertrochanteric fracture treated by Trochanteric fixation nail (TFN) in North Indian population: A prospective study. International Journal of Orthopaedics Sciences 2017; 3(1): 216-219.
2. Zuckerman JD. Hip fracture. N Engl J Med. 1996;334(23):1519-25.
3. Evans PJ, McGrory BJ. Fractures of the proximal femur. Hospital Physician. 2002;30-8.
4. Austin CA, Lawson PJ, Gibson R, Philp I. Proximal femoral fracture: achievements and prospects. Age Ageing. 1998;27:667-70.
5. Singh J, Selhi HS, Gupta R, Kaur G. Functional outcomes of reverse distal femoral locking plate in the extra capsular fractures of proximal femur. Int J Res Orthop 2019;5:417-21.
6. The Swedish National Hip Fracture Registry 2009. Accessed at http://www.rikshoft.se.
7. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. Osteoporos Int 1997;7(5):407-413
8. Melton LJ 3rd, Kearns AE, Atkinson EJ. Secular trends in hip fracture incidence and recurrence. Osteoporos Int 2009;20(5):687-694.
9. Hagino H, Furukawa K, Fujiwara S. Recent trends in the incidence and lifetime risk of hip fracture in Tottori, Japan. Osteoporos Int 2009;20(4):543-548.
10. Vimal Kumar KH, Arunkamal C, Devendra A, Ramesh P, Dheenadayalan J, et al. Comparison of radiological outcome of unstable Intertrochanteric femur fractures in elderly patients treated with Indian and Foreign Cephalomedullary nails. International Journal of Orthopaedics Sciences. 2018; 4(1): 296-302
11. Kane PM, Bryan V, David P, Sarath K, Born CT. Effect of distal interlock fixation in stable intertrochanteric fractures. *Orthopedics*. 2013;**36**(7):859–864.
12. Kyle RF, CabanelaME,RusellTA. Fractures of the proximal part of the femur. Instr Course Lect 1995; 44:227-253.
13. Zuckerman JD. Comprehensive care of orthopaedic injuries in the elderly, Baltimore : Urban and Schwarzenberg, 1990 .
14. Schumpelick W, Jantzen PM: A new principle in the operative treatment of trochanteric fracture of the hip, J.Bone Joint Surg 1988, 70-A:1297-303.
15. Himanshu H, Prasad MB, Verma AK, Manjhi LB. Proximal Femur Locking Plate: An Alternative Implant For Unstable Proximal Femoral Fractures. IOSR-JDMS. 2017;16(4):7-14
16. Chandy G, Saju S. A comparative study on the functional outcome of intertrochanteric fractures treated by proximal femoral nailing or dynamic hip screw fixation. Int J Res Orthop 2021;7:51-5.
17. Adams CI, Robinson CM, Court-Brown CM, McQueen MM. Prospective randomized controlled trial of an intramedullary nail versus dynamic screw and plate for intertrochanteric fractures of the femur. J Orthop Trauma. 2001; 15: 394-400.
18. 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 Am. 1996; 78: 1058-1064.
19. Kempf I, Grosse A, Taglang G, Favreul E. Gamma nail in the treatmentof closed trochanteric fractures: results and indications apropos of121 cases. Rev Chir Orthop Reparatrice Appar Mot 1993; 79:29-40.
20. Rosenblum SF, Zuckerman JD, Kummer FJ, Tam BS. A biomechanical evaluation of the Gamma nail. J Bone Joint Surg [Br]. 1992; 74-B:352-7.
21. Schwab E, Höntzsch K, Weise K. Die Versorgung in stabiler per und subtrochantärer Femurfrakturen mitdem Proximalen Femurnagel (PFN). Akt Traumatol 1998; 28:56-60
22. Ibrahim M, Pawar M, Nazneen K. Intertrochanteric fracture treated with TFN (trochanteric femoral nail): A clinical study. International Journal of Orthopaedics Sciences 2016; 2(2): 48-51
23. Liu W, Zhou D, Liu F, Weaver MJ, Vrahas MS. Mechanical complications of intertrochanteric hip fractures treated with trochanteric femoral nails. Journal of Trauma and Acute Care Surgery. 2013 Aug 1;75(2):304-10
24. Klima ML. Mechanical Complications After Intramedullary Fixation of Extracapsular Hip Fractures. Journal of the American Academy of Orthopaedic Surgeons. 2022 Dec 15;30(24):1550-62
25. Gardner MJ, Briggs SM, Kopjar B, Helfet DL, Lorich DG. Radiographic outcomes of intertrochanteric hip fractures treated with the trochanteric fixation nail. Injury. 2007 Oct 1;38(10):1189-96
26. Swaroop D, Kalambe HV, Handralmath SP. Comparative study of unstable intertrochanteric fracture treatment by trochanteric femoral nail versus hip hemiarthroplasty. International Journal of Orthopaedics. 2017;3(4):548-52
27. Lenich A, Vester H, Nerlich M, Mayr E, Stöckle U, et al. Clinical comparison of the second and third generation of intramedullary devices for trochanteric fractures of the hip—blade vs screw. Injury. 2010 Dec 1;41(12):1292-6
28. Ehlinger M, Favreau H, Eichler D, Adam P, Bonnomet F. Early mechanical complications following fixation of proximal femur fractures: From prevention to treatment. Orthopaedics & Traumatology: Surgery & Research. 2020 Feb 1;106(1):79-87
29. Bishnoi M, Kirmani TT, Huda N, Chahal G, Bishnoi S. Epidemiological analysis of hip fractures at a tertiary care center: A retrospective study. International Journal of Research in Orthopaedics. 2018;4(4):568
30. Brecher M, Monk T and Goodnough L. A standardized method for calculating blood loss. Transfusion 1997; 37(10): 1070–1074.
31. Dean GL, David SG, Jason HN. Osteoporotic pertrochanteric; management and concurrent controversies. J Bone Jt Surg (Am) 2004;72-B: 737-752.
32. Gadegone WM, Salphale YS. Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year. International Orthopaedics 2007; 31(3):403-8.
33. Morihara T Arai Y, Tokugawa S, Fujita S. Proximal femoral nail for treatment of trochanteric femoral fractures. Journal of Orthopaedic Surgery. 2007; 15(3):273-7.
34. Tang P. Proximal femoral nail antirotation versus hemiarthroplasty: A study for treatment of intertrochanteric fractures. Injury. 2012; 43(6):876-881.
35. Shen J. Bipolar hemiarthroplasty compared with internal fixation for unstable intertrochanteric fractures in elderly patients. J Orthop Science. 2012; 17(6):722-9.
36. Kim SY, Kim YG, Hwang JK. Hemiarthroplasty compared with intramedullary fixation of unstable intertrochanteric fractures: J Bone Joint Surg. 2005; 87-A:2186-92.
37. Mandal S, Banerjee U, Mukherjee AS, Saha P, Kundu S. Results of "Trochanteric Femoral Nailing (TFN)" in comminuted unstable trochanteric fractures. Acta Orthop. Belg., 2019, 85, 525-534
38. Choudhari P, Chhabra S, Alawa A. Study of Results of Trochantric Femoral Nail (TFN) for the Treatment of Inter Trochanteric Fracture of Femur. IJSR. 2015;4(8):90-93
39. Wolfgang GL, Bryant MH, O'Neill JP. Treatment of intertrochanteric fracture of the femur using sliding screw plate fixation. Clin Orthop Relat Res. 1982; 163:148-58.
40. Sernbo I, Johnell O, Gentz CF, Nilsson JA. Unstable intertrochanteric fractures of the hip: Treatment with Ender pins compared with a compression hip-screw. J Bone Joint Surg Am. 1988; 70:1297-303.
41. Sujana TJS, Marathe K, Gurumurthy B, Patted P. Management of intertrochantric fractures with dynamic hip screw and trochanteric femoral nail - A prospective comparative study. MedPulse International Journal of Orthopedics. March 2019; 9(3): 65-71
42. Dash SK, Panigrahi R, Palo N, Priyadarshi A, Biswal M. Fragility hip fractures in elderly patients in Bhubaneswar, India (2012-2014): a prospective multicenter study of 1031 elderly patients. Geriatr Orthop Surg Rehabil. 2015;6:11–15.
43. Mahale YJ, Kadu VV. Functional Outcome of Unstable Intertrochanteric Femur Fracture Patients Treated with Trochanteric Fixation Nail. Trauma International. 2017;3(1):32-37
44. Ibrahim M, Pawar M, Nazneen K. Intertrochanteric fracture treated with TFN (trochanteric femoral nail): A clinical study. International Journal of Orthopaedics Sciences 2016; 2(2): 48-51
45. Kumar TS, Senthilnathan A, Prabhakar R, Vishnu MH. Is trochanteric fixation nail a better implant in the management of intertrochanteric fracture in elderly compared to dynamic hip screw. International Journal of Orthopaedics Sciences 2017; 3(4): 191-196