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Research Article

Surgical Management of Intertrochanteric Fractures in Adults by Trochanteric Fixation Nail (TFN)

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Abstract

Background: Intertrochanteric femoral fractures are of more interest globally. Understanding biomechanics of these fractures and the development of implants had led to the various treatment modalities for these patients. The primary goal of surgical management is to provide the anatomical restoration of the normal abductor-lever-arm mechanism of the hip joint. Rigid intramedullary nailing has been suggested as a treatment option in these patients with intertrochanteric fractures due to the perceived advantages of stable fixation with higher union and low complication rates.

Objective: To prospectively review, collate and evaluate the functional outcome, advantages, union rate and complications of intertrochanteric fractures in adults using trochanteric fixation nail.

Materials and Methods: A prospective cohort study with 43 adult patients with intertrochanteric fractures were treated with trochanteric fixation nailing in JJM Medical College, Davangere between 2018 to 2020. The fractures included in the study were classified according to Boyd and Griffin classification. All the cases were followed at regular intervals as per our study protocol. The functional outcome were assessed with Modified Harris' Hip Score.

Results: In our study, we managed 43 intertrochanteric fractures by trochanteric fixation nailing. The mean radiological union of trochanteric fractures were 12.74±3.12 weeks. The functional assessment were made with Modified Harris Hip scores which were excellent in 23 cases (53.48.48%), good in 14 cases (32.55%), fair in 4 cases (9.30%) and poor in 2 cases (4.65%). No case of helical blade cut out, Z effect and reverse Z effect were reported in our study.

Conclusion: The load sharing device, trochanteric fixation nail (TFN), decrease the patient related morbidity during intra and postoperative period in intertrochanteric fractures and improve the functional status of the patients.

Keywords: Trochanteric Fixation Nail; Intertrochanteric Fractures; Boyd and Griffin

Introduction

Femoral intertrochanteric fractures are of greater concern internationally. Trauma mechanisms such as automobile accidents and falls from heights cause these injuries. An elderly population has a high risk of hip fracture due to an increased risk of osteoporosis and falls [1,2]. The highest post-surgical fatality rate of surgically treated fractures occurs in intertrochanteric fractures The understanding of these fractures' biomechanics, along with the development of implants, led to various treatment approaches for patients with these conditions [3,4].

To restore the normal abductor-lever-arm mechanism of the hip joint, the surgical treatment goal is to give the patient his anatomical structure back. Internal fixation with plate, and flexible and rigid intramedullary nails have evolved in the last few decades [5]. It has been suggested that a treatment option for intertrochanteric

fractures is using rigid intramedullary nailing. It has been claimed that it offers greater stability with better union rates with a low complication rate [6].

For implants, the revolution took place at the end of the 1990s. Femoral nailing was improved by the AO/ASIF with the introduction of two lag screws into the head of the femur in 1996 [7]. Trochanteric fixation nail with single large helical blade for femoral head was introduced in 2001 [8]. PFN-A (Proximal femoral nail anti-rotation) was introduced in 2004 as a helical blade in PFN [9].

Trochanteric fixation nails (TFN) were developed to improve the rotational stability of the proximal fracture fragment, and the nail tip was re-designed with a reduction in distal diameter to reduce the risk of intra and post-operative femoral shaft fractures by a significant reduction in bone stress [10]. For unstable intertrochanteric fractures, this implant is a centromedullary device that is biomechanically more stable [11]. TFN's shorter lever arm can reduce tensile strain on the implant and the risk of implant failure. It acts as a buttress to prevent shaft medialisation and provides controlled fracture impaction. The proximal helical blade improves resistance to varus collapse and rotational control of the head and neck fragments, as well as allowing length and rotational control in the absence of the lesser trochanter. The presence of longitudinal slots throughout hastens endosteal bone regeneration. The presence of a 6° medio-lateral angle facilitates easy nail insertion and a flexible distal tip to prevent stress generation and re-fracture. The nail's proximal end cap secures the helical blade, preventing it from backing out [12-17].

Purpose of the Study

The purpose of this article is to review, compile, and evaluate the functional outcome, advantages, union rate, and complications of intertrochanteric fractures in adults treated with a trochanteric fixation nail.

Materials and Methods

A prospective cohort study on the cohort of patients registered with the orthopaedic departments of Bapuji Hospital and Chigateri Government General Hospital in the JJM Medical College in Davangere, Karnataka, India was completed from September 2018 to August 2020. Convenient sampling was used to collect subjects for this study. Our study's findings show that out of the 176 cases of proximal femoral fractures, 43 patients received surgical treatment with trochanteric fixation nails and took part in our statistical analysis.

Only patients who were 30 to 80 years old and had unstable intertrochanteric fractures (type 2, 3 and 4) that were diagnosed through medical imaging and clinical symptoms were included in the study. Patients below the age of 30, patients with compound fractures, pathological fractures, and fractures to the left lower limb were excluded from the study.

After completing an in-depth clinical examination, the patients were enrolled in the study and given a formal written consent form. Institutional ethical committee approval was obtained. Radiographs such as an X-ray of the affected hip with the proximal femur were used as part of the basic investigation. The Singh index was used to assess the extent of osteoporosis. Each person had their own trochanteric fixation nail to be inserted. Each of the cases was posted for a surgery which includes the procedures of reduction and fixation of the trochanter with nailing or screws, and patient follow-up.

On an AP X-ray, the femur's diameter was measured to determine the isthmus nail diameter. The patients had their operations done either under spinal anaesthesia or general anaesthesia. The patients were positioned in a supine position on the fracture table with 10 to 15 degrees of adduction of the involved limb and a closed reduction of the fracture was accomplished with traction and internal rotation. A parallel incision was made in the fascia of the gluteus medius, starting proximal to the greater trochanter and ending distal to the middle of the tibia. The entry point was made on the tip of the greater trochanter, slightly lateral to the tip. Guide wire placement was verified to be centred in the medullary cavity in lateral view. A curved bone awl was used to enter the medullary canal after a guide wire pointed the way. A cannulated conical 17 mm reamer was used to ream the proximal femur to a depth of approximately 7 cm. It took multiple ordinary reamers, starting with the largest and progressing down to the smallest, to ream the distal femur until the calculated nail diameter was reached. Once the fracture reduction has been confirmed, an appropriate-sized nail has been assembled to the insertion handle and inserted manually, and the 8 mm screw is positioned into the inferior margin of the neck. The self-tapping 11 mm helical blade was inserted by means of a cannulated screw driver after drilling over the guide wire. The helical blade length and position were verified with the image in-

tensifier. One 4.9 mm distal locking bolt was commonly used with an image intensifier to confirm the position (As shown in figure 1a to 1f). The wound was covered with sterile dressings and a compression bandage, and then surgical closure was done in layers.

Intravenous antibiotics were administered for 5 days, after which oral antibiotics were given for 5 days. Within 48 hours of surgery, the active and passive exercise programmes were started. 5th postoperative day was the first time partial weight bearing was allowed. All the patients were advised to bear weight as soon as they were capable, which was within 10 to 12 weeks of their post-operative recovery period. All patients were seen one, two, six, twelve, and eighteen months after being enrolled in the study. Whenever the fracture union and complications are checked, radiographs of the upper femur and hip are taken. Modified Harris hip score was used to calculate the functional results.

Figure 1: Surgical technique of TFN insertion - 1a) Nail entry point, 1b) Insertion of guide pin, 1c) Proximal reamer, 1d) Insertion of TFN, 1e) Placement of proximal helical blade and 1f) Placement of 4.9 mm distal cortical screws.

Figure 2: Intertrochanteric fracture fixed with trochanteric fixation nail.

Results

The study identified 43 patients who had a radiologically confirmed unstable intertrochanteric fracture that required surgical treatment, and all of them had their trochanters fixed with trochanteric fixation nailing as per the study protocol. The descriptive statistics, including the sample mean and standard deviation, were reported for continuous variables, as well as for categorical variables, which provided percentages. The results of the study were statistically evaluated with IBM SPSS Statistics for Windows, Version 24.0, IBM Corp, Chicago, IL.

In this sample of 43 cases, a total of 29 cases (67.44% of the cases) were male, and 14 cases (32.55% of the cases) were female. This research had a maximum age limit of 76 years and a minimum age limit of 37 years. The mean age of the patients in the study was 46.28 with a standard deviation of 6.95 years. According to research, there were a total of 22 cases (51.16% of the population) who sustained injury in a road traffic accident, 14 cases (32.55% of the population) who fell from heights, and 7 cases (16.27% of the population) who experienced a trivial fall. Boyd and Griffin classifications indicates that of the 43 cases of trochanteric fracture,

19 have the pattern of fractures of type 2, 21 have the pattern of fractures of type 3, and 3 have the pattern of fractures of type 4. The number of surgeries performed were as follows: 31 surgeries (72.09 percent) were performed with closed reduction, and 12 surgeries (27.90 percent) included open reduction and internal fixation with trochanteric fixation nailing. During the surgical procedure, no intraoperative complications were noted.

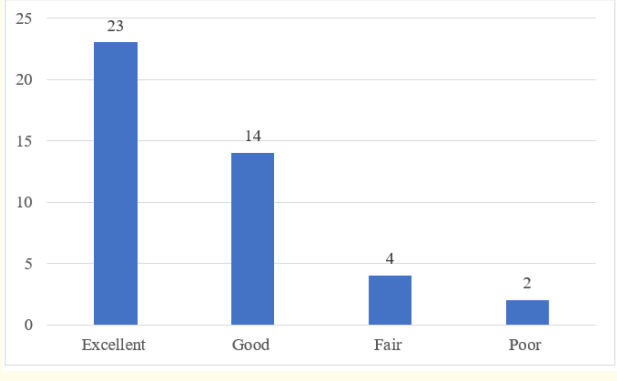
As specified in our study protocol, all the cases were followed up serially with serial clinical and radiographical examinations. Mean trochanteric fracture union duration was 12.74 weeks. The most commonly observed complication in our study was pain, which was reported in 17 cases (39.53 percent), delayed union, which was reported in 2 cases (4.65 percent), malunion, which was reported in 4 cases (9.30 percent) and varus angulation, which was reported in 3 cases (6.97 percent). During the follow-up period, no complications related to the Z effect or the reverse Z effect were observed. Functional assessment were done with Modified Harris Hip scores, which were excellent in 23 cases (53.48 percent), good in 14 cases (32.55 percent), fair in 4 cases (9.30 percent) and poor in 2 cases (4.65 percent). This is shown in the first graph, which has the following four outcomes: excellent, good, fair, and poor.

Figure 3: Hip flexion with knee extension.

Figure 4: Hip flexion with knee flexion.

Figure 5: On standing position.

Figure 6: On squatting position.



Graph 1: Modified Harris Hip score assessment with TFN for intertrochanteric fracture.

Discussion

The technical implication associated with intertrochanteric fractures is significantly more difficult and may lead to fracture fixation failure. Implant choice is by far the most important determining factor in surgical management. Over time, various intertrochanteric fractures have been treated using cephalo-medullary devices [18]. The trochanteric fixation nail (TFN) had an edge over other implants due to its greater efficiency.

Researchers Makki and others compared trochanteric antigrade nails (TANs) to proximal femoral nail antirotation (PFNA) in 58 patients, all of whom were placed into two groups with 22 individuals who received TANs and 36 individuals who received PFNA. However, the time to union was quicker in the TAN group. In the PFNA group, there were 8 implant failures, as opposed to none in the TAN group. Implant failure was found to be significantly associated with the degree of fracture, but was not linked to fracture reduction or the position of the implant screws. This study suggests that an implant that features a TAN-type system with two screws, such as an intertrochanteric hip fracture, may be better suited to the reversal of oblique intertrochanteric hip fractures [19].

This study, carried out by Flores., *et al*. found that an analysis of TAD is capable of predicting axial migration and cut out when using a TFN spiral blade system in 258 patients. Mechanical complications occurred at a rate of 10.1 percent. TAD was on the average 20.4 mm long. Eight patients underwent axial perforation. In 3 patients, axial migration up to subchondral bone occurred without a perforation. There was only one failed fracture in varus. The incidence of combined axial migration and perforation was greater in patients who had a TAD < 20 mm ($p = 0.03$). Logistic regression model found an increased chance of combined axial cutout and migration if the patient's total axial Deviation (TAD) was less than 20. In the case of axial migration and cutout, TAD < 20 mm was associated with an increased frequency [20].

YIn a research study done by Yoon., *et al*. and published in the journal BMC Musculoskeletal Disorders, the results showed that for the femoral trochanteric entry femoral nails, the revision rate was low. Trochanteric entry nails were the most popular with piriformis entry nails bringing up the rear (n = 108), followed by retrograde entry nails (n with piriformis n = 141). BMI was found to be significantly associated with DFV, after performing a univariate regression analysis. Multivariate analysis demonstrated that DFV scores for trochanteric entry nails ($p < 0.05$) were significantly lower than those for piriformis or retrograde nails. For those surgical procedures that employed the use of revision as an endpoint, trochanteric entry also had a lower revision rate even when all other variables were controlled ($p < 0.05$) [21].

Patil., *et al*. study the advantages of TFN in 40 cases of unstable intertrochanteric fractures. The patients were monitored at weeks 4, 6, 3, and 6 months after their treatment. Kyle's criteria were used to assess functional outcome. The incision decreased in size, intraoperative blood loss occurred, surgery lasted longer, and the hospital stay also included trochanteric fixation nail placement. Almost all cases demonstrated excellent to very good range of motion. There were no patients with a periprosthetic fracture. Unstable intertrochanteric fractures are a common problem, and they've found that a trochanteric fixation nail is useful in treating them [22].

Michael J Gardner and colleagues studied 273 people with intertrochanteric hip fractures, and they found that TFN was used on patients between the years of 2001 and 2005. Based on the migration of the average blade tip, we can infer that the blade holds firm purchase in the cancellous bone of the femoral head. They discovered that elevated telescoping in unstable fractures was constrained and kept below the level of the abductor tendon, protecting the length of the abductor tendon [23].

Using trochanteric fixation nailing, we managed to perform intertrochanteric fractures in 43 patients. Mean trochanteric fracture union duration was 12.74 weeks. Based on the Modified Harris Hip scores, 23 cases (53.48.48 percent) showed excellent hip scores, 14 cases (32.55 percent) showed good hip scores, 4 cases (9.30 percent) showed fair hip scores, and two cases (4.84 percent) showed poor hip scores (4.65 percent). No helical blade cutout, Z effect, and reverse Z effect have been reported in our study.

Conclusion

With minimal complications, we recommend trochanteric fixation nail as an implant of choice for intertrochanteric fractures of the proximal femur. The trochanteric fixation nail (TFN), a load-sharing device, reduces patient-related morbidity during the intra- and post-operative period and improves patients' functional status.

Bibliography

1. Karakus O., *et al*. "The relationship between the type of unstable intertrochanteric femur fracture and mobility in the elderly". *Journal of Orthopaedic Surgery and Research* 13.1 (2018): 207.

2. Gupta RK., *et al*. "Unstable trochanteric fractures: the role of lateral wall reconstruction". *International Orthopaedics* 34.1 (2010): 125-129.

3. Rozell JC., *et al*. "Recent advances in the treatment of hip fractures in the elderly". *F1000Research* 5 (2016).

4. Dougherty PJ. "CORR Insights TM Intramedullary nails result in more reoperations than sliding hip screws in two-part intertrochanteric fractures". *Clinical Orthopaedics and Related Research* 471.4 (2013): 1387-1378.

5. Zhang Y., *et al*. "Long and short intramedullary nails for fixation of intertrochanteric femur fractures (OTA 31-A1, A2 and A3): A systematic review and meta-analysis". *Orthopaedics and Traumatology: Surgery and Research* 103.5 (2017): 685-690.

6. Queally JM., *et al*. "Intramedullary nails for extracapsular hip fractures in adults". *The Cochrane Database of Systematic Reviews* 9 (2014): CD004961.

7. Gadegone WM and Salphale YS. "Proximal femoral nail – an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year". *International Orthopaedics* 31.3 (2007): 403-408.

8. Van Leur JPH., *et al*. "Trochanteric Fixation Nail® with Helical Blade Compared with Femoral Neck Screw for Operative Treatment of Intertrochanteric Femoral Fractures". *Hip Pelvis* 31.1 (2019): 48-56.

9. Shin WC., *et al*. "Radiographic Outcomes of Osteosynthesis Using Proximal Femoral Nail Antirotation (PFNA) System in Intertrochanteric Femoral Fracture: Has PFNA II Solved All the Problems?" *Hip Pelvis* 29.2 (2017): 104-112.

10. Gardner MJ., *et al*. "Radiographic outcomes of intertrochanteric hip fractures treated with the trochanteric fixation nail". *Injury* 38.10 (2007): 1189-1196.

11. Mohammed Ibrahim., *et al*. "Intertrochanteric fracture treated with TFN (trochanteric femoral nail): A clinical study". *International Journal of Orthopaedics Sciences* 2.2 (2016): 48-51.

12. Lenich A., *et al*. "First results with the trochanter fixation nail (TFN): a report on 120 cases". *Archives of Orthopaedic and Trauma Surgery* 126.10 (2006): 706-712.

13. T Sathish Kumar., *et al*. "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* 3.4 (2017): 191-196.

14. Shukla R., *et al*. "Trochanteric fixation nail in intertrochanteric fractures of femur in adult population". *African Journal of Trauma* 6 (2017): 27-31.

15. Liu W., *et al*. "Mechanical complications of intertrochanteric hip fractures treated with trochanteric femoral nails". *The Journal of Trauma and Acute Care Surgery* 75 (2013): 304-310.

16. Goodnough LH., *et al*. "Trochanteric fixation nail advanced with helical blade and cement augmentation: early experience with a retrospective cohort". *The European Journal of Orthopaedic Surgery and Traumatology* (2020).

17. Lenich A., *et al*. "First clinical and biomechanical results of the Trochanteric Fixation Nail (TFN)". *Technology and Health Care* 14.4-5 (2006): 403-409.

18. Angadi DS., *et al*. "Rigid intramedullary nail fixation of femoral fractures in adolescents: what evidence is available?" *Journal of Orthopaedics and Traumatology* 15 (2014): 147-153.

19. Daoud Makki., *et al*. "Comparison of the reconstruction trochanteric antigrade nail (TAN) with the proximal femoral nail antirotation (PFNA) in the management of reverse oblique intertrochanteric hip fractures". *International Journal of the Care of the Injured* (2015): 1-5.

20. Stephen A Flores., *et al*. "The Utility of the Tip–Apex Distance in Predicting Axial Migration and Cutout With the Trochanteric Fixation Nail System Helical Blade". *Journal of Orthopaedic Trauma* 30.6 (2016): e207-e211.

21. Richard S Yoon., *et al*. "Trochanteric entry femoral nails yield better femoral version and lower revision rates—A large cohort multivariate regression analysis". *International Journal of the Care of the Injured* (2016): 1-5.

22. Paresh Patil., *et al*. "A study of unstable intertrochanteric fractures treated with trochanteric fixation nail". *International Journal of Current Research* 8.5 (2016): 30742-30748.

23. Michael J Gardner and Dean G Lorich. "Unstable intertrochanteric fractures: lessons learned from a clinical study of the trochanteric femoral nail". *AO Dialogue* (2007): 30-31.

Volume 4 Issue 10 October 2021