

Study on the Outcomes of Intertrochanteric Femur Shaft Fracture Managed by Proximal femoral Nail

Kamleshkumar A Patel¹, Keyur Rajendrakumar Shah²

¹Associate Professor, Department of Orthopaedic, Nootan Medical College and Research Centre, Visnagar (Gujarat)

²Associate Professor, Department of Orthopaedic, Nootan Medical College and Research Centre, Visnagar (Gujarat)

Received: 28-05-2023 / Revised: 30-06-2023 / Accepted: 04-08-2023

Corresponding author: Dr. Keyur Rajendrakumar Shah

Conflict of interest: Nil

Abstract:

Introduction: Intertrochanteric fractures are rising due to longer life expectancies, especially in Asia. Lag screws and proximal femoral nailing have shown promising outcomes. New design improvements have overcome prior challenges. Surgeon expertise and local criteria determine implant choice. The research found statistically significant regional differences in Medicare enrollees' "proximal femoral nail use.

Aim and objectives: This study examines proximal femoral nail fixing for intertrochanteric femur fractures.

Method: 53 patients with intertrochanteric fracture from four high-volume clinics were included. Participants must be 60 or older and healthy enough to stroll around their areas. The procedure used an InterTAN nail and was on schedule. Lag screws supplied anatomical alignment and compression after fluoroscopically assisted reduction. After surgery, antibiotics and heparin helped with weight bearing. Non-institutional orthopedists judged bony union as a callus crossing two cortices.

Result: Table 1 shows preoperative findings: mean age 76.7 years (SD 8.9), 20 men, 33 women. BMD hip T-score -2.6 (SD 1.0), spine T-score -2.8 (SD 1.3). In Table 2, the surgery lasted 76.8 min (SD 29.9), blood loss was 184.5 ml (SD 97.9), and 1.3 blood units were transfused. Good 74, acceptable 17, bad 9. TAD 14.9 mm (SD 2.9), bone union 17.9 weeks (SD 7.9). Table 3 shows surgical complications, emphasising caution.

Conclusion: In conclusion, treatment with IM nails and lag screws for Asian patients with intertrochanteric fractures is effective. Correctly selecting patients and putting in screws is essential. Further investigation is recommended.

Keywords: Intertrochanteric fractures, proximal femoral, fewer blood transfusions.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

In recent years, as life expectancy has increased, the intertrochanteric fracture has become more common. Hip fractures have a rather high prevalence in Asia, according to population-based epidemiologic research and it has been determined that this number would likely rise sharply in the near future [1].

In Canada, there are over 25,000 hip fractures every year. Of these, "intertrochanteric (IT)" hip fractures account for almost half. Operative internal fixation, the current gold standard of care, aims to make an effort to restore the prior level of function and to enable early mobilization [2].

Patients that get intertrochanteric fractures most frequently are older, so various devices have been created to speed up surgery and enable immediate mobilization. Orthopaedic surgeons currently use a variety of fixation techniques for intertrochanteric

fractures, including plates and proximal femoral "nailing and dynamic hip screws [1].

The initial Fixation methods for IT hip fractures did not support the immobilization of the fracture and were made worse by the high incidence of hip joint penetration, cutting, and implant fatigue failure. Osteotomy procedures were created in a bid to move axial loading stresses away from the implant and towards the bone [2].

Even though no implant can fully meet all of the fixing requirements for these fractures, IM nailing is still widely used and has been proven to have excellent results. An IM nail accompanied by two lag screws is used to prevent cutout and consequent fixing failure, in particular, enhances internal femoral head rotational stability & bone purchase. The Z-effect phenomenon, which was initially identified and found by Werner-Tutschku et al. & afterwards by a number of researchers, caused this

design to fall out of favour. However, a recent reintroduction of a Smith-Nephew InterTAN nail, an IM nail and two lag screws have been made. To avoid Z-effect issues, Two lag screws were used to construct this nail. It also offers instant rotational stability and linear compression during surgery. In addition, this nail has been the subject of numerous reports that have shown freedom, good outcomes and no complications from the Z-effect phenomena [1].

Osteotomies, on the other hand, lost popularity as anatomic reduction techniques gave better overall results. Later, sliding hip screws were developed to operate forces are transmitted across the medial cortex by lateral tension bands, providing fracture compression [2]. Sliding pelvic screws have been gaining popularity since their debut been applied often to treat IT hip fractures. However, while using a swivelling hip screw as a treatment, comminuted IT fractures still have a considerable chance of shortening and malunion [10].

The biomechanical benefits of proximal femoral nail-screw systems differ from those of the sliding hip screws. IM nail screws sit towards the centre of gravity, have three points of fixation, and are load-sharing devices [11]. Less tensile strain is applied to the implant as a result of the related shorter lever arm. Percutaneous insertion, which allows for a simpler procedure and less blood loss than sliding hip screws, is a clinical advantage [2].

IM nail screws have had mixed clinical results despite their biomechanical benefits. Whereas some authors suggest that IM nail screws provide greater early mobilization following surgery, interest in these devices has been tempered by increased femur fracture rates and difficulties with distal locking. Recent design changes in the next-generation implantation have sought to solve the shortcomings of earlier-designed IM nail screw devices presently many people throughout North America use this technology [2].

The distal nail size and proximal offset are smaller on the “trochanteric fixation (TFN; Synthes; Paoli, PA)” nail [6]. The two stress risers are separated by a greater the distance between the locking bolt and the nail's tip, which could decrease the possibility of breakage. Because of the oblique distal locking bolt, the likelihood of fracture may be further reduced by lowering the related stress increase. The insertion handle has a locking mechanism built into it to make percutaneous distal locking easier. In order to protect bone tissue and reduce implant fracture at the insertion hole, the femoral head blade is helical [2].

In the last ten years, pertrochanteric fractures have been more often treated using proximal femoral nails. However, the development has minimal empirical support (2008), Parker and Handoll

(2008), Anglen and Weinstein (2008), and Rogmark et al. (2010). For these fractures, Conventional “sliding hip screws (SHSs)” should be used, however, the most current Cochrane review also encourages additional studies to determine whether INs are beneficial for certain fracture patterns (Parker & Handoll 2008). To our knowledge, however, no research examining the reoperation rate for AO/OTA type A1 as well as A2 subgroups has been published. In general, Saudan et al. (2002) found no benefits to using INs for AO/OTA type 1 and 2 fractures [3].

The results of randomized studies in orthopaedics don't recommend using plate-and-screw devices for some pertrochanteric fractures, especially those with an unstable pattern like reverse oblique & transverse intertrochanteric fractures. Treatment of intertrochanteric fractures without sub-trochanteric extension by proximal femoral nailing has some literature support, but the quality of the evidence is not as strong, and the outcomes may vary depending on the surgeon and technique. The occurrence of other, more typical pertrochanteric fracture patterns has shown a therapeutic benefit of proximal femoral nail fixing in clinical studies that are properly powered and well-designed. In spite of changes to the design, proximal femoral nail devices still carry a minimal but continuous during surgery as well as over several months, there is a risk for iatrogenic femoral shaft fracture after [4].

The selection of implants in the treatment of elderly individuals with intertrochanteric fractures is made with professional judgement by surgeons considering the little variations in functional & clinical outcomes between device types. In the absence of clearly better results with proximal femoral nailing over a majority of intertrochanteric fractures, it is possible that surgeons choose the device, at least within the part, based on non-patient factors, including local and group practise norms, surgical experience, level of scientific difficulty, as well as the level of financial reimbursement [5].

We assessed the regional variation in proximal femoral nail usage in the present investigation for intertrochanteric femora fractures among Medicare enrollees in the United States. Although For femoral neck fractures, total hip replacement has been used and evaluated in relation to geographic variance, this is, It is, according to our expertise, the initial study to assess how much proximal femoral nail usage varies by region. We anticipated this spatial variance is significant and that it persists despite patient-related variables having been taken into account. Because proximal femoral nail implants hadn't undergone substantial design modifications since 1998 and were already in widespread usage at the time, we chose the study period of 2000 through 2002 [5].

Method

Research Design

This clinical trial was conducted during the period of one year in our hospital with those patients who came to the orthopaedic department with intertrochanteric fractures. The study included 53 patients with intertrochanteric fractures, all of whom were checked by two orthopaedic surgeons independently.

Rehab and surgical procedures were performed according to established standards (using the InterTAN nail). Closed reduction under fluoroscopic guidance achieved intraoperative alignment. By inserting lag screws, anatomical alignment and compression could be attained. It was documented how well the reduction went, where the screws went, and if there were any difficulties. Antibiotics, heparin, and aided early weight-bearing are prescribed after surgery. There will be follow-ups at 6th, 3rd, and 12th months. Recuperation times and bone union rates were measured as clinical and radiographic outcomes. The X-ray measurements were taken by orthopedists who were not affiliated with the hospital. A callus formed between two cortices is considered a bony union.

Inclusion and exclusion Criteria

Inclusion

1. Individuals older than 60 years of age.
2. Community walker, with or without a walking aid, before surgery.
3. An injury to the space between the thighbones, or intertrochanteric.
4. Willingness to take part and give proper consent.

Exclusion

1. Individuals who are younger than 60 years of age.
2. Patients who are unable to ambulate.
3. The topic of discussion pertains to pathologic fractures.
4. The patient presents with a multitude of significant medical comorbidities.

5. The lack of capacity or reluctance to grant informed consent.
6. Additional circumstances that were considered inappropriate by the attending physicians.

Statistical analysis

The study used SPSS 25.0 for effective analysis. Kappas were used to evaluate radiological measure agreement. Meaning of these coefficients: Values less than 0.00 indicate poor agreement, 0.00–0.20 indicate slight agreement, 0.20–0.40 indicate fair agreement, 0.40–0.60 indicate moderate agreement, 0.60–0.80 indicate substantial agreement and 0.80 or higher indicate almost perfect agreement. Results were analysed using Student's t-test and provided as mean \pm SD for continuous data. The level of significance was considered to be $p < 0.05$.

Ethical approval

Ethical approval was obtained from the Institutional Review Board, and all patients who participated in the study provided informed consent.

Result

Table 1 presents the preoperative clinical particulars. The mean age of the participants was 76.7 years, accompanied by a standard deviation of 8.9. Within the cohort of participants, it was observed that there were 20 individuals who identified as male, whereas 33 individuals identified as female. The categorization of fracture types resulted in 37 instances being classified as stable and 63 cases being classified as unstable. The results of the "Bone Mineral Density (BMD)" measurements indicate that the average hip T-score was -2.6, with a standard deviation of 1.0. Similarly, the average spine T-score was -2.8, with a standard deviation of 1.3. The mean duration from admission to operation was found to be 2.8 days, with a standard deviation of 1.2. The average ASA score was found to be 2.9, with a standard deviation of 0.4. The aforementioned preoperative details offer a full picture of the patient group and their fundamental characteristics.

Table 1: Baseline clinical features before the operation

Characteristic	Data
Age (years)	76.7 \pm 8.9
Sex male (female)	20 (33)
Type of fractures (cases)	
Stable	37
Unstable	63
BMD (t-score)	
Hip	-2.6 \pm 1.0
Spine	-2.8 \pm 1.3
Admission to operation (days)	2.8 \pm 1.2
ASA score	2.9 \pm 0.4

Perioperative data is presented in Table 2. During the intraoperative period, the average time of the surgical procedures was found to be 76.8 minutes, with a standard deviation of 29.9. The mean blood loss was estimated to be 184.5 ml, with a standard variation of 97.9 ml. On average, 1.3 blood units were transfused. The categorization of fracture reduction yielded positive outcomes in 74 instances, was acceptable in 17 instances, and yielded suboptimal results in 9 instances. The

average “tip-apex distance (TAD)” was found to be 14.9 mm, with a standard deviation of 2.9. Following the surgical procedure, the mean duration for the process of bone union was found to be 17.9 weeks, accompanied by a standard deviation of 7.9. The aforementioned data offer valuable insights into the surgical procedure and its associated outcomes, hence facilitating the assessment of treatment efficacy and patient recuperation.

Table 2: Perioperative data

Variable	Data
Intraoperative	
Duration of surgery (min)	76.8±29.9
Estimated blood loss (ml)	184.5±97.9
Transfusion (units)	1.3±0.2
Adequacy of fracture reduction (cases)	
Good	74
Acceptable	17
Poor	9
TAD (mm)	14.9±2.9
Postoperative	
Time to bony union (weeks)	17.9±7.9

The surgical complications are presented in Table 3. During the intraoperative period, four cases were observed to have an inevitable superior positioning of the lag screw, whereas three cases were found to have lateral wall fractures. the surgical procedure, two instances were observed where varus collapse occurred along with cut-out, while two cases involved the back out of the compression lag screw. Additionally, two occurrences of hematoma

formation were documented. Furthermore, it is worth noting that one instance involved a periprosthetic fracture, while another example exhibited a pseudoaneurysm. The aforementioned findings shed light on a range of difficulties that are linked to surgical operation, underscoring the importance of thorough deliberation and prospective enhancements in approaches to mitigate the incidence of such events.

Table 3: Post-operative Complications related to surgery

Complication	Cases
Intraoperative	
Unavoidable superior position of the lag screw	4
Lateral wall fracture	3
Postoperative	
Varus collapse with cut out	2
Preprosthetic fracture	1
Compression lag screw back out	2
Hematoma formation	2
Pseudoaneurysm	1

Discussion

Reucker et al. stated that the trochanteric gamma nails took 46 minutes on average to operate, the InterTAN nail took 41 minutes on average, which is comparable to the duration reported by Utrilla et al.²⁷. The compression hip screw took 44 minutes on average to operate. However, Yaozeng et al.²⁸ and Qin and An¹² showed that the third generation of gamma nails required an average operation duration of 73.1 minutes and 66.6 minutes, respectively, for the proximal femoral nail

antirotation. Although average operation times are undoubtedly influenced by the intricacy of the fracture, we think that in some patients, the technical challenge of a small femoral neck or a varus neck geometry may be to blame for lengthier operation times. [1]

According to Leung et al., older Chinese people with short femurs and significant anterior bowing have regular gamma nails with tips that extend past the area within the anterior bow that is most convex. Ruecker et al. noted no nail impingement

or thigh discomfort in individuals treated with an intertrochanteric fracture using this nail. In addition, considering the fact that one periprosthetic fracture occurred We experienced no thigh discomfort or nail impingement one month following surgery following falling from a height [1].

According to Kim et al., compared to Caucasians and African-Americans, Koreans have a narrower and cross-sectionally smaller femoral neck [8].

Jong Won K et al., In since longevity has increased in recent years, the intertrochanteric fracture has become more common. Orthopaedic surgeons currently use a variety of fixation techniques for intertrochanteric fractures, including Dynamic hip screws, proximal femoral plates, and nailing. Recently, intertrochanteric fractures have been treated using the two integrated lag screws on the proximal femoral nails. There is, however, no research in Asian populations. This prospective study's goal was to outline the IM nail's limitations with two integrated lag screws and their clinical and radiologic results in Asian patients. In the study, InterTAN nails were used for osteosynthesis of 100 patients having intertrochanteric fractures who underwent surgery and were then followed up for at least a year. They assessed complication rates, time to bone union, and rates of recovery to pre-fracture status. There were 74 patients who could be seen for follow-up exams after at least a year. 45 patients (60.8%) returned to their pre-fracture state. It took an average of 18.3 + 8.6 weeks for the bony union. Five cases involved intraoperative technical issues caused by the lag screw's inevitable superior placement. Three patients experienced postoperative problems that necessitated repeat surgery: two occurrences one incident of periprosthetic fracture and one case of varus collapse following cut out [10].

Christophe Sadowski et al., Intertrochanteric fractures are made up of various anatomical patterns that differ in how stable they are after internal fixation and open reduction. Reverse oblique and transverse are terms used to describe the fracture pattern, and group AO/OTA 31-A3 is classified as being extremely unstable. The study compared the outcomes of plate fixation with proximal femoral treatment for these intertrochanteric fractures in older adults. 39 older people with intertrochanteric femur fractures in accordance with AO/OTA 31-A3 were randomly assigned to one of two treatment groups, and they were monitored for at least a year after that. The 20 The 19 patients in Group I underwent therapy via a 95 fixed-angle screw-plate (Dynamic Condylar Screw), while the patients in Group II received a proximal femoral nail (Proximal Femoral Nail) [11]. Regarding all demographic and injury factors, the therapy groups were comparable. In contrast to

patients Patients who received a proximal femoral nail instead of a 95 screw-plate had quicker operations, fewer blood transfusions, & shorter hospital stays. Seven out Of the 19 patients who had 95 screw-plate therapy had implant failure and/or non-union. Twenty fractures that were fixed with a proximal femoral nail only had one that did not recover. As a consequence of this study's findings, it is recommended that reverse oblique & transverse intertrochanteric fractures among people not be fixed with a 95 screw-plate older patients. Instead, a proximal femoral nail should be used instead [12].

Xiang Zhao et al., Asian patients' tiny bones are considered to be the best ones for the Trigen short repair "trochanteric antegrade nail (TAN)". The study assessed TAN's efficacy in treating Asian patients' intertrochanteric fractures. In our department, TAN was used to treat 174 fractures in 164 patients between January 2006 and March 2009 [13].

A retrospective examination was done on fracture kinds, radiographic changes, epidemiological information, clinical outcomes, complications, and cortical bone indices during a mean of 26 months. They found that for type 31-A3 fractures, the reduction rate was 15.9%, the lateral trochanter fracture rate was 41.4% and the nail tip fracture rate was 17.0%. A review of these cracking instances revealed that they were all comminuted lateral trochanter fractures together with type 31-A3 unstable fractures. While other fractures did not exhibit infection, delayed union or nonunion, two shaft fractures required correction. No screws broke, however, there was one cut-out, which required revision of the total hip arthroplasty. Finally, all other fractures were healed. Fracture type, age, cortical bone, gender, or index of the patient were not linked to the risk of distal shaft fractures. Despite the TAN's theoretically superior design, Despite the majority of fractures healed and showing satisfactory activities at their most current follow-up, the distal region within the nail's design had a chance to cause a femoral shaft fracture and caused inadequate reduction and coxa vara. Future enhancements must be made this system usable for Asians [14].

Marc Saudan et al., to evaluate the effectiveness of comparing a sliding compressive hip screw against a proximal femoral nail to treat pertrochanteric fractures. Prospective computer-generated randomization divided 206 patients into two study groups: those who underwent proximal femoral nailing (Group 2; 100 patients) and a sliding compression hip screw (Group 1; 106 patients) therapy. all individuals with trochanteric fractures above the age of 55 who report being brought on by low-energy trauma are categorised as Types 31-A1 and A2 of AO/OTA. Treatment with a moving

compression hip screw (Dynamic Hip Screw; Synthes-Stratec, Oberdorf, Switzerland) or a proximal femoral nail (Proximal Femoral Nail). Time spent during surgery and fluoroscopy, the difficulty with the procedure, intraoperative issues, and blood loss are all considered intraoperative. Radiologic: Fixation failure and fracture healing. Clinical: score for mobility, social functioning, and pain. AO/OTA 31-A1 and A2 treating low-energy pertrochanteric fractures, a proximal femoral nail has no advantages to a sliding compression hip screw, particularly given its higher cost and dearth of data demonstrating fewer problems or better patient outcomes [15].

Conclusion

The study has concluded that the employment of a proximal femoral nail that is fitted with two integrated lag screws has been shown to have favourable effects among patients who have sustained intertrochanteric fractures and are of Asian heritage. Despite the fact that the study uncovered issues that had not been previously documented, it emphasises how important it is to identify patients carefully and implant screws accurately. Despite the possibility of beneficial outcomes being linked with this procedure, the data highlight the requirement of painstaking consideration and exact execution in order to attain the greatest outcomes for Asian patients having this treatment. It is important to note the limitations of the study. The limited size of the patient group was a challenge in conducting a thorough assessment of the efficacy and incidence of complications. It is advisable to conduct a more extensive prospective investigation in order to do a comparison assessment with alternative fixation procedures. Variability was introduced by many surgeons practising at various hospitals. Nevertheless, the implementation of standardised training protocols and regular inspections of lag screws played a crucial role in addressing this particular issue.

References

- Kim, J. W., Kim, T. Y., Ha, Y. C., Lee, Y. K., & Koo, K. H. Outcome of intertrochanteric fractures treated by proximal femoral nail with two integrated lag screws: A study in Asian population. *Indian journal of orthopaedics*, 2015;49(4): 436–441.
- Bienkowski, P., Reindl, R., Berry, G. K., Iakoub, E., & Harvey, E. J. A new proximal femoral nail device for the treatment of intertrochanteric hip fractures: Perioperative experience. *The Journal of trauma*, 2006;61(6): 1458–1462.
- Palm, H., Lysén, C., Krasheninnikoff, M., Holck, K., Jacobsen, S., & Gebuhr, P. Proximal femoral nailing appears to be superior in pertrochanteric hip fractures with a detached greater trochanter: 311 consecutive patients followed for 1 year. *Acta orthopaedica*, 2011;82(2): 166–170.
- Forte, M. L., Virnig, B. A., Kane, R. L., Durham, S., Bhandari, M., Feldman, R., & Swiontkowski, M. F. Geographic variation in device use for intertrochanteric hip fractures. *The Journal of bone and joint surgery. American volume*, 2008;90(4): 691–699.
- Ruecker, A. H., Rupprecht, M., Gruber, M., Gebauer, M., Barvencik, F., Briem, D., & Rueger, J. M. The treatment of intertrochanteric fractures: results using a proximal femoral nail with integrated cephalocervical screws and linear compression. *Journal of orthopaedic trauma*, 2009;23(1): 22–30.
- Sadowski, C., Lübbecke, A., Saudan, M., Riand, N., Stern, R., & Hoffmeyer, P. Treatment of reverse oblique and transverse intertrochanteric fractures with use of a proximal femoral nail or a 95 degrees screw-plate: a prospective, randomized study. *The Journal of bone and joint surgery. American volume*, 2002;84(3): 372–381.
- Zhao, X., Yan, S. G., Li, H., & Wu, H. B. Short reconstruction nail for intertrochanteric fracture: does it really fit Asian feature? *Archives of orthopaedic and trauma surgery*, 2012;132(1): 81–86.
- Mohan, Hariharan & Kumar, Prakash & Gohil, Kushal & Dhaniwala, Mukund. Outcome and complications of intertrochanteric femur fractures treated by proximal femoral nail. *International Journal of Orthopaedics Sciences*. 2019;5: 339-343.
- Anglen, J. O., Weinstein, J. N., & American Board of Orthopaedic Surgery Research Committee. Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice. A review of the American Board of Orthopaedic Surgery Database. *The Journal of bone and joint surgery. American volume*, 2008;90(4): 700–707.
- Baumgaertner, M. R., Curtin, S. L., Lindskog, D. M., & Keggi, J. M. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *The Journal of bone and joint surgery. American volume*, 1995;77(7): 1058–1064.
- Foss, N. B., Kristensen, M. T., Kristensen, B. B., Jensen, P. S., & Kehlet, H. Effect of postoperative epidural analgesia on rehabilitation and pain after hip fracture surgery: a randomized, double-blind, placebo-controlled trial. *Anesthesiology*, 2005;102(6): 1197–1204.
- Palm, H., Jacobsen, S., Sonne-Holm, S., Gebuhr, P., & Hip Fracture Study Group. Integrity of the lateral femoral wall in

- intertrochanteric hip fractures: an important predictor of a reoperation. *The Journal of bone and joint surgery. American volume*, 2007;89(3): 470–475.
13. Parker, M. J., & Handoll, H. H. Gamma and other cephalocondylic proximal femoral nails versus extramedullary implants for extracapsular hip fractures in adults. *The Cochrane database of systematic reviews*, 2008;(3): CD000093.
14. Parker, M. J., & Palmer, C. R. A new mobility score for predicting mortality after hip fracture. *The Journal of bone and joint surgery. British volume*, 75(5), 797–798.
15. Saudan, M., Lübbecke, A., Sadowski, C., Riand, N., Stern, R., & Hoffmeyer, P. Pertrochanteric fractures: is there an advantage to a proximal femoral nail?: a randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. *Journal of Orthopaedic Trauma*, 2002;16(6): 386–393.