Remittances Review
April 2024,
Volume: 9, No: 2, pp.1795-1806
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received : 10 Januanry 2024, Accepted: 15 April 2024
DOI: https://doi.org/10.33282/rr.vx9i2.96

Functional outcomes of subtrochanteric fractures of femur managed via long proximal femoral nail (PFN)

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Abstract

Background and Objectives: One of the most difficult fractures orthopedic surgeons treat are subtrochanteric femur fractures. In the younger age group, fractures are primarily caused by automobile accidents, but the majority of fractures in the elderly are caused by insignificant falls while standing or walking. Operative management is the best course of treatment for these subtrochanteric fractures since closed management makes it harder to achieve and sustain a reduction. Therefore, the purpose of this study was to ascertain the difficulties associated with the care of subtrochanteric fractures as well as the efficacy of intramedullary fixation of subtrochanteric fractures using a long proximal femoral nail.

Methodology: A long proximal femoral nail was used to treat 25 cases of subtrochanteric fractures that were admitted to ORTHOPEDIC department Gujranwala medical college (Jan 2023 to Dec 2023) This study is

prospective in nature. Cases were accepted based on inclusion and exclusion criteria, such as an adult's fresh subtrochanteric fracture. The study excluded patients with pathologic fractures, multiple fractures, pediatric fractures, and elderly neglected fractures.

Results: Of the 25 cases in our study, 16 were male and 9 were female. The patients' ages ranged from 17 to 75 years, with the majority being in the 21–40 year age range. Road traffic accidents accounted for 67% of the cases admitted, followed by falls from a height of 23% and trivial falls from 10%, with the right side being more frequently affected. In 40% of instances, the fracture was a Seinsheimer Type IIIA fracture. Our patients' mean length of stay in the hospital was 12 days, and their mean duration of full weight bearing was 14 weeks. 25 instances in all. In our study, good to outstanding outcomes were observed in 80% of patients.

Conclusion Our research leads us to the conclusion that long PFN is a dependable implant that promotes little soft tissue damage and a high rate of bone union for subtrochanteric fractures. Although the procedure is technically challenging, intramedullary fixation offers advantages in terms of biology and biomechanics. It will take a lot of patience and gradual learning to make this procedure really least invasive.

Keywords: Harris Hip Score, Seinsheimer Classification, lengthy PFN, and subtrochanteric fractures

Introduction

Subtrochanteric fractures are femoral fractures that happen in the femur shaft below the lower trochanter and up to 5 cm distal [1]. The reason for these fractures' common occurrence is that they usually happen at the point where the trabecular and cortical bones meet, where the femur experiences the most mechanical stress across the junction. 10% to 34% of all hip fractures are these kinds of fractures [2]. During daily activities, the subtrochanteric area is typically subjected to higher levels of stress. A large lever arm with considerable medial compressive loads and lateral tensile strains is produced by axial loading forces via the hip joint. Significant rotational shear forces are produced by hip muscle forces in addition to

bending forces and torsional effects. Up to six times the body weight is transferred to the subtrochanteric area of the femur during routine everyday activities. The thick cortical bone in this area has less vascularity because to the strong stresses acting on it, which raises the risk of healing disruptions. As a result, subtrochanteric fractures are challenging to treat and can result in complications [3]. Because it can be challenging to achieve and sustain a reduction with closed management of these subtrochanteric fractures, surgical management is the recommended course of care. Restoring normal length and angulation is the aim of surgical treatment in order to provide the abductors with sufficient tension, initiate early mobility, and allow for weight bearing. Therefore, the goal of this research is to ascertain the functional results, operational risks, complications, and union rate in subtrochanteric fractures treated with the long proximal femoral nail [3].

Methods

The current study included 25 adult patients who had extended PFN treatment for subtrochanteric femur fractures at ORTHOPEDIC department Gujranwala medical college (Jan 2023 to Dec 2023), following approval from the Academic Review Board and Institutional Ethical Committee.

Seinsheimer classification was used to categorize the fractures, and 25 patients were monitored on a regular basis. The study only looked at recent adult subtrochanteric fractures. Exclusions from the study were pathological fractures, pediatric fractures, old neglected fractures, and periprosthetic fractures. Following the appropriate resuscitation and splint aging with skeletal traction, the patient with a suspected subtrochanteric fracture was admitted to the ward following the completion of the required clinical and radiological evaluation. All patients had standard blood testing. with sufficient preoperative preparation, which involves using a goniometer to measure the neck shaft angle and the nail diameter at the level of the isthmus on the femur. The usual length PFN of 340–440 mm with a distal diameter of 9, 10, and 11 mm was used in our investigation. Operative Techniques: . The patient is positioned supine on the fracture table, with the affected limb extended by 10 to 15 degrees. The fracture is closed by tra tion and internal rotation, and is checked under an image intensifier. If closed reduction is

unsuccessful, an open reduction is carried out. 2. All patients receive a prophylactic antibiotic 30 minutes prior to surgery. 3. A 5-cm longitudinal incision was made proximal from the greater trochanter. 2. A parallel incision was made in the fascia lata, and the gluteus medius was split in line with the fibers. 4. The greater trochanter is exposed. 5. In the AP view on the C-arm, the entry point is on the greater trochanter. 2. The medullary canal is entered with a curved bone awl, and the guide wire is inserted into the medullary canal. A cannulated conical reamer is used to reamer the proximal femur over a distance of roughly 7 centimeters.

An appropriate size nail, selected preoperatively, is attached to the insertion handle and manually inserted once sufficient fracture reduction has been confirmed. After making a stab incision, a 2.8 mm guide wire is passed through the drill sleeve. For the hip pin, a second 2.8 mm guide wire is put through the drill sleeve above the previous one. Till the drill is 8 mm short of the guide wire's tip, drilling is done over 2.8 mm of guide wire. A screwdriver with a cannulated tip is used to insert the neck screw. A hip pin of the proper length is also placed. The C-arm image confirms the screw's length and location.

Typically, two cortical screws are used in distal locking, which is done by hand. A locking screw is placed and tightened verified using an image intensifier. The wound was wrapped in layers, covered with a sterile dressing, and given a compression bandage. During the recovery phase, antibiotics were still administered. Removing the suture on the twelfth post-operative day. Immediately following surgery, patients were instructed in knee mobility exercises and quadriceps static exercises. Gait training was given to patients before they were released from the hospital. Every patient was checked on at 4 weeks, 12 weeks, and then every 6 weeks until fracture union was observed. After that, they were checked on at 6 months, 9 months, and 1 year. The patient's hip and knee function, walking capacity, fracture union, deformity, and shortening were all clinically evaluated at each appointment. The Harris Hip Score was used to evaluate hip function. Antero posterior and laterally full length hip and thigh X-rays were obtained to evaluate implant bone contact and fracture union.

RESULTS

The least age in our study was 18 years old, and the maximum age was 97 years old. The majority of the patients were in the 21–40 age range. The average age was 36. In our study, there were ten female patients and twenty male patients (TABLE 4). Thirteen incidents involved the right side, while seventeen included the left (TABLE 5). In our series, road traffic accidents accounted for 13 cases, the most common mode of injury, followed by falls from heights (11 instances) and trivial falls (6 cases)(TABLE 6). The Seinsheimer classification was used to categorize the 30 subtrochanteric fractures in our investigation. Ten instances of IIA, five cases of IIB, six cases of IIIA, five cases of IIIB, and three cases of IV were included in our study. An average of 10 days passed between each patient's operation and the trauma day. Five cases of superficial wound infections in our series necessitated three weeks of intravenous antibiotic therapy. Not experiencing any further complications such as systemic infection, fat embolism, acute respiratory distress syndrome, or deep vein thrombosis.

After surgery, the average length of hospital stay was 12 days, with a range of 10 to 14 days.Every patient was checked on at 4 weeks, 12 weeks, and then every 6 weeks until a fracture union was observed. At six months, nine months, and a year (TABLE 1). Follow-up radiographs of the hip and upper femur were obtained at each visit to evaluate screw cut out, implant failure, and fracture union. Antero-posterior and lateral X-rays in three cortices showing the obliteration of fracture lines and trabecular continuity between the two fragments were considered evidence of radiological union. (TABLE 1)

Anatomical Results

The presence or absence of shortening, varus deformities, and range of motion in the hip and knee joints were used to evaluate the anatomical findings on 25 patients who were accessible for follow-up; 77% of the cases had good results and 23% had fair results.

Functional Outcomes

25 instances that were eligible for follow-up had their functional results evaluated using the Harris Hip grading system. (TABLE 3)

Union in Weeks		
Union in Weeks	**Frequency**	**Percentage**
0-12 wks.	0	0
13-16 wks.	0	0
17-20 wks.	13	43.4
21-24 wks.	9	30
25-28 wks.	8	26.6
TOTAL	30	100

TABLE 1

Delayed Complications		
Delayed Complications	**No. of Cases (25)**	**Percentage**
Hip Joint Stiffness	**5**	**16.7**
Knee Joint Stiffness	**3**	**10**
Delayed Union	**5**	**16.7**
Implant Failure	**0**	**0**
Shortening	**0**	**0**

TABLE 2

Functional results		
RESULTS	**Frequency**	**Percentage**
EXCELLENT	**18**	**60**
GOOD	**8**	**26.7**
FAIR	**4**	**13.3**
POOR	**0**	**0**
TOTAL	**30**	**100**

TABLE 3

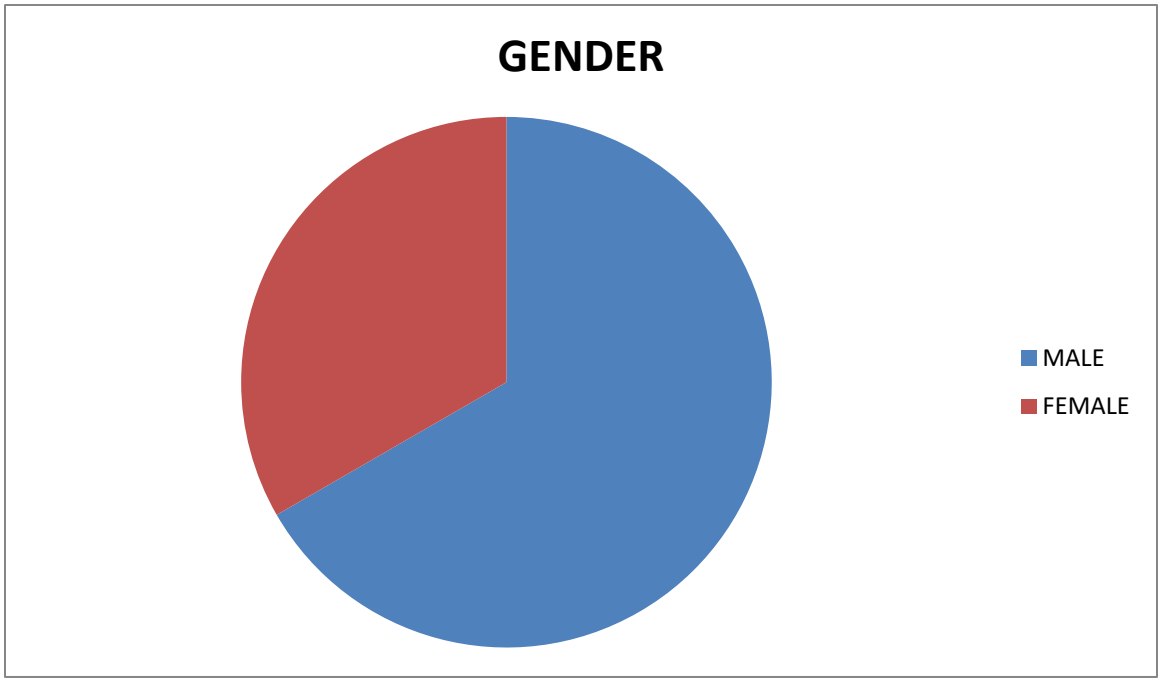

TABLE 4

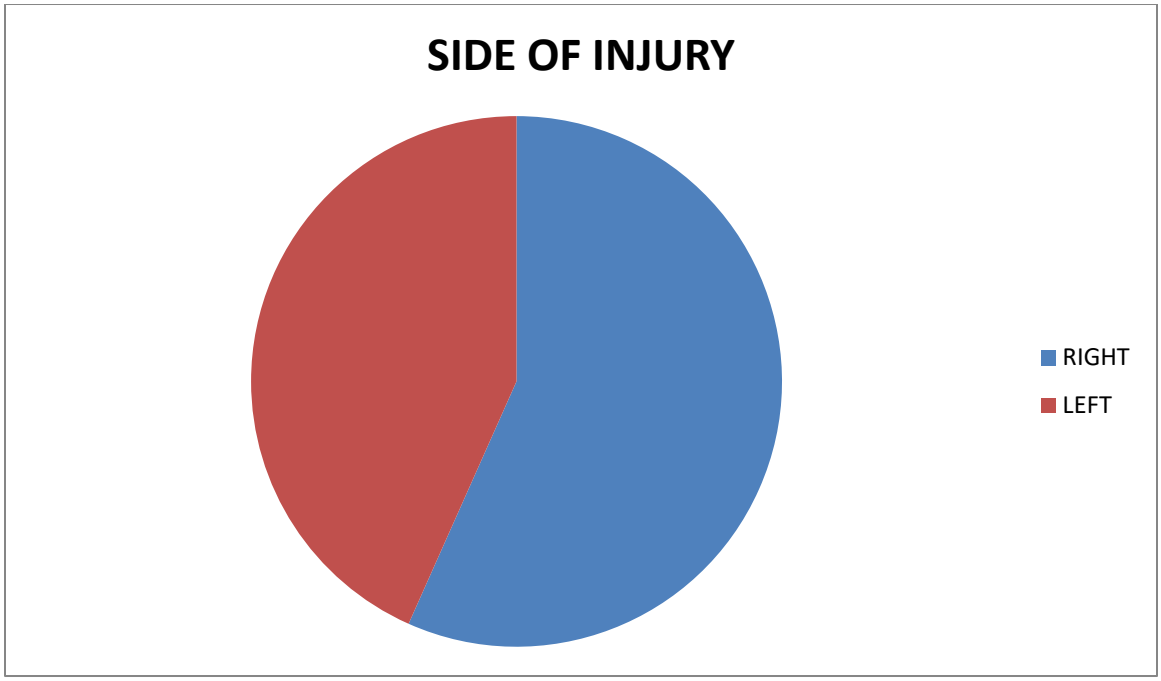

TABLE 5

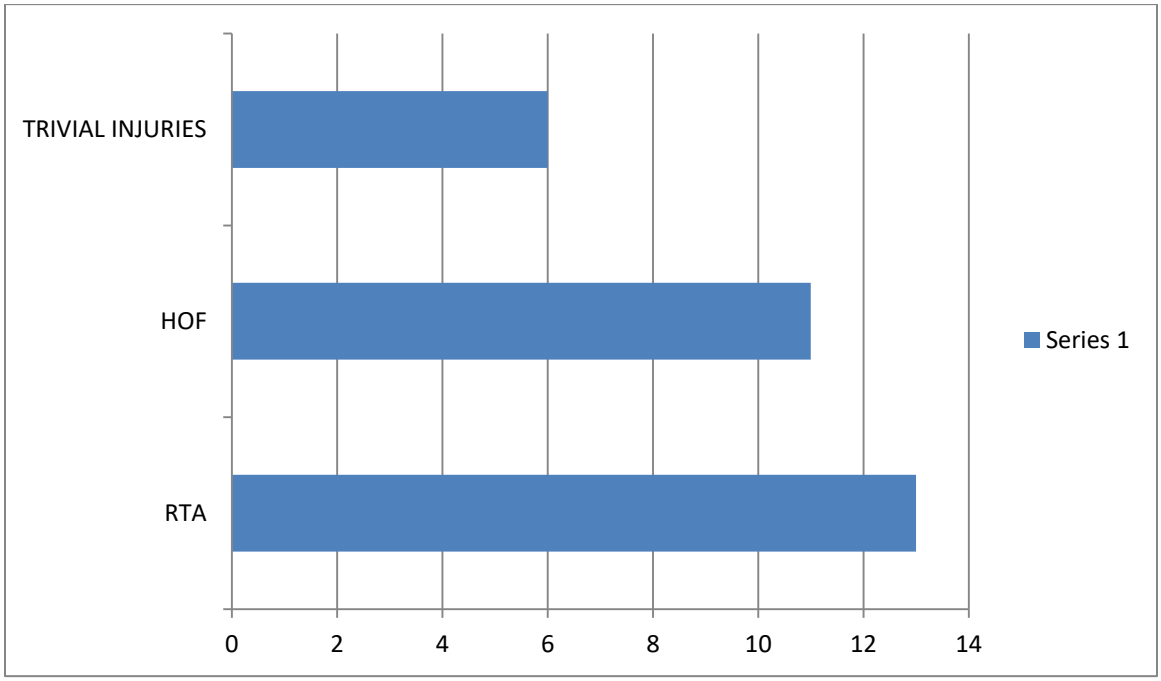

TABLE 6

Discussion

Subtrochanteric fractures are typically caused by high-energy trauma, and they can be severely displaced as well as quite challenging to reduce closely using traction. According to De Lee et al., conservative treatment for fractures has been eliminated in modern trauma care because to the high frequency of delayed union, malunion, and non-union [4]. In addition to its mechanical advantages over plate fixation, intramedullary nailing is strongly associated with "biological internal fixation" since it permits a minimally invasive technique. By minimizing soft tissue dissection, the surgeon can lower the risk of surgical stress, blood loss, infection, and wound problems with intramedullary fixation [5, 6]. Therefore, in order to lower the risk of difficulties connected to implants, the AO ASIF developed the long Proximal Femoral Nail in 1996.

To improve the rotational stability of the neck fragment, the long PFN has a 6.5 mm anti-rotation screw in addition to the 8 mm load-bearing femoral neck screw. reduces tension and focalized stress in the femoral shaft as well. This should lower the possibility of femoral shaft fractures both during and after surgery. All of the benefits of an intramedullary device, including a shorter lever arm, the ability to place the device using a closed approach that preserves the fracture hematoma, less blood loss, less soft tissue dissection, and a reduced risk of wound infections, are also present with long PFN. Gotze et al. (1998) examined the osteosynthesis loadability of subtrochanteric fractures in an experimental research and discovered that the long PFN could support the maximum loads of any device [7]. Our study's objective was to evaluate the functional results of subtrochanteric fractures treated with this more recent intramedullary fixation technique using a long proximal femoral nail. We evaluated the outcomes in terms of the functional outcome, post-operative outcomes, and intraoperative details. Inger B. Schipper came to the same conclusion in his 2002 study on the biomechanical evaluation of long PFN: if the hip pin's hole through the nail was changed to a slot, the axial pressures on the hip pin would be significantly reduced, which would lower the likelihood of a cutout [8].

The name Z-effect was initially used by Werner et al. and was identified in 5 (7.1%) out of 70 instances. In this investigation, the incidence of the neck screw being cut out was 8.6%. During the postoperative phase of weight bearing, the Z-

effect phenomenon is defined as a characteristic sliding of the proximal screws in different directions [9]. Fogagnolo et al.'s study, which is the most recent to assess the use of extended PFN, included 46 patients with an average rate of intraoperative technical or mechanical problems of 23.4%. Additionally, they reported one fracture below the nail tip and two implant failures [9]. In our investigation, there were no implant. In a clinical study of 155 consecutive patients treated with a long proximal femoral nail, Daniel FA Menzes et al. and Axel Gamulin (2005) reported that 2% of the fixation failed, and 0.7% of the femoral shaft failed. The fixation failures included one cut out, one delayed fracture healing, and one lateral displacement of the antirotation screw [10]. There was no fixation failure in our investigation. In a clinical multicenter research, Simmermacher et al. (1999) found that in 5% of instances, there were technical problems with the long PFN due to inadequate reduction, malrotation, or the incorrect screw selection. In 0.6% of cases, the neck screw was taken out [11]. In our study, there was one instance of a delayed union and a 4% failure rate.

Conclusion

Surgical intervention is typically used to treat subtrochanteric femur fractures. Because of the following benefits, more and more modern intramedullary techniques have replaced extra medullary methods of fixation with various angle plates or with a compression hip screw with a plate in the last ten years: With a biomechanically robust fixation, the surgical process is quicker, less blood is lost, and the bone heals primarily in the decreased position. This enables early weight bearing on the bone with less local and general problems. There is an increased pressure on the treating surgeon to return function to almost normal because subtrochanteric fractures are becoming more common in younger, active males. The benefits of great rotational stability are available with osteosynthesis using the long proximal femoral nail.

Being an intramedullary device, the long proximal femoral nail has the benefit of collapsing at the site of fracture and is biomechanically sound. Because the implant is designed rigidly and the fixation is strong, early mobilization may occur after surgery. Our research leads us to the conclusion that long PFN is a dependable

implant that results in a high rate of bone union and little soft tissue injury for subtrochanteric fractures. While there are biological and biomechanical benefits to intramedullary fixation, the procedure is technically complex. It will take a lot of patience and gradual learning to make this procedure really least invasive.

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