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Original Research Article

A Prospective Clinical Outcome Assessment of Proximal Femoral Nailing in Adult Patients with Subtrochanteric Fractures of the Femur

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Abstract

Aim: To assess the functional result of proximal femoral nailing in adult patients with subtrochanteric fractures of the femur.

Materials and Methods: This was a retrospective study conducted in the Department of Orthopedics, SKMCH, Muzaffarpur, Bihar, India. 25 patients who sustained subtrochanteric femur fracture treated with proximal femoral nail. Patients above 18 years of age having closed fracture and open Grade 1 or 2 included in this study. Patients <18 years of age with open fractures Grade 3, pathological fracture and fractures with vascular injury were excluded from this study. As per ATLS guidelines, hemodynamic stabilization of all patients was carried out and injury to head, chest, or abdomen was ruled out and treated accordingly. Partial weight-bearing walker walking was started around 6-8 weeks and full-weight-bearing walker walking was allowed usually between 10 and 14 weeks after assessing for radiological and clinical union. There were signs of initiation of radiological union at around 4 to 6 weeks. The evaluation of the results was done with the help of Harris hip score.

Results: Out of 25 patients, PFN with encirclage with SS wire was done in 6 (24%) patients due to a long spiral oblique fracture pattern. However, 19(76%) patients required PFN only. The average operative time for surgery was 59.5 min (20 patients) with minimum operative time being 49 min (5 patients) and maximum time being 94 min (2 patients). Patients were advised full weight-bearing walking with walker between 10 and 14 weeks with average time around 12 weeks. The average radiological union time for subtrochanteric fracture was 13.2 weeks with the earliest union was seen at 11 weeks. In our study, out of 25 patients, 4 patients had postoperative complications. One (4%) patient had non-union. One (4%) patients had postoperative infection within 2 weeks. Two (8%) patients had broken implant in the form of broken distal locking screws of proximal femoral nail, the fracture united in these patients. In our series, the average Hip Harris score is 92.6 (Ranging from 71 to 100)

Conclusion: PFN is a closed nailing procedure which achieves biological fracture fixation with minimal blood loss, preserving the fracture hematoma and thus aiding in healing of the fractures. As compared to other modalities, there is a low infection rate, as well as lesser postoperative complications. Proximal and distal screws passed through femoral nail gives good axial and rotational stability and prevent shortening and malunion and stainless steel (SS) wire encirclage whenever required adds on stability to fracture site.

Keywords: Proximal femoral nailing, Subtrochanteric fractures, Femur

Introduction

Subtrochanteric fractures of the femur, which occur in the region extending from the lesser trochanter to 5 cm distal to it, present a significant challenge in orthopedic trauma due to their high incidence of complications and technical difficulty in treatment. These fractures, typically resulting from high-energy trauma in young adults or low-energy falls in the elderly, require robust fixation to withstand the substantial biomechanical stresses at this anatomical site. The advent of proximal femoral nailing (PFN) has revolutionized the management of subtrochanteric fractures, offering a minimally invasive approach with promising outcomes. [1,2] Subtrochanteric fractures account for 10-30% of all hip fractures and are associated with considerable morbidity and mortality, particularly in the elderly

population. The proximal femur is subject to high compressive and tensile forces, which complicates the fixation of fractures in this area. Traditional fixation methods, such as plate osteosynthesis, have been associated with high rates of mechanical failure, non-union, and soft tissue complications due to extensive surgical dissection . The introduction of the proximal femoral nail (PFN) marked a significant advancement in the treatment of subtrochanteric fractures. The PFN, a type of intramedullary nail, is designed to provide stable fixation with minimal soft tissue disruption. It combines the biomechanical advantages of an intramedullary device with proximal locking screws that enhance stability. The design of the PFN allows for a minimally invasive surgical approach, reducing operative time and blood loss, and facilitating faster post-operative recovery. Biomechanically, the intramedullary position of the PFN allows it to act as a load-sharing device, which is crucial in the proximal femur where forces are high. The nail is inserted through a small incision at the tip of the greater trochanter, and it traverses the medullary canal, providing axial and rotational stability. Proximal locking screws are inserted into the femoral head and neck, securing the nail and providing resistance to varus and rotational forces. [3,4] The surgical technique for PFN involves closed reduction of the fracture, which minimizes soft tissue damage and preserves the fracture hematoma, an essential element for healing. Fluoroscopic guidance is used to ensure accurate placement of the nail and screws. This method reduces the risk of infection and blood loss compared to open reduction and internal fixation (ORIF). Despite its advantages, PFN is not without complications. Technical errors during nail insertion or screw placement can lead to malalignment, non-union, or iatrogenic fractures. Additionally, improper placement of the proximal screws can result in cut-out or varus collapse, emphasizing the need for meticulous surgical technique and careful post-operative monitoring. Moreover, complications such as femoral shaft fractures distal to the nail and implant-related issues such as screw backout or breakage have been reported. However, advances in nail design and the development of augmentation techniques, such as the use of cement to enhance fixation in osteoporotic bone, continue to address these challenges. [5,6]

Materials and Methods

This was a retrospective study conducted in the Department of Orthopedics, SKMCH ,Muzaffarpur , Bihar, India for one year. 25 patients who sustained subtrochanteric femur fracture treated with proximal femoral nail. Patients above 18 years of age having closed fracture and open Grade 1 or 2 included in this study. Patients <18 years of age with open fractures Grade 3, pathological fracture and fractures with vascular injury were excluded from this study. As per ATLS guidelines, hemodynamic stabilization of all patients was carried out and injury to head, chest, or abdomen was ruled out and treated accordingly. After stabilization, anteroposterior and lateral radiograph of the affected part were done. Subtrochanteric fractures were classified in the current study according to Seinsheimer's classification. Skin traction with counter traction was given. Patients were posted for surgery after all routine investigations and anaesthetic clearance under regional or general anaesthesia. The patient was placed on a radiolucent fracture table in supine position with perineal post in place. Closed reduction was achieved by traction and manipulation. Reduction was checked under the flouroscopic guidance with AP and lateral view. A 5 cm incision was made approximately 5–8 cm proximal from the tip of the greater trochanter. A parallel incision in the fascia of the gluteus medius was made and the gluteus medius was split in line with the fibers. For patients requiring encirclage with stainless steel (SS) wire, a 2 cm incision was made and SS wire was inserted. Entry was taken with an awl/ guide pin over a protector sleeve slightly medial through the pyriformis fossa. A guidewire was inserted across the fracture site through the cannulated awl. Its position was checked in the C-arm and the entry was widened with the proximal reamer. Reaming of the shaft was done in younger patients. Appropriate size long proximal femoral nail was fixed with a jig and inserted manually as far as possible with twisting movements or hammered down the canal. The position of the holes for the hip screws was checked in the C-arm for the depth of the nail insertion. Guidewires for the screws were inserted through the jig with the help of a drill sleeve. The ideal position of the guide wires is parallel and in the lower half of the neck in AP views and the center of the neck in the lateral views. The guide pins were inserted up to 5 mm from the articular surface of the femoral head and size of the lag screw determined. Reaming for the lag screw and anti-rotation screw was done and appropriate size screws inserted approximately 5 mm away from the subchondral bone. Distal locking was performed with two locking bolts with freehand technique under IITV guidance. Postoperatively, a radiograph was done. Quadriceps exercises with knee and ankle mobilization were started from 2nd postoperative day. Injectable antibiotics were given till the 3rd postoperative day. After that oral antibiotics were given till removal of sutures. Local wound care and dressing were done regularly and sutures were removed between 13th to 16th postoperative day. Patients were advised non-weight bearing walker walking after suture removal. Partial weight-bearing walker walking was started around 6-8 weeks and full-weight-bearing walker walking was allowed usually between 10 and 14 weeks after assessing for radiological and clinical union. There were signs of

initiation of radiological union at around 4 to 6 weeks. The evaluation of the results was done with the help of Harris hip score.

Results

This is a retrospective study of evaluation of results of 25 patients who sustained subtrochanteric femur fracture and treated with PFN. All the patients in this study were above 18 years of age. The youngest patient was 20 years old and the oldest patient was 79 years old. The mean age was 40.7 years. Out of 25 patients, 20 (80%) were male and 5 (20%) were female. In our study, 17 (68%) patients had road traffic accident whereas, 5 (20%) patients were injured following a fall from height and 3 (12%) patients were injured following domestic fall. This suggests that the majority of patients had subtrochateric fracture as a result of high-velocity trauma. In this study, the most common type of fracture was Seinsheimer Type-4 10 (40%). In our study, out of 25 patients, PFN with encirclage with SS wire was done in 6 (24%) patients due to a long spiral oblique fracture pattern. However, 19(76%) patients required PFN only. The average operative time for surgery was 59.5 min (20 patients) with minimum operative time being 49 min (5 patients) and maximum time being 94 min (2 patients). Most of the patients were advised partial weight-bearing in the form of walker walking [Table 3] between 6 and 8 weeks with average time around 7 weeks. Patients were advised full weight-bearing walking with walker between 10 and 14 weeks with average time around 12 weeks. The average radiological union time [Table 2] for subtrochanteric fracture was 13.2 weeks with the earliest union was seen at 11 weeks. In our study, out of 25 patients, 4 patients had postoperative complications. One (4%) patient had non-union. One (4%) patients had postoperative infection within 2 weeks. Two (8%) patients had broken implant in the form of broken distal locking screws of proximal femoral nail, the fracture united in these patients. In our series, the average Hip Harris score is 92.6 (Ranging from 71 to 100) [Table 1]. Twenty one (84%) patients showed excellent-to-good results which suggest that intramedullary fixation of subtrochanteric femur fracture treated with PFN provides good results.

Table 1: Results According To Harris Hip Score

Results	No. of patients (n %)
Excellent	18(72%)
Good	3(12%)
Fair	2(4%)
Poor	2(4%)

Table 2: Radiological union in weeks

Weeks	No. of patients
10-12 weeks	7
12-14 weeks	12
14-16 weeks	5

Table 3: Weight bearing initiation

Weeks	No. of patients
4-6 weeks	2
6-8 weeks	16
8-10 weeks	7

Discussion

PFN is an effective intramedullary load-sharing device. It incorporates the principles and theoretical advantages of Dynamic hip screw, and locked intramedullary nail. The advantages of PFN are minimal blood loss, shorter operative time, and early weight-bearing. In comparison with intertrochanteric fractures, subtrochanteric fractures are generally associated with slightly higher failure rates. We have studied 32 cases of subtrochanteric fracture of femur treated with proximal femur nailing. In our series, high-velocity trauma was observed in 22 (88%) patients which is comparable with Indian series by Sangwan et al. [5] which had 75% of patients with high-velocity motor vehicle accidents. The most common type was Seinsheimer's Type IV accounting for 11 (44%) followed by Type III accounting for 8 (32%) which is comparable with a study by Zhou, et al. [6] Our study shows that surgery time with PFN takes a shorter time (mean duration of 59.5 min) compared to extramedullary implants such as Dynamic hip screw, Dynamic condylar screw, and blade plates described in studies by Sadowski et al. [7], Rahme et al. [8] The average union time in our study was 13.2 weeks, which is in comparable to Boldin et al. [9] As compared to extramedullary fixation the amount of blood loss during PFN was less because it is essentially a close procedure and even when open reduction is done, the soft tissue dissection is

much less than extramedullary fixation. [10] This decreases the morbidity and preserves the biology thus improving the union chances and decreasing the rate of complications. We had 1 case of postoperative infection which were cured by antibiotics and dressing. Chances of postoperative infection in PFN are much less owing to small incisions and less surgical dissection. There was 1 non-union (4%) in our study. Non- union rate of 28% (Rahme et al.) [8], 10% (Yolmaz et al.) [11] for Angled plate have been reported. PFN is essentially a close intramedullary fixation with proximal and distal locking with resultant small incision and good stability resulting in better patient compliance during postoperative rehabilitation. Longer immobilization and non-weight bearing were seen with the use of other implants. Seinsheimer [12] stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment, and quality of postoperative care. In our study, we achieved 84% excellent-to-good results and 16% fair-to-poor result with our standard surgical care using proximal femoral nail. Zhou, et al. [6] have reported 96.05% excellent-to-good result and 3.95% patients have fair-to-poor results. Our results are comparable with other series. The limitations of this study were less number of patients and no alternative treatment to compare this study.

Conclusion

PFN is a closed nailing procedure which achieves biological fracture fixation with minimal blood loss, preserving the fracture hematoma and thus aiding in healing of the fractures. As compared to other modalities, there is a low infection rate, as well as lesser postoperative complications. Proximal and distal screws passed through femoral nail gives good axial and rotational stability and prevent shortening and malunion and stainless steel (SS) wire encirclage whenever required adds on stability to fracture site.

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