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Research Article

Our experience of management of sub trochanteric fractures of femur by proximal femoral nail

Ashish Vinod Batra[1]*, Harpreet Singh[2], Supradeeptha Challa[1], M .V. Ramanna Rao[1]

[1]Department of Orthopaedics, Swatantra Hospitals, Rajahmundry, Andhra Pradesh, India
[2]Department of Orthopaedics, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India

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***Correspondence:**
Dr. Ashish Vinod Batra,
E-mail: ashishbatra13@gmail.com

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ABSTRACT

Background: Sub trochanteric fractures of the femur remain some of the most challenging fractures. Most of the fractures result from trivial fall in the elderly; while in the younger age group, it's mainly due to road traffic accidents. Operative management is the preferred treatment. This study is intended to assess the outcome of the intramedullary fixation of sub trochanteric fractures with Proximal Femoral Nail (PFN).
Methods: This study is a prospective, uncontrolled study of 40 cases of sub trochanteric fracture of femur admitted to a tertiary level hospital between August 2011 and November 2013; and treated with proximal femoral nails. Adults with recent sub trochanteric fracture of femur were included in this study; while patients less than eighteen years of age, pathologic fractures, periprosthetic fractures, and old neglected fractures were excluded from the study.
Results: In our study of 40 cases, there were 28 male and 12 female patients with mean age of 51.43 years (range 22-87 years). Based on Seinsheimer's classification, type IIIA fractures accounted for majority (32.5%) of the cases. majority of patients, i.e. 35% (n=14) showed union at 20 weeks after surgery. Cases were followed up and assessed according to the Harris hip scoring system (Modified). The outcome was good to excellent in 82.9% cases.
Conclusions: From our study we conclude that PFN is a reliable minimally invasive implant for sub trochanteric fractures, with good to excellent functional outcome in the majority of cases.

Keywords: PFN, Seinsheimer's classification, Intramedullary nailing, Hip screw

INTRODUCTION

The sub trochanteric zone of the femur is the area extending up till 5 cm distally from the inferior border of the lesser trochanter or the junction of the proximal third and middle third of the femoral shaft. Fracture patterns presenting major displacement in this area are considered sub trochanteric fractures despite their proximal or distal extension.[1] High biomechanical stress concentration along with lower vascularity, leads to high rates of non-union and implant failure, seen in this anatomical region.[2,3] Sub trochanteric fractures account for 7 to 44% of all proximal femoral fractures.[1,4,5] The inherent instability of these fractures and the enormous muscle forces acting across the fracture fragments, render most treatment options difficult.[6] A medial buttress is important to minimise the implant stress and the fatigue failure;[7-9] but when comminution is severe, as is often the case, this cannot be achieved. Options for surgical stabilization of sub trochanteric fractures include dynamic hip screw, gamma nail, Proximal Femoral Nail (PFN) and proximal femoral plate. Intramedullary devices, such as the proximal femoral nail, are biomechanically stronger, more rigid compared to extra medullary devices such as dynamic hip screws,[10] offer theoretical advantages of high rotational stability of the

head-neck fragment; besides an unreamed implantation technique and the possibility of static or dynamic distal locking.[11] But the operative technique of proximal femoral nailing for sub trochanteric fractures has a steep learning curve.[12,13]

This study has been conceived to study the functional outcome and complications, if any, with the use of PFN in the management of sub trochanteric fractures; and report our experience about the same.

METHODS

Forty consecutive adult patients aged more than 18 years, with fresh sub trochanteric fractures of the femur, admitted in a tertiary care hospital, during the two-year period from August 2011 to August 2013, were included in this study. The Seinsheimer's classification system was used to classify the fractures.[4]

Patients less than eighteen years of age, pathological fractures, periprosthetic fractures and old, neglected fractures were excluded from this study. A written informed consent was taken from all patients. Preoperative investigations such as radiographs of the fractured region and those required for the purpose of pre anaesthetic evaluation were done.

In our study, we used PFNs of varying lengths, depending on the fracture pattern; with a proximal diameter of 14mm and a distal diameter of either 10, 11 or 12 mm, depending upon the width of the medullary canal at the isthmus, as measured preoperatively and finally determined intraoperatively. A proximal de rotation screw, of 6.5mm diameter, was used; along with a sliding distal lag screw of 8mm. Distal locking was done with self-tapping 4.9 mm cortical screws, one in static mode and the other in dynamic mode, allowing 5 mm of dynamization. These nails had a mediolateral angulation of 6 degrees proximally to allow insertion from the tip of trochanter; and its neck shaft angle was 135 degrees. We did not use the end cap.

The surgical operations were performed under general or spinal anaesthesia, with the patient in the supine position, on the fracture table. The upper part of the body was curved to the opposite side, with the injured lower extremity adducted as much as possible for the ease of nail insertion. Fractures were reduced under traction and C-arm fluoroscopy. A lateral longitudinal incision of about 3 cm was made superior to the greater trochanter after the top of the greater trochanter was palpated by the surgeon's index finger. The entry-hole on the top of the greater trochanter, usually at the junction of anterior third and posterior two thirds, was made with a trochar under fluoroscopic monitoring. A guide rod was inserted through this hole into the distal femoral canal, followed by reaming of the femoral isthmus and the proximal fragment. Insertion of the PFN was accomplished manually by the surgeon holding the aiming device, and use of a hammer was forbidden. When closed reduction was not sufficient to insert the guide rod into the distal femoral canal, open reduction and fixation with circlage wiring or cable bandage was performed through a small incision at the fracture site. The cephalic lag screw was inserted into the femoral neck with the aid of the aiming device under fluoroscopic control, and then the de rotation screw of the PFN was inserted subsequently. Distal locking of the nails was carried out under C-arm fluoroscopy by freehand technique. Postoperatively, the patients were encouraged to do active flexion and extension of the hip and knee of the affected side on the first day. Ambulating with crutches but without weight-bearing was started on the third day. Partial weight-bearing was initiated, as soon as possible depending upon the fracture pattern; and full weight-bearing was begun when the clinical and radiological signs of union appeared.

For the patients with associated injuries, the rehabilitation programme was begun as tolerated. All the patients were asked to come back to the hospital for follow-up at 6 weeks, 12 weeks, 6 months, 1 year and 2 years after their operation.

Postoperatively, clinical information including demographic data, clinical and radiological status, range of motion, and overall functional outcomes was compiled at predetermined intervals i.e. at 2 weeks, 6 weeks, 3 months, 6 months, 12 months, and 2 years, post operatively. The overall functional assessment was done using the modified Harris hip score.[14] Using this scoring system, the results were classified as excellent (score 90-100), good (score 80-90), fair (score 70-80) and failed (score below 60).

RESULTS

40 adults with fresh sub trochanteric fractures of the femur were included in this study. In our series, majority of the cases i.e., 42.5% (n=17) were in the age group of 31-50 years, followed by 32.5% cases (n=13) in the age group of 50-70 years. The mean age was 51.43 years (range 22-87 years). 70% of the patients were males (n=28) and 30% (n=12) were females. The cause of injury was road traffic accidents in 67.5% (n=27); and 32.5% (n=13) were due to fall from other causes. Right side was involved in majority of the cases (57.5%). Majority of the cases i.e., 32.5% (n=13) had fracture classified as Sensheimer's type IIIa, followed by type IIb in 20% (n=8) and type IIc in another 20% (n=8), as shown in Figure 1.

Four patients had associated head injury and were managed conservatively for it. One patient had associated closed fracture of shaft of tibia, which was managed with intramedullary interlocking nail. Two patients had associated distal radius fracture. One of them treated conservatively and the other was treated with open reduction and internal fixation with a locking

compression plate. Two patients had ipsilateral fracture clavicle and were treated conservatively for it. The patients were taken up for surgery depending upon their general medical condition and after assessment of their associated injuries. The average time interval between the day of trauma and surgery was 7 days. In 90% of the cases, close reduction and nailing was done while 10% required open reduction.

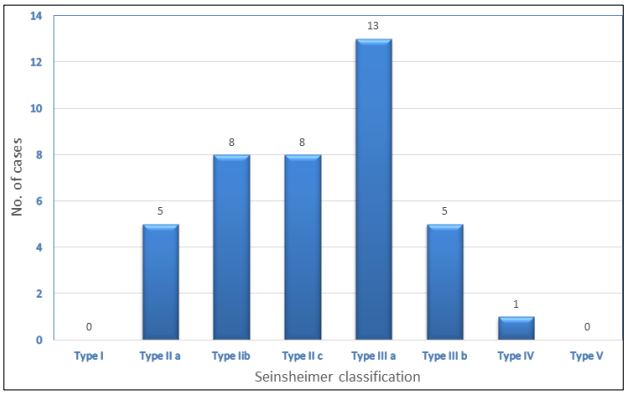

Figure 1: Showing case distribution according to Seinsheimer's classification (n=40).

1 case of superficial wound infection was seen post operatively, which was managed with regular dressings and appropriate intravenous antibiotics based upon the culture sensitivity. No deep infection was seen. At 6 weeks of follow up, two patients had prolonged postoperative knee stiffness, which improved after rigorous physiotherapy. The complications seen, at final follow up, as shown in figure 2, were varus mal union of the head-neck fragment in 3 cases (varus <10 degrees); and 3 cases of delayed union. Two cases had a limb shortening of 2 centimetres and were advised a shoe raise. We had no cases of non-union, implant failure or cutting out of screws. Two of our patients expired, one a month after surgery as he had ischaemic heart disease and died due to cardiac failure; while the second patient expired 3 months after surgery due to congestive cardiac failure. 3 patients failed to attend the first follow up and were lost for further follow up. The results were assessed in the rest of the patients.

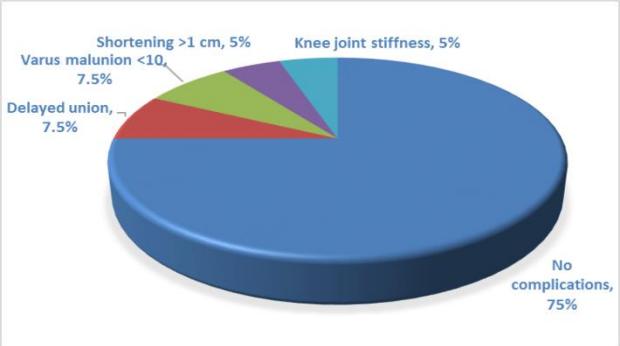

Figure 2: Showing the percentage of cases with various delayed complications.

Radiological union was said to be achieved on the evidence of trabecular continuity and obliteration of fracture lines between the two fragments on anteroposterior and lateral X-rays. 22.5% cases (n=9) showed union at 16 weeks, another 22.5% (n=9) at 18 weeks and 35% (n=14) showed union at 20 weeks, after surgery, as shown in Figure 3.

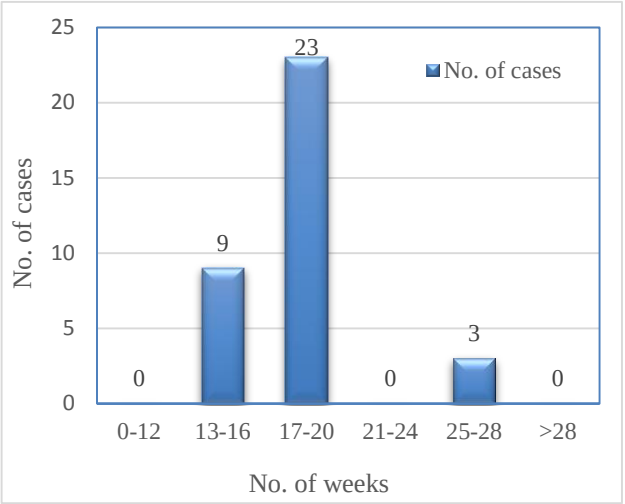

Figure 3: Showing the duration of radiological union (in weeks) in the patients (n=35).

Dynamization was done for the 3 cases of delayed union, which united at an average of 26 weeks. Anatomical results were assessed by the presence or absence of deformities, shortening and the range of motion at the hip and knee. At final assessment, 78.42% of the patients in our series had no or slight pain that did not affect their activities. 82.7% of these patients had no or slight limp. 50.8% of the patients mobilized without any walking aids. Cane was required for long walks in 27.3% of patients and most of the time in 19.04% of patients. Only one patient required crutch for mobilization. Difficulty in squatting and sitting cross legged was noted in 42.6% of patients. Most of these patients were of geriatric age group who had associated degenerative disease of the knee. Limb length discrepancy was noted in 2 patients with Seinsheimer's type IIIB and type IV fracture patterns; both of them had shortening of 2 centimetres.

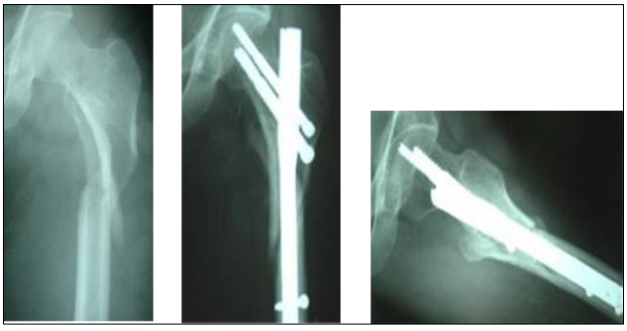

Figure 4: Showing preoperative and postoperative X-rays of a case.

Figure 5: X-ray and clinical pictures of same case as in Figure 4, showing him being able to stand and squat, at 14 weeks postoperatively.

Assessed according to the Harris hip scoring system (Modified),[14] outcome at final follow up was good to excellent in 82.9% cases, fair in 11.43% and poor in 5.71%, as depicted in Figure 6.

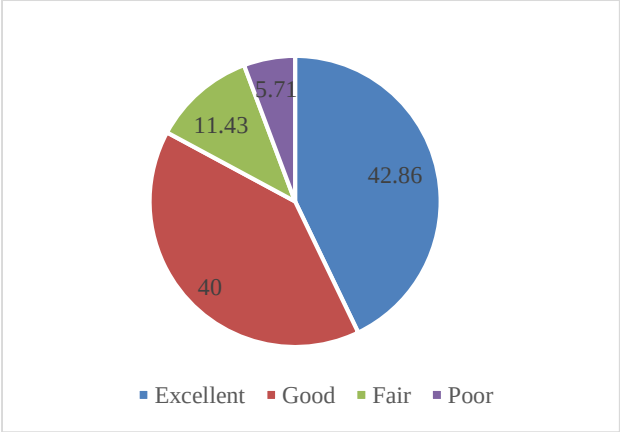

Figure 6: Showing functional outcome according to modified Harris hip score.

DISCUSSION

Unlike osteoporotic trochanteric fractures, sub trochanteric fractures are usually the result of high-energy trauma, are often significantly displaced; and pose great difficulty in closed reduction through traction. The high incidence of delayed union, mal union and non-union of these fractures has left conservative treatment of these fractures, as advocated by De Lee et al,[15] almost non-existent in present scenario. Closed intramedullary devices have a mechanical advantage that effectively addresses the peculiar anatomic and mechanical factors at play in these fractures. The deforming forces acting on the proximal femur (psoas, adductor, and gluteal muscles) create a characteristic fracture deformity pattern, pulling the short proximal fragment in flexion, abduction, and external rotation, which is difficult to reduce and then maintain during nail insertion.[16] The benefit of minimal surgical exposure, more efficient load transfer through calcar femorale and decreased tensile strain on the implant because of its shorter lever arm, makes proximal femoral nail a good choice of implant for these fractures.

This implant consists of a femoral nail, self-tapping 6.5 mm hip pin, self-tapping 8 mm femoral neck screw, 4.9 mm distal locking screws, and an end cap. Proximal femoral nail is made up of either 316L stainless steel or titanium alloy and comes in varying lengths and diameter. The nail is having 14 mm proximal diameter, which increases the stability of the implant. There is 6° medio lateral valgus angle, which prevents varus collapse of the fracture even when there is medial comminution. The distal diameter varies from 9 to 12 mm; and this part also has grooves to prevent stress concentration at the end of the nail and avoid fracture of the shaft distal to the nail. Proximally it has 2 holes; the distal one is for the insertion of 8 mm neck screw which acts as a sliding screw, the proximal one is for 6.5 mm hip pin which helps to prevent the rotation. Distally, this nail has two holes for insertion of 4.9 mm locking screws, of which one is static and the other is dynamic, allowing dynamization of 5 mm.

Wan et al. (2014) in their study of sub trochanteric fracture models with various types of internal fixation concluded that the stiffness ratio of PFN and its failure load were the highest as compared to other implants; and that PFN as well as PFLP (Proximal femoral locking plate) produced reliable stability in type IIIA sub trochanteric fractures while only PFN provided stability in type IV fractures.[17] Chakraborty and Thapa (2012) in their study on sub trochanteric fractures declared PFN as a reliable cephalo medullary implant which gave best fixation and excellent results. They say that eccentrically placed devices like plates were susceptible to breakage due to mechanical load shearing effect; and also lead to excessive soft tissue dissection, severe blood loss besides non-union and implant failure.[18]

In our series, fractures were classified according to the Seinsheimer's classification and type III A fracture pattern constituted the highest percentage, i.e. 32.5% of all fracture patterns. Seinsheimer,[4] in his original study, also noted a high incidence of type III A fracture pattern (38.29%) as compared to others. Intra operatively, in our study, fracture reduction was achieved by closed means in 90% of the patients. The result of the reduction was considered good in 95% of the patients. Poor reduction was noted in 5% of patients and this was associated with poor outcome. In the study by Schipper et al. (2004), reduction was good to acceptable in 96.2% of their patients and poor reduction was seen only in 2.9% of their patients.[19] Post operatively 1 patient (2.5%) in our study had superficial infection and this settled with parentral antibiotics for few days. We did not encounter any deep infections in our series. Cut out of hip screw was not noted in any of our patients. The average time for radiological union was 19 weeks in our study. 6% of patients in Schipper series had the problem of "cut out";

while superficial and deep infections were seen respectively in 4.1% and 2.5% of their patients. The average time to radiological union in their series was 16 weeks.[19]

Various studies have considered proximal femoral nail as an excellent minimally invasive implant for sub trochanteric fractures.[17-20] The final outcome was good to excellent in 82.9% and fair in 11.4% of our patients; and our results have been comparable with other such studies in the literature. Younger age group patients irrespective of their fracture pattern had excellent outcome in our series while most of the poor results were seen in the elderly age group. The mean Harris hip score was in our series was 85.7%, while Schipper et al. (2004) reported a mean Harris hip score of 77.6 in their series.[19]

CONCLUSION

From our study, we conclude that PFN is a reliable implant for sub trochanteric fractures, leading to high rate of bone union, minimal soft tissue damage and a good overall functional outcome. Intramedullary fixation has biological and biomechanical advantages but the procedure is technically demanding; needs gradual learning and great patience to make this method truly minimally invasive. The scope of this study could be further expanded to include a comparative outcome of PFN with other conventionally used intramedullary and extramedullary implants, in sub trochanteric fractures.

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Ethical approval: Not required

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