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Outcome of intertrochanteric fractures treated with proximal femoral nail: A prospective study

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ABSTRACT

Introduction: Intertrochanteric fractures are common in the elderly especially with the increase in the incidence of osteoporosis. Various studies have shown good results when treated with intramedullary devices such as the proximal femoral nail (PFN) while other studies have shown high rates of complications. **Aim:** To study the outcome of intertrochanteric fractures treated with proximal femoral nailing by using Kyle's criteria. **Materials and Methods:** The study involved fifty cases of intertrochanteric fractures of femur that were treated with PFN. Fractures were classified using Orthopaedic Trauma Association classification. Patients were followed up at 4 weeks, 3 months, and 6 months and results were evaluated using Kyle's criteria. **Results:** The study included fifty patients, 32 males and 18 females of age 38-94 years with an average of 57 years. Excellent and good results were found in 44 patients (88%). Intra- and post-operative complications were found in 12 patients (24%). **Conclusion:** Good fracture reduction is critical in the management intertrochanteric fractures with PFN. Proximal femoral nailing is an excellent treatment option for unstable intertrochanteric fractures.

Key words: Intertrochanteric fractures, Kyle's criteria, proximal femoral nail

INTRODUCTION

Intertrochanteric fractures are common in old age group.[1] These fractures are three to four times more common in elderly women, and the mechanism of injury is usually due to low energy trauma like simple fall or due to road traffic accidents. These fractures unite readily with conservative treatment, but with the risk of complications such as malunion, coxa vara, medialization of shaft, and external rotation deformity resulting in shortening of limb and limp.[2] The primary goal of the treatment has to be early mobilization to avoid secondary complications. Various operative procedures with different implants have been described for the treatment of intertrochanteric fractures. Treatment options include dynamic hip screw (extramedullary fixation), gamma nail (intramedullary fixation), and proximal femoral nail (PFN) (intramedullary fixation).

The hip screw has been considered the device of choice but has been associated with complications such as collapse of the femoral neck, leading to loss of hip offset, and shortening of the leg. Although some such sliding is expected, too much shortening is detrimental to hip function. With this in mind, the PFN was designed in 1996 which gave an advantage

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of minimally invasive surgery.[3] Multiple studies have shown the superior stability of intertrochanteric fractures treated with PFN[4-6] while other studies have shown higher complication rates with PFN.[7-9]

We report our results of using PFN in the management of intertrochanteric fractures by analyzing the factors which influence the postoperative mobility using Kyle's criteria.[10]

MATERIALS AND METHODS

A total of fifty consecutive cases of intertrochanteric fractures which were treated with PFN were chosen for the study. The study period was for 3 years. Patients with fresh closed intertrochanteric fractures were included in the study while compound and pathological fractures were excluded. All patients were operated within 10 days of the occurrence of fracture.

Patients were examined and investigated with radiographs of pelvis. Skin traction was applied to the affected limb in all cases. Preoperatively, radiographs were reviewed again and fractures classified according to Orthopaedic Trauma Association (OTA) classification. Neck-shaft angle and medullary size were assessed. The reduction was achieved primarily by traction and internal rotation, and adduction or abduction as required. If reduction was not achieved by traction and manipulation, nail reduction was done where the nail was introduced in the proximal fragment and reduction was achieved by rotational movements and compression by the nail. If this failed, reduction was achieved by limited open reduction at the fracture site. Reduction was confirmed under an image intensifier.

The PFN we used had a standard configuration with a length of 250 mm, mediolateral angulation of 6° and a neck-shaft angle of 135°. The nail had a proximal diameter of 14 mm and distal diameter of 10, 11, and 12. We used a proximal derotation screw of 6.4 mm and distal lag screw of 8 mm. Distal locking was done with self-tapping 4.9 mm cortical screws, one of which were applied in static mode and the other in dynamic mode allowing 5 mm dynamization.

Postoperatively, the limb was elevated with a pillow. Intravenous antibiotics were given for first 48 h followed by oral antibiotics for the next 3 days. Static quadriceps exercises were started on the 4th postoperative day. Active quadriceps and hip flexion exercise were started on 6th and 7th postoperative day. Dressing was done on 2nd, 5th and 8th postoperative days. Sutures were removed on 12th postoperative day. Patients were advised to walk nonweight bearing with axillary crutches as soon as tolerable. Partial weight bearing was started at about 4 weeks postoperatively. Full weight bearing walking was allowed after assessing for the radiological and clinical union. The presence of callus radiologically and absence of tenderness was considered bony union. Patients were evaluated at 4 weeks, 12 weeks, and 24 weeks [Figure 1]. The patients were assessed using the Kyle's criteria[10] at the follow-ups.

RESULTS

This study involved fifty cases of intertrochanteric fractures of either sex above the age of 30. All cases were treated by intramedullary fixation with a PFN. The age distribution was from 38 to 94 years (average 57 years). The largest group of patients was from 51 to 60 years. There were 32 males (64%) and 18 females (36%) in the study.

Thirty-three patients (66%) sustained the fracture due to a fall and 17 patients (34%) due to road traffic accident. Most of the patients who sustained the fracture due to fall were older in age and had osteoporosis.

All the fractures were classified as per OTA classification [Table 1]. Fracture pattern, 31A1 was considered stable and 31A2 and 31A3, unstable fractures. In our study, 19 patients (38%) suffered from fracture pattern 31A1, twenty patients (40%) suffered from 31A2 and 11 patients (22%) from 31A3. Average operating time was 65 min (32–95 min) after anesthesia. Closed reduction was achieved in 44 patients (88%) whereas six patients (12%) required open reduction. The average hospital stay was 15.11 days. It was more in patients with co-morbid conditions and complications with highest being 22 days.

Figure 1: Immediate postoperative radiograph

We encountered complications and treatment failure in 11 (22%) patients [Table 2]. Early complications include inadequate reduction in one patient (2%), failure to put derotation screw in one patient (2%), difficulty in distal locking in one patients (2%), varus deformity in one patient (2%), superficial infection in two patients (4%), implant failure in two patients (4%), and z effect in one patient (2%). Other complications include shortening in one patient (2%) and malunion in one patient (2%). Breakage of nail and inadequate fixation were considered implant failure [Figures 2-4].

According to Kyle's criteria,[10] we had excellent results in 64% (32) of patients, good results in 24% (12) patients, fair results in 8% (4) patients, and poor results in 4% (2) of patients [Table 3]. Our results were comparable to similar studies done by Gadegone and Salphale[11] and Pavelka *et al*.[12]

DISCUSSION

The successful treatment of Intertrochanteric fractures with PFN depends on many factors such as the general health of the patient, time from fracture to treatment, adequacy, and stability of the fixation.

Dynamic hip screw is considered the gold standard for treatment due to its favorable results and low rate of complications when used in the management of stable

Table 1: Fractures classified according to Orthopaedic Trauma Association classification

Fracture pattern	Number of patients	Percentage
31A1 – stable	19	38
31A2 – unstable	20	40
31A3 – unstable/reverse oblique	11	22

Table 2: Complications

Complication	Number of patients	Percentage
Inadequate reduction	1	2
Failure to insert de-rotation screw	1	2
Difficulty in distal locking	1	2
Varus deformity	1	2
Shortening	1	2
Superficial infection	2	4
Implant failure	2	4
Z-effect	1	2
Malunion	1	2
Total	11	22

Table 3: Results according to Kyle's criteria

Results	Percentage
Excellent	64 (32)
Good	24 (12)
Fair	8 (4)
Poor	4 (2)

Figure 2: Complication, Z-effect

Figure 3: Complication, failure to insert distal screw

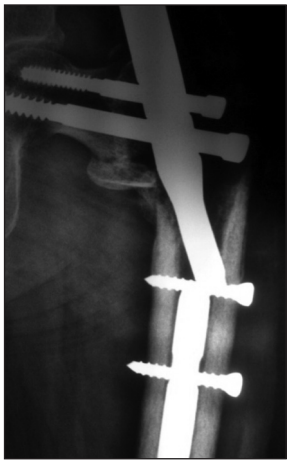

Figure 4: Complication, implant failure 2 months postoperatively

fractures.[13] Along with the requirement of a relatively larger exposure, more tissue trauma, it has been associated with intra- and posto-perative varus collapse especially when used in unstable and reverse oblique fractures, ultimately leading to medialization of the shaft and deformity.[14] In such cases, an intramedullary fixation with PFN can be advantageous. Intramedullary devices have been shown to be biologically stronger and can withstand higher static and several fold higher cyclical loading than dynamic hip screw.[15] A medial buttress provides adequate reduction in implant stress and fatigue.[16] PFN also acts as a buttress in preventing the medialization of the shaft. Moreover, thus, the fracture heals without the primary restoration of the medial support. The implant compensates for the function of the medial column.[12]

The nail's position near the weight bearing axis reduces the stress generated on the implant significantly. The entry point of the PFN is at the tip of the greater trochanter, so it reduces the damage to the hip abductors unlike the gamma nail which is inserted through the pyriformis fossa and with a derotation screw reduces the chances of cutout as compared to the gamma nail.[16-18] The hip screw and the anti-rotation cervical screw of the PFN adequately compress the fracture, leaving between them adequate bone block for further revision should the need arise.

The most common mode of injury in our study was low energy trauma due to fall (62%) in elderly. In the young age group, fracture was due to high energy trauma. In our study, 38% were stable fracture and 62% were unstable. Stable fractures required less radiation exposure than the unstable fractures. Most patients with low energy trauma had osteoporosis. The most common grade of osteoporosis was Singh's Grade 3. Our operating time reduced gradually during the study which reflected the steep learning curve of the proximal femoral nailing.

The anatomical reduction and secure fixation of the patient on the operating table are absolutely vital for easy handling and good surgical result. In our study, 12% of patients required limited open reduction which was higher in comparison to the study by Boldin *et al*. (9%).[19] The entry point of the nail was taken on the tip or the lateral part of the greater trochanter. As the nail has 6° of valgus angle medial entry point causes more distraction of the fracture. The hip pin was inserted 5 mm away from the subchondral bone in the lower half in the anteroposterior (AP) view and center on the neck in the lateral view. The cervical screw should be placed parallel to the hip screw in AP view, and they should overlap it in lateral view. Ideally, the cervical screw should be 10 mm shorter than the hip screw. This ensures that the cervical screw does not take the weight load but only fulfill the anti-rotational function. Failure to do this leads to "Z-effect," when the cervical pin backs out, and the hip pin pierces the joint or vice-versa. We observed this complication in one patient. The patient underwent revision surgery and the fracture healed. One patient (2%) had an implant breakage this has been addressed with a long PFN. There was no case of nonunion. The overall rate of complication was 22%. This is comparable to Gadegone and Salphale[11] it was slightly lower than their study. In the series of 295 patients with trochanteric fractures treated with PFN by Domingo *et al*.[20] the average age of the patient was 80 years, which possibly accounted for 27% of the patients developed complications in the immediate postoperative period. Although the higher price of PFN is a limiting factor as compared to dynamic hip screw, we believe that treatment of intertrochanteric fractures particularly of unstable pattern with PFN is a good and efficient treatment [Figure 5].

Figure 5: Range of movement at 6 month follow-up

CONCLUSION

Regardless of the fracture type, adequate fracture reduction is critical in the management of intertrochanteric fractures. Proximal femoral nailing following good anatomic reduction is an efficient and minimally invasive surgical treatment for intertrochanteric fractures particularly of unstable fracture patterns probably due to better axial telescoping and rotational stability.

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Conflicts of interest

There are no conflicts of interest.

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