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Original Research Article

Treatment of subtrochanteric fracture femur by open reduction and internal fixation by long proximal femoral nailing

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ABSTRACT

Background: Subtrochanteric fractures are devasting injuries that most commonly affect the elderly population and also in young.

Methods: This is a prospective study of 20 cases of subtrochanteric fracture admitted to KIMS, Huballi between November 2008 to August 2010 treated with left proximal femoral nail (LPFN) by open method. Cases were taken according to inclusion and exclusion criteria, i.e., fresh subtrochanteric fracture in adults. Pathologic fractures, multiple fractures, fractures in children, old neglected fractures were excluded from the study. Objectives of this study were to study subtrochanteric fractures and to determine effectiveness of LPFN in tretment of subtrochanteric fractures by open reduction and internal fixation (ORIF).

Results: In our study of 20 cases, there were 16 male and 4 female patients with age ranging from 17 years to 75 years with most patients in between 21-40 years. 65% of the cases admitted were road traffic accidents, 25% due to fall from height and 10% due to trivial fall with right side being more common side affected. Russell and Taylor type IA fracture accounted for 40% of cases. Mean duration of hospital stay was 24 days and mean time of full weight bearing was 14 weeks in our patients. Good to excellent results were seen in 85% of cases in our study.

Conclusions: Subtrochanteric fractures of femur can be successfully treated by ORIF by LPFN resulting in proper anatomical reduction and hence alignment and high rate of bone union.

Keywords: PFN, LPFN subtrochanteric fractures, Russell and Taylor

INTRODUCTION

Subtrochanteric fractures are femoral fractures where the fractures occur below the lesser trochanter to 5 cm distally in the shaft of femur.[1] These fractures occur typically at the junction between trabecular bone and cortical bone where the mechanical stress across the junction is highest in the femur, which is responsible for their frequent comminution. These fractures account for 10% to 34% of all hip fractures.[2]

These fractures occur typically in two age groups. In young and healthy individuals, the injury results from high-energy trauma, whereas in the elderly population. Most of the fractures are osteoporotic, resulting from a fall. With the increase in the aging population, there is also considerable growth in the number of pathological fractures and fractures around hip prostheses (periprosthetic fractures).

Subtrochanteric region is usually exposed to high stresses during activities of daily living. Axial loading forces through the hip joint create a large moment arm, with significant lateral tensile stresses and medial compressive loads. In addition to the bending forces, muscle forces at the hip also create torsional effects that lead to significant rotational shear forces. During normal activities of daily living, up to 6 times the body weight is transmitted across the subtrochanteric region of the femur.

As a result of these high forces, the bone in this region is a thick cortical bone with less vascularity and results in increased potential for healing disturbances. Hence subtrochanteric fracture is difficult to manage and associated with many complications.[3]

Closed management of these subtrochanteric fractures thus poses difficulties in obtaining and maintaining a reduction, making operative management the preferred treatment. The goal of operative treatment is restoration of normal length and angulation to restore adequate tension to the abductors.[3] The obvious advantages of operative treatment are it avoids complications of prolonged bed rest and hospitalization, it provides accurate reduction and anatomical alignment and early mobilizing and weight bearing, is possible with new implants and fixation technology.

The two primary options for treatment of subtrochanteric fractures are intramedullary fixation and extramedullary fixation.[3] Many internal fixation devices have been recommended, but because of high incidence of complications like nonunion and implant failure, a series of evolution in designing a perfect implant has begun. Only recently better understanding of biology, reduction techniques and biomechanically improved implants like Gamma nail, Russell Taylor nail, proximal femoral nail (PKN) allowed for these fractures to be addressed with consistent success. Hence this study was conducted to study subtrochanteric fractures and to determine effectiveness of LPFN in treatment of subtrochanteric fractures by ORIF.

METHODS

The present study consists of 20 adult patients with subtrochanteric fractures of femur who were treated with LPFN by ORIF at KIMS, Hubbali between November 2008 to August 2010. The fractures were classified according to Russell and Taylor classification. 20 cases were followed at regular intervals. This study was conducted with due emphasis for clinical observation and analysis of results after surgical management of subtrochanteric fractures of femur with long proximal femoral nail by ORIF.

Inclusion criteria

Patients with subtrochanteric fractures in adults, those who are unstable intertrochantaic fractures (reverse oblique fractures and intertrochanteric fractures with loss of postero-medial cortex).

Exclusion criteria

Patients with pathological fractures, fractures in children, old neglected fractures, pen prosthetic fractures, interochanteric fractures involving piriformis fossa, stable interochantaic fractures were excluded.

Data collection

After the patient with subtrochanteric fracture was admitted to hospital all the necessary clinical details were recorded in proforma prepared for this study. After the completion of the hospital treatment patients were discharged and called for follow up.

Management of patient

As soon as the patient with suspected subtrochanteric fracture was seen, necessary clinical and radiological evaluation was done and admitted to ward after necessary resuscitation and splintage with skeletal traction.

The following investigations were done routinely on all these patients pre-operatively. Blood test which includes haemoglobin percentage (Hb%), bleeding time, clotting time, blood grouping and cross matching, fasting and post prandial blood sugar, blood urea and serum creatinine. Urine test which includes albumin, sugar, microscopic examination were done and X-ray of pelvis with both hips AP view, chest X-ray and PA view in necessary patients.

All the patients were evaluated for associated medical problems and were referred to respective department and treated accordingly. Associated injuries were evaluated and treated simultaneously. The patients were operated on selective basis after overcoming the avoidable anaesthetic risks.

Pre-operative planning proximal femoral nail

Determination of nail diameter

Nail diameter was determined by measuring diameter of the femur at the level of isthmus on an anteroposterior (AP) X-ray.

Determination of the neck shaft angle

Neck shaft angle was measured in unaffected side in AP X-ray using goniometer.

Length of the Rii1

A standard length PFN (250 mm) was used in all our cases except one case for which long PFN was used

Long proximal femoral nail

The implant consists of long PFN, self-tapping 6.5 mm pin, self-tapping one 1 mm femoral neck screw. 4.9 mm distal locking screw and an end cap. LPFN is made up of either 316 l stainless steel or titanium alloy. The nail is having 17 mm proximal diameter. This increases the stability of the implant.

In our study we used the LPFN of suitable lengths with distal diameter of 9, 10, 11 and 12. The proximal diameter of the nail is 17 mm. Proximal derotation screw of 6.5 mm and distal lag screw of 1 mm. Distal locking is done with self-tapping 4.9 mm bolts, one in static mode and the other in dynamic mode allowing 10 mm dynamization. The nail is universal with 6° of mediolateral valgus angulation and with neck shaft angle of 135°. End cap was not used.

Operative technique

The patient is placed in supine position on fracture table with adduction of the affected limb by 10-15 degrees and closed reduction of the fracture was done by the traction and internal rotation. The unaffected leg is flexed and abducted as far as possible or kept in wide abduction. The image intensifier was positioned so that anterior-posterior and lateral views of hip and femur could be taken.

The patient is then prepared and draped as for any standard hip fracture fixation. Prophylactic antibiotic is given in all patients 30 mins before surgery. Open reduction is performed.

Approach

The tip of greater tronchanter was located by palpation in thin patients and in obese patients, we used image intensifier. About 15 cms longitudinal incision was taken centering over the greater trochanter. A parallel incision was made in fascia lata and gluteus medius was split in line with the fibers. Vastus lateralis was split in line of incision. Tip of greater tronchanter is exposed.

Clamp assisted reduction

Once vastus lateralis was split, underlying bone was exposed and fracture site was visualised. Both fragments were held with bone holding clamps to achieve anatomical reduction.

Determination of entry point and insertion of guide wire

In AP view on C-arm, the entry point is on tip or slightly lateral to the tip of greater tronchanter. In lateral view, guide wire position is confirmed in the center of the medullary cavity. Medullary canal entered with a curved bone all, the guide wire is inserted into the medullary canal.

Reaming

Using a cannulated conical reamer proximal femur is reamed for a distance of 4; about 7 cms. Distal femur is reamed with successive no of reamers depending on the calculated nail diameter.

Insertion of LPFN

After confirming satisfactory fracture reduction, an appropriate size nail as determined preoperatively is assembled to insertion handle and inserted manually. This step is done carefully without hammering by slight twisting movements of the hand until the hole for 8mm screw is at the level of inferior margin of the neck.

Insertion of the guide wire for neck screw and hip pin

These are inserted with the help of aiming device lightly screwed to the insertion handle. A 2.8 mm guide wire is inserted through the drill sleeve. This guide wire is inserted 5 min deeper than the planned screw size. The final position of the guide wire should be in the lower half of the neck in AP view and in the center of the neck in lateral view.

A second 2.8 mm guide wire is inserted through the drill sleeve above the first one for hip pin. The tip of this guide wire should be approximately 25-20 mm less deep than planned neck screw.

Insertion of the neck screw and hip pin

Drilling is done over 2.8 mm guide wire until the drill is 8 mm short of tip of the guide wire. Tapping is not done as neck screw is self-tapping. Neck screw is inserted using cannulated screw driver. Similarly appropriate length hip pin is inserted. Length and position of the screw is confirmed with c-arm image

Distal locking

Distal locking is usually performed with two distal bolts. Locking is done with free hand technique by making drill hole using 4mm drill bit. Locking screw is inserted and position confirmed with image intensifier.

Closure

After fixation is over, lavage is given using normal saline and incision is closed in layers. Suction drain is used in case open reduction is performed. Sterile dressing applied over wound and compression bandage given.

Data was analysed using microsoft excel and presented in number and percentages.

RESULTS

The following observations were made from the data collected during the study of 20 cases of subtrochanteric fractures treated by LPFN by open method in the Department of Orthopaedics in K1MS, Hubbali between November 2008 to August 2010.

In our study maximum age was 75 years and minimum age was 17 years. Most of the patients were between 21-40 years. Mean age was 37.53 years. The no of male patients in our series were 16 and female were 4. The most common mode of injury in our series were road traffic accidents accounting for 13 cases , followed by fall from height in 5 cases and trivial fall in 2 cases (Table 1).

Table 1: Age distribution.

Age group (years)	Frequency	%
1-20	3	15
21-40	10	50
41-60	4	20
61-80	3	15
Total	20	100.0

The 20 subtrochanteric fractures in our study were classified according to Russell and Taylor classification. In our study we had 8 cases of IA, 7 cases of IB and 5 cases of IIA Russell and Taylor classification (Table 2).

Table 2: Classification of subtrochanteric fracture.

Russell-Taylor classification	Frquency	%
IA	8	40
IB	7	35
HA	5	5
JIB	0	0
Total	20	100

All the cases included in our study group were fresh fractures who underwent surgery at the earliest possible in our set up. The delay was due to associated injuries and medical condition of the patient. All the patients were operated at an average interval of 10.6 days from the day of trauma

Intraoperative details: all the patients' intraoperative details were noted in the terms of the duration of surgery, ease of reduction, complications, radiation exposure and amount of blood loss. Duration of surgery was longer in the initial operated cases. With frequent use of the proximal femoral nail system the duration has come down. Duration was longer in managing subtrochanteric fractures type IIA due to the difficulty in achieving anatomical reduction and difficulty in identifying the entry point. Reduction was easier in type IA subtrochanteric fractures (Table 3).

Table 3: Intraoperative details.

Mean duration of Surgery (min)	105
Reduction (min)	
Easy	15
Difficult	5
Mean blood loss (m1)	300
Mean duration of radiation (sec)	140

Radiation exposure was high in the initial cases due to lack of experience. Radiographic exposure was more for comminuted fractures with difficult reduction. The average duration of radiation exposure was 140 seconds.

Amount of blood loss was comparable as for an average hip surgery. Blood loss was measured in terms of mop count and suction collection. The average amount of blood loss was 300 ml. There was more blood loss as open reduction was performed.

Neck screw size used: in our study most commonly we used 75 mm neck screw for 10 patients and 70 mm neck screw for 5 patients.

Anatomical results were assessed on 20 patients available for follow up by presence or absence of shortening, varus deformities and range of movements in hip and knee joints. 80% of the cases had good results and 20% had fair results (Table 4).

Table 4: Anatomical results.

Results-anatomical	Frequency	%
Restriction of hip ROM	3	15
Shortening >l cm	1	5
Varus deformity	0	0
Good	16	80
Total	20	100

Functional results were assessed in the 20 cases available for follow up by Harris Hip scoring system and the Harris Hip Score of each patient were given in Master chart. Excellent results were noted in 9 cases, good in 7 cases, fair in 3 cases and poor in 1 case (Table 5).

Table 5: Functional results.

Results	Frequency	%
Excellent	9	45
Good	7	35
Fair	3	15
Poor	1	5
Total	20	100

DISCUSSION

Unlike osteoporotic trochanteric fractures, subtrochanteric fractures are usually the result of high-energy trauma and often subjected to significant displacement and great difficulty in close reduction through traction. The high incidence of delayed union, malunion and non-union of fractures has left conservative treatment, as advocated by De Lee et al, abolished in modern trauma care.[4]

Extra medullary fixation with plating has the potential disadvantages of extensive surgical exposure, severe soft tissue damage and blood loss, thus leading to problems of fracture union and implant failure. In addition, the eccentrically plating is prone to fatigue breakage due to their mechanical load-sharing effect.

Allowing a minimally open approach, intramedullary nailing is closely linked to -biological internal. fixation, in addition to its mechanical benefits over plate fixation. Intramedullary fixation allows the surgeon to minimize soft tissue dissection thereby reducing surgical trauma, blood loss, infection, and wound complications.[5]

A laboratory study comparing a locked gamma nail to a standard sliding hip screw for the fixation of stable and unstable subtrochanteric fractures showed that the intramedullary nail was more rigid and permitted less fracture displacement and concluded that intramedullary fixation was superior to extramedullary fixation. The currently used Gamma nail as an intramedullary device also has a high learning, curve with technical and mechanical failure rates of about 10% (collapse of the fracture area, cut-out of the implant, fracture of the femur shaft). The Gamma nail is susceptible to fail at its weakest point, the lag screw —implant interface.[6]

The AO ASIF (Association for osteosynthesis/ Association for the Study of Internal Fixation) in 1996, therefore developed the PFN to reduce the risk of implant related complications. Therefore in addition to the 8 mm load bearing femoral neck screw, the PFN has a 6.5 mm antirotation screw to increase the rotational stability of the neck fragment. An anatomic 6° neck valgus bend in the coronal plane, a narrower distal diameter and distal flexibility of the nail eliminates the need for routine' reaming of the femoral shaft and also minimizes stress concentration and tension in the femoral shaft. This should reduce the risk of intraoperative and postoperative femoral shaft fractures.

In an experimental study compared the loadability of osteosynthesis of unstable per and subtrochanteric fractures and found that the PFN could bear the highest loads of all devices.[7] Since its introduction in 1997 several clinical studies have shown good result with few intra operative problems and low rates of complications.

The aim of our study was to assess the epidemiology and functional outcomes of subtrochanteric fractures with this newer method of intramedullary fixation with long proximal femoral nail by ORIF. We assessed the results with respect to intraoperative details, post-operative results and functional outcome.

In 2002, Schipper et al in their study on biomechanical evaluation of PFN also concluded that if the hole through the nail of the hip pin was modified to a slot there is signific ant reduction of axial loads on hip pin thereby reducing the cut out risk.[8]

The most recent study evaluating the use of PFN is from Fogagnolo et al, who reported 46 patients with an average rate of intraoperative technical or mechanical complications of 23.4%. They also reported 2 implant failures and 1 fracture below the tip of the nail.[9]

CONCLUSION

From our study we conclude that LPFN is a reliable implant for subtrochanteric fractures, leading to high rate of bone union restoring the anatomical alignment and reduced chance of implant failure or deformties. Intramedullary fixation has biological and biomechanical advantages, but the operation is technically demanding. Gradual learning and great patience is needed in order to make this method truly successful.

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