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Ender's nailing in intertrochanteric femur fracture

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Abstract

Intramedullary ender nailing in intertrochanteric fractures was very popular in the past. Although it has advantages like short operative procedure, minimally traumatic, little blood loss, early mobilization, negligible risk of infection and risk of delayed union or non-union is also reduced. However other complications such as irritation at the knee, decreased range of knee motion, distal and proximal migration of nail are still present in some cases. The osteoporosis is considered as a significant factor contributing to complications. External rotation deformity has not been a major problem in the present study and improved by using nails with ante version bend. All intertrochanteric fractures healed within 3 months which represent favorable results in comparison with other method.

Keywords: Ender's nail, Intertrochanteric femur fracture, osteoporosis

Introduction

The complication of nail plate fixation of intertrochanteric fractures of the femur- early postoperative mortality, delayed union and non-union of the fracture, wound infection and osteomyelitis, persistent pain in hip, diminished walking capacity, and ultimately the need for additional surgery on hip-have been well known ^[1]. Failure of fixation with nail-plate devices have been defined as penetration of nail into acetabulum, cutting out of nail, bending or breaking of nail-plate, and separation of plate from femoral cortex after breakage or loosening of screws. These complications tend to occurs if fracture fixed in unstable position ^[2, 3]. Additionally degree of osteoporosis in proximal part of femur plays role. Other causes of failure and complication of nail-plate fixation are due to errors in selection of implant, their appropriate length and their insertion in proper position in the femoral neck and head. As well as inadequacy of reduction of the fracture ^[4].

Introduction of Ender nail inserted with a condylocephalic intramedullary technique in the treatment of intertrochanteric fractures has strongly affected the complications, but irritation at the knee, decreased range of knee motion, distal and proximal migration of nail and Supracondylar fracture and cortical infarction at the site of insertion of the nail are some new complications. With ender technique, fatigue failure of the device and osteomyelitis as complication of treatment of the fracture are virtually eliminated.⁵ The present study of Ender nailing of intertrochanteric fractures was undertaken to assess the over-all results, in particular as regards complication, failures, and the types of technical errors encountered with Ender nailing.

Materials and Method

This was a prospective study including 30 cases of intertrochanteric femur fractures which was conducted in Krishna Institute of Medical Sciences, Karad, Satara between 2015 and 2018.

The fractures were classified according to their relationship with lesser trochanter. Stable and unstable types were also designated, essentially being two part or three part or four part fractures respectively. The fractures were classified according to same scheme as femoral shaft fractures, as proposed by Pankovich *et al.* ^[1] simple and short oblique fracture (which were stable postoperatively) ^[2] long oblique or long spiral fracture (which were potentially unstable due to tendency of the fragments to slide and which often require cerclage) ^[3] fracture that had single butterfly fragment or comminution on only one side (these are unicortical comminution

and usually stable after nailing although some settling due to overriding of the fragment could occur. Particularly if medullary canal is not fully stacked with nails) [4] fractures in which there was comminution of the entire circumference of the cortex, potentially very unstable fractures and often require cerclage wiring and careful follow up because of possible shortening.

Roentgenographic grading of osteoporosis of the proximal end of femur by the method of Singh *et al.* was used whenever possible. Grade 1 was the most severe, in grade 6, 5 and 4, the principal tensile trabeculae were present but progressively decreased in thickness. They were discontinuous or missing in grade 3, 2 and 1.

Technique of Ender's Nailing

Patient shifted to operation theatre. After the patient was positioned on the fracture table, the fracture was reduced under C Arm and table was locked. Procedure was performed

under all aseptic precautions. Procedure was performed under spinal or general anesthesia.

In most intertrochanteric fractures over reduction in internal rotation was considered desirable and was accomplished by positioning patella 20 to 30 degrees internally from middle position. If cerclage was needed, always done before inserting the nail.

Nailing usually was performed from medial side. A longitudinal incision made 3-4 cm from the proximal adductor tubercle, the muscles were bluntly separated, bone holding clamp was applied and the window was opened in the bone using the awl. Size of ender nail is determined by keeping it over drapes under C-Arm. For stable intertrochanteric fracture the proximal tip of the inserted nail should reach up to within 1 cm of the subchondral plate of the femoral head. For unstable fracture, in which sliding of the fragments might be expected, the tip of the selected nail should reach up to center of the femoral head.



Fig 1: Intra-operative images of nail insertion

The first pair of nails to be inserted were bent at the tip, not only to enable them to negotiate the curve of the femoral calcar but also to place their tips inferior to those of subsequent nails so as to spread out the nails in the femoral head and trochanter. The distal 1/3rd shaft is held with bone holding forceps to prevent complication such as an iatrogenic supracondylar femur fracture. The second or subsequent nails were only slightly bent and were aimed to the centre and proximal part of the femoral head. The nails used were bent 10-15 degrees 5-6 centimeter distal to the tip, in order to

increase the rotational stability of the assembly. All the nails are tied with cerclage wire through the eyeholes with SS wire at the base to prevent backing out.

Traction was released after one or two nails had crossed the fracture site.

Postoperatively, the patients were given derotation boot or cast for a period of 15 days to prevent rotation. Patient was allowed to sit up in the bed immediately. Knee mobilization was started after 2 weeks. Partial Weight bearing was started after 4 weeks post operatively.

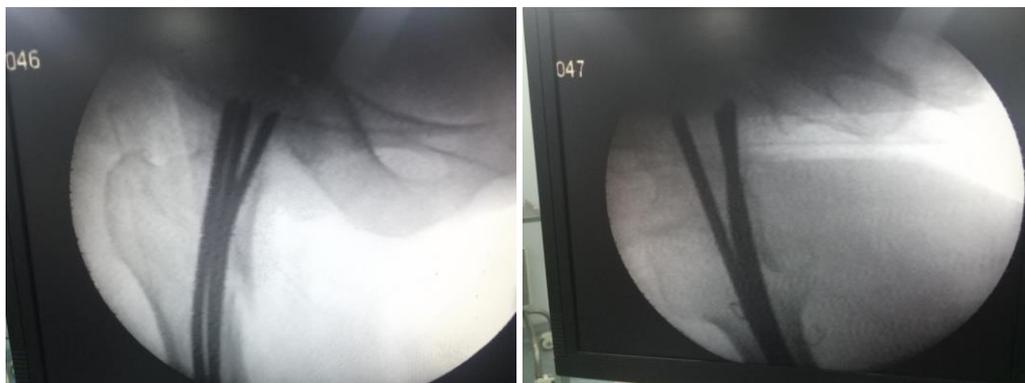


Fig 2: C- ARM Pics

Results

The patients with intertrochanteric femur fracture, 30 in total out of which 15 were male and 15 were female with ages ranged from sixty to ninety years were included in the study.

The average delay from injury to nailing was 5 days, and the average hospital stay was 17 days. The estimated average

operative blood loss was 30 ml, and 200 milliliters of packed red cells, on average, was given to patients with a low hematocrit, regardless of the amount of intraoperative blood loss in stable intertrochanteric fractures the average operative time was fifty minutes. The median time was 1 hour.



Fig 3: Post-operative follow up



Fig 4: Complication - Medial nail prominence

Complication and mortality: All the patients with intertrochanteric femur fracture operated with Ender nailing have been united without any major complications such as early postoperative mortality, delayed union and non-union of the fracture, wound infection and osteomyelitis, persistent pain in hip, diminished walking capacity, distal or proximal migration of nail, Supracondylar fracture femur, femoral neck fracture, and various position of head in relation to the neck. Patients were followed for from every month up to 12 month post operatively with an average of 8.5 months. All the patients healed within three months.



Fig 5: Post-operative x-ray (1 year)

Discussion

It is generally well known that posteromedial cortical instability and osteoporosis increase the failure rate of fixation of intertrochanteric and subtrochanteric fractures, and this knowledge has led to the development of various kinds of treatment. One such treatment is osteotomy of the greater trochanter and medial displacement of the distal fragment of the fractured femur. Other treatments involve specialized nails designed with the purpose of either diminishing the stress at the fracture site or making the nail strong enough to sustain that stress until the fracture is healed. Pankovich *et al.* used the term *dynamic controlled motion* to describe the favorable extent of motion of fracture fragments fixed with Ender nails [6].

As for the number of Ender nails, we chose to use 3 nails with an anteversion as opposed to the 4-5 Ender nails recommended to fill the medullary cavity completely. In the Ender nail surgery performed in our previous studies, we observed that while the first of the nails were sent to the femoral neck with no problem, the sending of the 4th and 5th nails became more difficult. To undo perforation that may occur along the fracture of the femoral neck, Waddell [7] suggested that the nails be pulled back and redirected for better assessment. Unfortunately, this prolongs the operation and the duration of X-ray exposure. Moreover, the bone window in the femoral supracondylar area must naturally be opened wider. In the operations we performed using the classic method of filling the medullary cavity completely with Ender nails, we observed that in most cases, additional fissures occurred in the bone window. As a result, one may encounter unexpected complications, including the loss of stability, distal migration of the nails, or an additional supracondylar fracture due to the fissures in the femoral supracondylar region. These potential results contraindicated our expectations of more stability.

In our study, we were able to send Ender nails to the medullary cavity more rapidly by opening a hole in the bone with an awl instead of window, and by making a 3-4 cm mini-incision in the femoral supra-condylar area. Moving along the fracture line in an intramedullary direction, the nails adapt easily to the anteversion angle because they are so few in number in the femoral neck, and because they are flexible, as Pankovich [8] stated.

We prefer Ender nails as fixation materials in our technique, as they utilize the biomechanical advantages of the nails, thereby resulting in a more rapid treatment process. Because

Ender nails are flexible, their proximal tips are anatomically suited to the arch shaped structure in the proximal femur; this ability is unmatched by other methods. As Ender nails perform with a three-point principle, reduction and assessment occur more often in the valgus. Furthermore, it was found in Pauwell's biomechanical studies [9] of the hip that flexing momentum is the highest in the subtrochanteric area, where the compound force from the femoral proximal in a healthy hip while standing or walking intersects with the long axis of the femoral shaft in this area. These measures show that in plate screw systems such as the Dynamic Hip Screw, the level of the flexing force becomes elongated, while in intramedullary nails such as Ender nails, the lever shortens. Despite their advantages, the rotational stability of Ender nails is weak. Because the external rotator muscles of the hip force the hip into an external rotation motion, particularly in unstable fractures, we neutralized it by using Derotation brace.

Rigid plate screws, however, caused complications, including delayed union and non-union, wound infections and implant failure. In addition to bone fragments being devascularized, healing by callus formation is slow in the open reduction with DHS. Postoperative varus collapse, limb shortening and medial displacement of the distal fragment, as critical complications, were reported with DHS, which is one of the most widely used techniques for intertrochanteric fractures. Furthermore, plate fracture secondary to failure in a bending mode may occur. Intramedullary nails have a biomechanical advantage over DHS due to the fixation device within the medullary canal and also as it is load sharing. The bending strength is considerably less than with DHS. Therefore, the use of long intramedullary nails that end at the supracondylar region of the femur has been advocated.

It is quite clear from the present study that the rate of complications was higher in unstable intertrochanteric fractures than in stable fractures. In unstable fractures it was more difficult to insert the nails properly across the fracture site and into the femoral head, and consequently the operative time was usually longer. More postoperative complications, in particular proximal and distal migration of nails and failure of fixation, were evident. Functional results were clearly better in the stable fractures than in the unstable fractures.

In this study we confirmed that there is a high rate of complications in intertrochanteric fractures in osteoporotic bones. Erroneous driving of the distal end of the nails into the medullary cavity usually resulted in extended operative time, required for nail retrieval. Cortical infarctions and longitudinal cortical fractures at the portals were commonly produced, particularly in osteoporotic bone. Anterior placement of the portal holes and consequent protruding of nail ends contributed to discomfort in knee. Most of these problems could have been avoided by careful technique. An unavoidable and common difficulty was in passing the nails across the fracture site and properly positioning them in the femoral head, particularly in unstable intertrochanteric fractures. This difficulty usually contributed to longer operative times.

In Ender nailing of intertrochanteric fractures, the nails are subject to minimum bending stress due to their central position within bone. Therefore fatigue fracture is unlikely to occur.

Theoretically delayed union and non-union are unlikely to occur after ender nailing because the nails provide some pistoning of the fracture fragments and to some degree rotational and bending motion. Pistoning of the fragments

however responsible for migration and penetration of nails into the hip joint, possibly some fragments were nailed in a distracted position [13].

Fracture of femoral neck can happen if nails were not placed in a fan shaped manner and were too short and straight and the femoral canal was not well stacked. There are variation in the regimens of postoperative management of intertrochanteric fractures and ambulation, according to method of fixation used. The regimen may range from extended non weight bearing to immediate full weight bearing. In the present study, patients given derotation boot for four weeks, started the knee range of motion at two weeks and partial weight bearing at six weeks postoperatively.

The patients with unstable intertrochanteric fractures, were able to walk only with a walker and needed weeks. These results regards functional rehabilitation are better than other studies where devices other than Ender nails were used. Jones *et al.* noted that in 1/3rd of their patients an external rotation deformity developed following Ender nailing. They explained the deformity as a result of rotation of fracture fragments relative to each other. The ender nails were curve in one plane only, and were inserted in femoral head while the distal fragment are held in some internal rotation, but during reduction of the fractures the neck loses all anteversion. Waddell and Czitrom made an anteversion bend at tip of nail and found that detail of technique effective in controlling external rotation. Complication and failures after ender nailing still are relatively frequent. In order to keep them at a minimum, Ender emphasized that careful selection of nails of appropriate length is of the greatest importance. The nails have to be just long enough so that their tips reach the subchondral bone in the femoral head. Fan shaped placement of the nails in the femoral head is also important so are stacking the nails in the femoral canal in order to prevent their proximal and distal migration, accurate placement of the portal holes, and proper positioning of the distal end of each nail.

Conclusions

The data from our study are not in agreement with Enders emphasis that subchondral placement of all the tips of nails always is essential. Our study shows that the tips of the nails should reach various depth in the femoral head according to the fracture type and the anticipated degree of settling of the fracture fragments.

It appears from the present study that there are four main advantages of ender nailing method. Short operative procedure, minimally traumatic, little blood loss, early mobilization, negligible risk of infection and risk of delayed union or non-union is also reduced.

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