Outcome of Proximal Femoral Nailing in unstable trochanteric fractures

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Abstract: The incidence of intertrochanteric fractures of the femur has been increasing in the recent years and the treatment of these fractures pose a challenge, due to their unstable nature. Surgical management of these unstable fractures is primarily aimed at restoring functional status of the patient and achieve good ambulation. A variety of treatments are available which can be done with either intramedullary or extramedullary devices with variable results. Here, we present the results of a prospective study conducted on about fourteen patients who presented with an unstable pattern of trochanteric fracture during a study period of 15 months and were treated with an intramedullary proximal femoral nail of size 250mm fixed with 2 proximal lag screws. Results were evaluated on the basis of quality of anatomical reduction radiologically, the operating time, the postoperative complications and functional outcome of patients based on Harris hip score and Barthel activity score after surgery. Intramedullary nailing with PFN appears to provide a very good option in the treatment of unstable intertrochanteric fractures.

Keywords: Proximal Femoral Nailing, Unstable Intertrochanteric Fractures, PFN, Cephalomedullary Nail, Hip Fracture

INTRODUCTION

The rising incidence of intertrochanteric femoral fractures can be attributed 90% to increasing osteoporosis in the elderly - 4 times more common in females and pathological fractures even in minor trivial injuries and 10% to increasing road traffic accidents in the young. Hip fractures are increasing so much in the world that it is expected to reach a number of 5,12,000 by the year 2040 [1].

According to AO/ Orthopaedic Trauma Association classification system, trochanteric fractures of the femur are classified as AO/OTA 31-A [2]. A1 fractures include simple two-part fractures where the oblique fracture line extends from the greater trochanter to medial cortex while the lateral cortex remains intact. A2 fractures have a comminuted fragment postero-medially while the lateral cortex remains intact. These are unstable generally depending on the size of the medial fragment. A3 fractures include both reverse oblique and transverse patterns of fracture where the fracture line extends across both medial and lateral cortices. Fractures A2.2 to A3.3 are generally unstable.

Non-operative conservative management of these fractures have disadvantages like need for prolonged bed rest, decubitus ulcers, urinary tract and respiratory tract infections, DVT and thromboembolic complications apart from joint contactures, varus and external rotation deformity and limb shortening.

Current surgical treatment options includes mainly two types of implants, extramedullary implant - dynamic hip screw(DHS) and intramedullary implants - Gamma nail and Proximal femoral nail(PFN). The Dynamic hip screw performed less well and has been associated with greater failure rates due to complications such as collapse of the femoral neck and leg shortening and this has been reported as unsuitable for treating intertrochanteric fractures[3-5].

There are studies which cite a better stability of the fractures being treated with proximal femoral nail [6,7], although some show higher complication rates [8,9]. Here, we present the results of unstable intertrochanteric fractures of the femur treated with proximal femoral nail fixed with two lag screws, which were evaluated on the basis of the anatomical reduction, quality, operating time, postoperative complications and the functional outcome of these patients.
MATERIALS AND METHODS
From June 2016 to Aug 2017, we have selected 14 patients with AO/OTA 31 a fractures of unstable type were selected for this prospective study. All the patients were treated with Proximal femoral nail and came for regular followup. The age group of our patients varied from 4 years (Figure 3) - 60 yrs. The mean follow up of our patients was of 6 months duration. Of the 14 patients, 9 were male and 5 were female patients. Right hip was involved in 8 patients and left in 6 patients.

Fractures of AO/OTA 31 A2.2 to A3.3 were included in the study. The mode of injury was road traffic accident in 9 and accidental fall in 5 patients. The average time interval between time of injury and surgery was 5 days. Initially the patients were managed by skeletal traction until surgery was taken up. Preoperative templating with anteroposterior view of the injured hip was done to determine the nail diameter and lag screw length. Surgery was done with the patient in supine position on the traction table, with the help of image intensifier, under subarachnoid block. Closed reduction initially with alignment of the medial cortex was done.

A 5 cm incision extending proximally from the tip of the greater trochanter was made. Abductor muscles were carefully separated. The entry point is at the tip of the greater trochanter, made with C-arm guidance. The guide wire is inserted using a tissue protector and position checked in anteroposterior and lateral views. Entry point reamed using 15 mm entry point reamer. The proximal femoral nail is inserted with the help of a jig over the guide wire. The nail along with the jig is inserted by gentle twisting movements by the hand. After the nail is positioned appropriately and checked with C-arm, the guide wire is removed and drill sleeves attached to the jig, which are pushed upto the lateral cortex through a stab incision over the lateral thigh – one each for compression screw and derotation screw. The guide pin passed into head and neck and was removed and lag screw length. For long PFN, distal locking is done with free hand technique. The average operating time was estimated as 55 mins. Blood loss during the procedure was between 150 to 300 ml.

Postoperatively, limb elevation was done using a pillow. Antibiotics were administered intravenously for first 2 days and orally for the next 3 days. Knee and hip mobilization was started on the first postoperative day. Patients were allowed partial weight bearing under guidance and sutures were removed on the 12th postoperative day.

The time taken for fracture healing was evaluated based on clinical and radiological criteria. Clinical union was observed as absence of tenderness/pain on full weight bearing. Radiological union was observed when bony consolidation was observed in 2 planes on the X-ray during follow-up. The patients were evaluated clinically and radiologically at 3 weeks intervals for the first 3 months and then monthly for the next three months. Harris hip score was evaluated at 6 months postoperatively based on parameters like pain, limping, sitting, deformities present/absent and range of motion. Z-effect or reversed Z-effect of the lag screws were taken as technical failures of the procedure.

RESULTS
The average operating time was estimated as 55 mins. Blood loss during the procedure was between 150 to 300 ml.

The average time of union was 13 weeks. Harris hip score at the end of 6 months was 84.3.

Two of the fourteen patients developed superficial wound infection, which settled down with antibiotics. No deep infection was noted.

The fractures healed well in all patients. No “Z” effect was noted, which is due to sliding of the screws and femoral head articular surface. Proximal locking with compression screw inferioiy is done first followed by derotation screw applied superiorly, whose length is determined pre- and per-operatively. Distal locking done with the aid of jig and 2 distal locking screws. For long PFN, distal locking is done with free hand technique. The average operating duration was 45 to 60 mins. Blood loss varied from 150 to 300 ml.

Short stainless steel PFN of 250mm length, proximal diameter 15 mm and distal diameters – 9,10,11 mm was used in all cases except one case, where long proximal femoral nail (Fig. 1(e)) was decided to be used to prevent the nail impinging against the anterior femoral cortex. The proximal nail has an angulation of six degrees to prevent varus collapse and allow for easy insertion of the nail. The derotation screw used was of 6.5 mm diameter and lag screw of 8 mm diameter. The distal locking screws of 4.9 mm were used.

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We encountered no intra-operative complications and no cortical hypertrophy was noted at the level of the tip of the implant during the radiological follow-up.
Fig-1(a): Preoperative anteroposterior view of right hip joint showing intertrochanteric fracture

Fig-1(b): Post operative anteroposterior view of right hip joint showing successful reduction

Fig-1(c): Postoperative anteroposterior view showing long proximal femoral nail
Fig-2(a): Preoperative anteroposterior view showing intertrochanteric fracture of left hip

Fig-2(b): Postoperative anteroposterior view of left hip showing successful reduction

Fig-3(a): Preopreative anteroposterior view of right hip joint showing intertrochanteric fracture in a 4 yr old child
Fig-3(b): Postoperative anteroposterior film of the child showing successful reduction and drain in situ

Fig-4(a): Preoperative anteroposterior view of the hip of a 50 year old patient showing comminuted intertrochanteric fracture of right femur – Boyd and Griffin type II

Fig-4(b): Postoperative Xray showing successful reduction of the fracture (AP view)
Fig-4(c): Closer view of the successful reduction in the patient postoperatively

Fig-5(a): Preoperative anteroposterior view of hip of a 42 year old female patient showing intertrochanteric fracture of the left hip – Boyd and Griffin type 3 and AO classification 31-A3
DISCUSSION

Intertrochanteric fractures are one of the most important causes leading to mortality and morbidity, especially in the elderly population. The treatment success of these trochanteric fractures depends on many factors such as age and health status of the patient, the time period from fracture to the treatment of the fracture, the treatment adequacy and stability of the fixation [10]. In unstable and reverse oblique patterns of fracture, use of dynamic hip screw leads to medialisation of the shaft and deformity, non union and implant failure[11] . The intramedullary PFN proves to be advantageous in such cases, it being biologically stronger with a shorter moment arm than DHS and can withstand higher loads of static and cyclical loading[12]. It also prevents medialisation of the shaft. The larger proximal diameter provides additional stiffness to the nail. Minimal blood loss, shorter operating time and early weight bearing are added advantages of PFN over DHS. In comparison, mechanical failure of DHS occurs in 10 - 20% of the cases due to cutting out of lag screw superiorly[13]. Full weight bearing is delayed in patients treated with DHS.

As per the Norwegian hip fracture registry which analysed the results of dynamic hip screw & Intramedullary nailing for the unstable patterns of trochanteric fractures, the number of re-surgeries needed for those treated with DHS was much higher and also these patients had more pain and decreased mobility comparatively which favours the use of Proximal femoral nail[14].

The intertrochanteric region of the hip is primarily characterized by dense trabecular bone which serves to transmit stress and distribute it similar to the cancellous bone of femoral neck. The femoral head and neck are antverted to an angle of 10⁰ - 15⁰ in relation to the plane of the shaft. The femoral shaft has an anterior bow and also a lateral bow. The greater and lesser trochanter are sites of insertion of major muscles like iliopsoas - flexor, gluteus medius and minimus - abductors and piriformis, obturator internus and externus and superior and inferior gemelli - external rotators of the hip joint. These muscles surrounding the hip contribute significantly to the fracture deformity. Also, these muscles being well vascularised, can lead to significant hemorrhage during injury/surgery. So , early hemodynamic and surgical stabilization of the patient is necessary to decrease the mortality and to reduce the complications[15,16].

As far as biomechanics of the proximal nail is concerned, the nail compensates for the medial column function and the fracture heals without any primary restoration of medial support [17]. Usage of two proximal lag screws provides a better control of the head fragment and decreases the cut-out of the head by preventing toggling of the head fragment [18]. In order to prevent varus collapse of the head, it is essential to place the inferior lag screw close to the inferior cortex of the femur neck as much as possible. Also both the derotation and lag screws need to be close to the central part of the neck[10].

Unlike the A1 and A2 fracture types, fracture impaction by axial loading doesn’t occur in A3 fractures, and the distal fragment gets displaced medially due to the unstable nature of the fracture [19]. In a randomized prospective trial, by Sadowski et al. [20], conducted on patients with a reverse obliquity or transverse pattern of trochanteric fracture, managed with either a 95 degree screw-plate or an intramedullary nail, a greater failure was noted for those fixed with the plate-screw implant (7 out of 19 patients) but only one patient of the Cephalomedullary nailing category had experienced a failure.

The smaller diameter of the distal shaft and fluting of the nail tip help in protecting against fractures of the shaft of femur. There exists negligible stress on

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the implant because the PFN is positioned close to the weight bearing axis of the body. The entry point of the PFN has a disadvantage as it is through the greater trochanter and can lead to injury to the hip abductors. Yet, on the whole, soft tissue injury with PFN use is much lesser and this helps in early restoration of physical activity.

Femoral fractures can occur preoperatively and postoperatively with the use of Proximal Femoral nail. The reason may be implicated to many factors including the implant design and the technique used. These complications can be overcome by reducing the curvature and diameter of the implant, adequately reaming the femoral canal, implant insertion by hand and proper careful placement of the distal locking screws[21]. Those patients with a narrow femoral canal and with abnormal curvature of the femur can be regarded as contraindications to Proximal femoral nail. We had been cautious in these respects and hence, did not experience any preoperative or postoperative fracture of shaft of femur. Limitations of our study are a short follow-up period & no control group.

The outcome does not differ significantly as far as use of short or long PFN is concerned. The short PFN, of 250 mm length, is preferred for more proximally placed fractures and long PFN for the more distal ones. In patients with subtrochanteric fractures, either short or long PFN can be used based on the patient[22].

Thus, the Proximal Femoral nail has distinct advantages over the DHS, provided proper and adequate surgical technique is employed.

CONCLUSION

Cephalomedullary nailing with the PFN has many advantages in the fixation of unstable trochanteric fractures like shorter operating time, lesser blood loss and better and early functional recovery. Early mobilization in these patients decreases incidence of bedsores, thromboembolic complications and hypostatic pneumonia.

Complications like injury to the abductor tendon which can lead to abductor lurch and the incidence of preoperative and postoperative complications can be reduced by proper planning preoperatively, correct and careful surgical technique, adequate reaming of the femoral canal, hand insertion of the implant and meticulous placement of the distal locking screws.

Thus, Proximal Femoral nailing is significant advancement in the management of unstable trochanteric fractures.

REFERENCES


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