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Review Article

ROLE OF PROXIMAL FEMORAL NAILING ANTIROTATION (PFNA) ON TREATMENT OF INTERTROCHANTERIC FRACTURE: A REVIEW

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ABSTRACT

Intertrochanteric fractures commonly occur in elderly patients with osteoporosis and its incidence will continue to rise due to the increasing life expectancy. The main aim of surgery is to mobilize the patient early. It is crucial to use an implant that is minimally invasive, allows early weight bearing, and has low complication rates . Unstable intertrochanteric fractures are those with major disruption of the posteromedial cortex because of comminution or are fractures with reverse oblique patterns or fractures with subtrochanteric extension. Fractures without posteromedial cortex disruption or subtrochanteric extension are considered stable. The purpose of this review is to evaluate the functional and radiological outcome of proximal femoral nail antirotation in the treatment of intertrochanteric fractures . We recommend PFNA for fixation of unstable intertrochanteric fractures with less operative time and low complication rate. However, proper operative technique is important for achieving fracture stability and to avoid major complications.

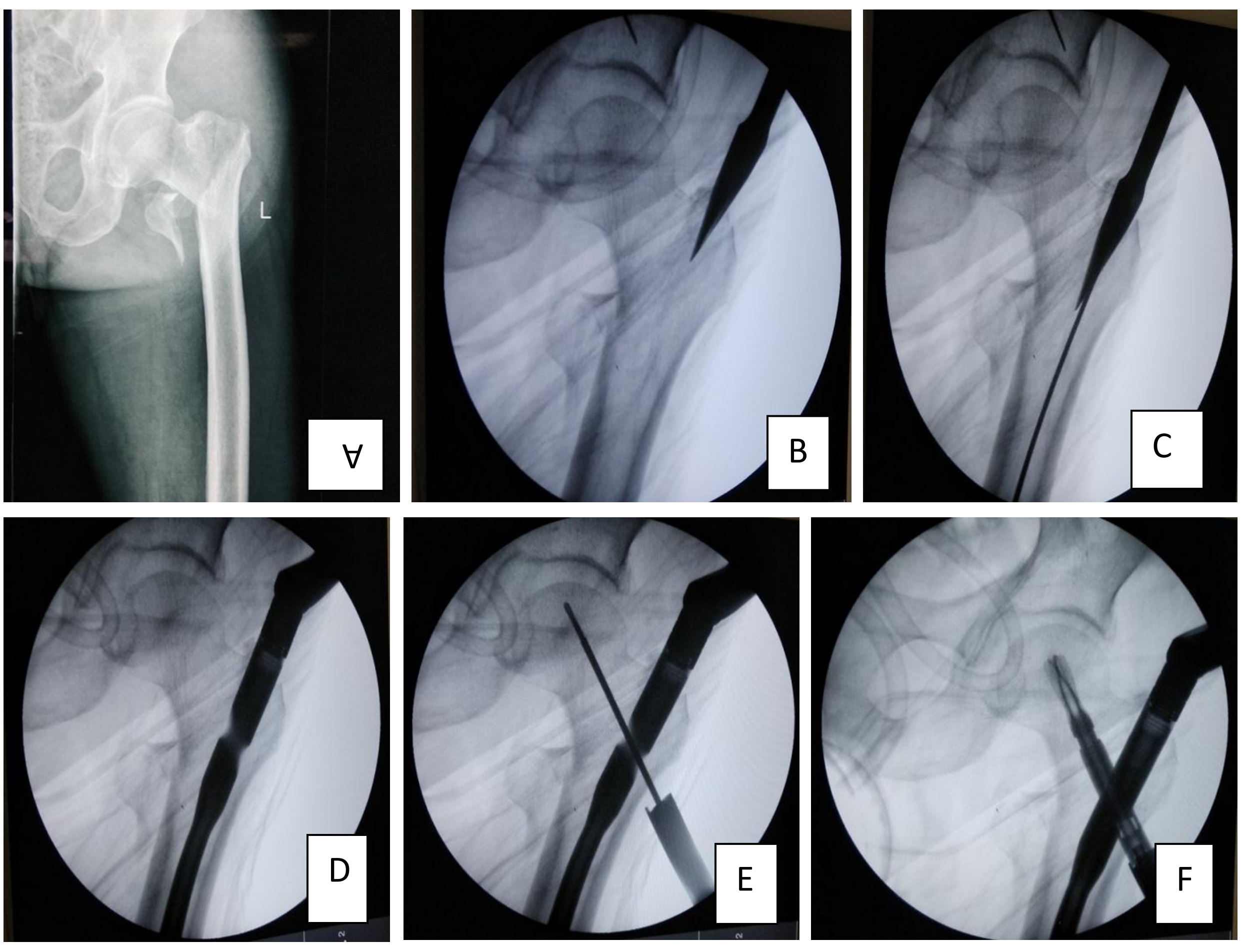
Keywords: Intertrochanteric fracture,Proximal femoral nailing antirotation,Fixation

INTRODUCTION

Intertrochanteric fractures usually involve parts below the intracapsular fracture of the femoral neck(IFFN) and the margin of the lesser trochanter.Unstable fractures such as comminuted fractures and wedge fracture, often occur in elderly individuals with osteoporosis with a prevalence of about 12.4-23.1%. The prevalence of fractures in young adults due to accidents and injuries caused by falls is approximately 5.6%[1]. Organ dysfunction in the elderly complicates the clinical outcome. Studies [1] suggested that external fixation in patients afflicted with intertrochanteric fractures led to limb shortening in 56.4%, wound infection in 60.2%, knee stiffness in 64.2% and hip varus deformity in 48.8% of the patients within 6 months post-surgery. Dynamic hip screw (DHS) is a popular extra medullary fixation device and is considered as the “gold standard” for the treatment of stable intertrochanteric fracture[2].However, the limitations in its design include the inability to address unstable intertrochanteric fracture due to the DHS steel located lateral to the weight-bearing line. The stress is not effectively conducted through the calcar due to a missing femoral intertrochanteric cortex. The varus stress is focused on the outside plate, resulting in nail plate fracture, screw skipping, caput femoris rotation and other issues. The surgical failure rate is about 16.5 to 23.1%[3]. The advantages of proximal femoral nail anti-rotation (PFNA) in clinical bone healing, surgical complications and quality of life are as follows:1- spiral blade and bone closely fit to enhance stability,prevent rotation and varus deformity[4]; 2- the large flank of the hip screw terminal compresses the surrounding bone, especially in osteoporosis resulting in a better grip force[5]; 3- nails with 6°outer angle are easily inserted into the top of the greater trochanter[6]; 4- the distal locking hole leads to static or dynamic locking[7]. PFNA-II is designed for Asians based on anatomical characteristics of the proximal femur and is better than PFNA-I in terms of stability[8]. The prevalence of spiral blade shift in patients receiving PFNA for the treatment of unstable fracture in osteoporosis rotor is rare within 6 months after surgery, and 62.4% of patients recovered pre-fracture functional status11. A comparative meta-analysis of PFNA and DHS12 showed that PFNA minimized blood loss in surgery, operative time, fixation failure rate and complications. The two randomized controlled studies indicated that intramedullary fixation was more suitable for unstable intertrochanteric fractures than extra medullary fixation[9].

Surgical techniques:

The patient was positioned supine on an extension table. The unaffected leg was abducted as far as possible and placed on a leg support, so that it allowed free fluoroscopic examinations.Adducting the affected leg by 10–158 favours the access to the medullary cavity. Closed reduction was performed under image intensifier control. In the majority of these cases, good reduction could be obtained by both adducting and internally rotating the affected leg under traction. Once the result was satisfactory, a 5-cm incision was made approximately 5-cm proximal from the tip of the greater trochanter.The correct entry point and angle were essential for a successful result. The guide wire should be inserted on the tip or slightly laterally of the greater trochanter at an angle of 68 to the intended extension of the medullary. Occasionally, this procedure was rather difficult when there was a ‘floating’ greater trochanter or the reduction could only be maintained with the affected leg abducted.The femur was opened by power tool at high speed or carefully by hand. To prevent dislocating the fracture fragments, lateral movements or excessive compression forces were avoided. After mounting the nail on the radiolucent insertion device, the nail could be introduced manually into the femoral shaft. It was not a problem when there was a fracture line at the entry point, but sometimes the fracture fragments dislocated after nail insertion,mainly due to the incorrect entry point. Via the aiming arm, the guide wire for the PFNA blade was introduced into the femoral neck in such a way that the PFNA blade would be placed into the lower half of the neck on the AP view and centrally on a lateral view. Care should be taken to avoid the fracture line on the lateral aspect of subtrochanteric area during the guide wire insertion.Unlike the insertion of the hip screws of PFN, the PFNA blade was inserted by hammering. Simmermacher et al. did not think reaming of the femoral neck was necessary in osteoporotic bone.Nevertheless, we advise to ream the femoral neck in every case,otherwise dissociation of the fragments may occur during the helical blade insertion . After reaming of the femoral neck, the guide wire for the helical blade was sometimes pulled out along with the reamer. It was necessary to reassure the position of the reinserted guide wire under image intensifier. Distal interlocking via the aiming arm was achieved. Distal interlocking was performed under image intensifier control.



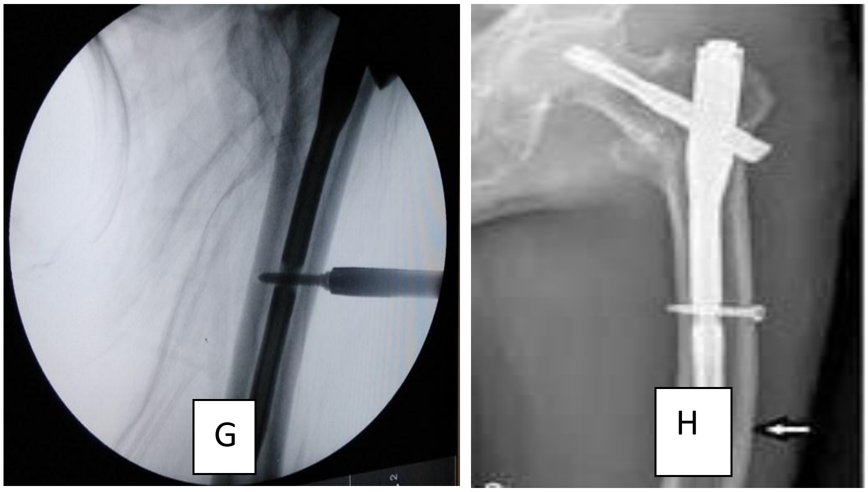


Figure: A)Intertrochanteric fracture lt, B)making entry point with Awl, C)guide wire inserted, D)PFNA inserted, E)Pin inserted for helical blade, F)Helical blade insertion, G)Locking of distal screw, H)IT fracture fixed with PFNA

Outcome parameters:

The WHO Performance Score[10] was used to measure the quality of life before and after the fracture. It consists of five levels in which 0 means full activity without restriction and 4 means completely disabled and totally confined to bed or chair.

The Parker Mobility Score[11] was used to assess the walking ability before the accident and at the follow-up. The particular capability to walk inside, walk outside and having social contact is evaluated in 4 levels with "no difficulty", "alone", "with help from another person" and "not at all". A maximum of nine points means unlimited walking ability. In addition, the use of a walking aid was documented for every patient before and after the accident.

Pain was assessed using the visual analog scale (VAS) as previously described[12] and widely known. The VAS was found to have good measurement properties for assessing pain in hip fracture patients[13].

The fracture pattern was assessed and classified as AO. The cortical thickness index [14] was assessed in the preoperative and in the follow-up X-rays. The cortical thickness index shows a significant positive correlation with the T-Score of the femoral neck[15] and was therefore used to classify the local bone quality in the study population. A cortical thickness index lower than 0.40 (lateral film) and 0.50 (ap film) has been described as a threshold for osteoporosis where all measured femora had a lower local bone mineral density than 2.5 standard deviations below the peak bone mass which is the WHO definition of osteoporosis [15].

On the postoperative X-rays, evaluated the quality of fracture reduction as anatomic (no displacement), near-anatomic (<3 mm displacement or 5°–10° varus/valgus and/or anteversion/retroversion) or non-anatomic (>3 mm displacement or >10° varus/valgus and/or anteversion/retroversion) [20, 39]. On the follow-up X-rays, signs of fracture healing were assessed. The lateral blade migration was measured as previously described [16].

On the preoperative and follow-up X-rays, the hip joint space was measured as the distance of the femoral head and the acetabulum in three defined positions in the anterio-posterior X-ray to assess a potential cartilage damage due to the procedure. Furthermore, the presence of signs of a head necrosis by means of sclerosis or subchondral collapse was assessed in the follow-up X-rays by one of the authors (HD).)

DISCUSSION

The incidence of unstable intertrochanteric fractures is increasing and this trend is likely to continue. These fractures are challenging for an average orthopaedic surgeon. Treatment modalities include osteosynthesis with dynamic hip screws and cephalomedullarynails and in selected cases, arthroplasty.However, the choice of implant for unstable intertrochanteric fractures is still debatable. PFNA are now favoured in west and there are multiple studies coming from that region to support this [17, 18]. In the study done by G.N kiran kumar et al.of unstable intertrochanteric fractures treated by PFNA , there were good outcome with very few complication rate and high union rate with short operative time and early post-operative mobilization. The complication rate is comparable to previous studie.The change to helical blade was aimed to decrease the risk of cut out. However, the cut out of helical bladestill remains to be the common cause of failure. There were no cases of cut outs in the study. The various studies have reported wide range of cut out rates varying from 2 - 25% [7, 17]. The design of helical blade was quoted as a possible reason for cut out and medial perforation of subchondral bone[17] .

Baumgaertner *et al.* [19] documented that the optimal placement of the lag screw was in the centre/centre position.The correct placement of the lag screw and helical blade at the centre of the femoral head and neck is important in both the antero-posterior and axial views. TAD is one of the most important predictive factors for the occurrence of a cut out [20]. Geller *et al.* reported 44% of cut outs in intertrochanteric fractures fixation with TAD of > 25 mm and did not cut out with TAD of < 25 mm[21]. We agree with Jin *et al.* and preferredusing a blade that is shorter than usually recommended to prevent inadvertent femoral head perforation due to collapse at fracture site [20].Nikoloski *et al.* hypothesized that the helical blade behaved in different way to a screw in the femoral head and recommended the TAD to be kept between 20-30 mm [22].

Jin *et al.* preferred long over the shorter PFNA nail when there is excessive anteriorcurvature of the femur. In the study, noticed impingement of tip of nail (240 mm length) to the anterior cortex in four cases due to excessive bowing and short femur length in Indians. There is mismatch between design of shorter nails and anatomy of femoral canal in Chinese population[23] . It is better to use longer nail to bypass the curvature or relatively shorter nail to prevent this complication especially in patients with excessive anterior bowing of femur.No cases of intra operative femoral shaft fractures were noted in the study. Yaozeng *et al.* reported 6 (5.6%) intraoperative femoral shaft fractures in their series of 107 intertrochanteric fractures [5]. Adequate reaming of the femoral canal especially when using longer nails can decrease the incidence of this complication.

Boopalan *et al.* [24] reported 21% incidence of intra operative lateral wall fractures in 31 A1 and A2 pertrochanteric fracture fixation. The fracture union was not affected by the presence of lateral wall fractures in their study. Gotfried [25] reported 24 cases of lateral wall fractures in their study. On radiographic examinations, he observed varus malalignment with medialisation of femoral shaft in all these cases. This was attributed to the use of a lateral cortex drill of 16 mm diameter for sliding screw [25]. This occurs most commonly when the broad proximal portion of the nail passes through the intertrochanteric area. The proximal fracture fragment translates along the intertrochanteric line and distal part of the nail pushes the femur laterally giving rise to distraction. This can be associated with varusmal alignment. Varus deformity and distraction also occurs when the guide wire is inserted directly through the fracture site [26]. They advised to use entry reamer after over-distracting the fracture. This will ream the lateral edge of medial fragment, which is the main reason for varus and distraction. We have found the method described by Janardhana Aithala P *et al.* useful. They have advised to ream the proximal fragment adequately as this assists in easy passage of the nail and also asks the assistant to apply and maintain some pressure over trochanter while passing proximal portion of the nail. Use of long artery forceps or a hohmann retractor in the lesser trochanteric area under the neck of femur to push it up during nail passage also prevents distraction.In the last 3 years, several studies [27, 28] have reported successful outcome with low complication rates with PFNA in unstable per trochanteric fractures.

CONCLUSION

In conclusion, we recommend PFNA II for fixation of unstable intertrochanteric fractures with less operative time and low complication rate. However, proper operative technique is important for achieving fracture stability and to avoid major complications.

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