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Distal unlocked proximal femoral intramedullary nailing for intertrochanteric femur fractures

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Abstract We investigated whether a proximal femoral nail (PFN) having two lag screws can be implanted without distal locking screws in AO/OTA 31-A1 and 31-A2 intertrochanteric femur fractures. Twenty-four patients with AO/OTA 31-A1 and 31-A2 fractures were treated with a PFN without distal interlocking by a single surgeon. The mean follow-up was 12 months (range: 7–23). Clinical and functional outcome was assessed according to the Harris hip score and Barthel's activity score. The fractures healed in all patients; the average consolidation time was 14 weeks (range: 9–28). Fourteen patients had excellent and good results, 9 patients had fair results, and 1 patient had poor results according to the Harris hip score; 17 patients had a high range of mobility according to the Barthel activity score. Our results suggested that the PFN can be successfully implanted without distal interlocking in 31-A1 and 31-A2 fractures.

Résumé L'objectif est d'analyser les résultats de l'enclouage fémoral sans verrouillage distal pour des fractures inter trochantériennes de type AO/OTA31-A1 et 31-A2. Matériel et méthodes : 24 patients présentant ce type de fracture ont été traités par un enclouage fémoral proximal sans verrouillage par le même chirurgien. Le suivi moyen a été de 12 mois (7 à 23). Les résultats cliniques et fonctionnels ont été analysés selon le score de Harris et selon le score d'activité de Barthel. Résultats : toutes les fractures ont consolidé chez tous les patients. Le temps de consolidation moyen a été de 14 semaines (de 9 à 28 semaines). 14 patients ont eu un excellent résultat, 9 patients un résultat moyen et un un résultat médiocre selon le score de Harris. 17 patients avaient une bonne mobilité de la hanche selon le score de Barthel. En conclusion : nos résultats permettent de penser que la fracture inter trochantérienne du fémur proximal peut être traitée de façon positive avec un clou fémoral sans verrouillage distal pour des fractures de type 31-A1 et 31-A2.

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Introduction

The incidence of fractures in the trochanteric area has risen with the increasing numbers of elderly persons with osteoporosis. According to the Orthopaedic Trauma Association (OTA) classification system, these fractures are classified as AO/OTA 31-A and are further subdivided into groups A1, A2 and A3. A1 fractures consist of two-part fractures, A2 fractures have multiple fragments and A3 fractures include reverse, oblique and transverse fracture patterns [5, 12].

There are two main types of implants available for the treatment of these fractures, namely extramedullary and intramedullary implants. The most widely used extramedullary implant is the dynamic hip screw, which consists of a sliding neck screw connected to a plate in the lateral femoral cortex [3, 4]. Intramedullary devices such as the Gamma nail and the proximal femoral nail (PFN) provide a biomechanical advantage due to their shorter lever arms and the diminished deforming forces across the implant.

Although the PFN system developed by the AO/ASIF overcame many of the previously mentioned limitations of the Gamma nail, it still has some disadvantages. Distal locking screws can act as stress risers that cause subsequent implant breakage and can also induce fascia

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lata irritation. Thus, in this prospective study, we tried to find out whether two lag screws can be applied to the PFN without distal proximal locking screws in 31-A1 and 31-A2 fractures.

Patients and methods

From 2006 to 2008, 24 patients with AO/OTA 31-A1 and 31-A2 fractures were treated with the PFN by a single surgeon. Every patient was followed up for at least 7 months. The PROFIN PFN (TST SAN, Istanbul, Turkey) is a cannulated straight tube made of titanium alloy, with a proximal curvature of 6° and a distal slotted design. The proximal part of the nail is 16 mm in diameter and has two oblique lag screws with diameters of 8.5 mm. The neck-shaft angle of the nail is 135°; it has two distal holes that allow either dynamic or static fixation. The transverse locking screw at the distal end of the PFN has a diameter of 4.5 mm. The operations were performed within 5 days of the occurrence of the fractures and closed reduction was achieved in all cases. We classified the extent of reduction as anatomical (<5° of varus, valgus, anteversion, or retroversion), acceptable (5–10°) or poor (>10°) [2]. The fracture was determined to have healed when the fracture site was filled with callus and the patient did not feel any pain at the fracture site [7].

Fig. 1 Preoperative anteroposterior roentgenogram of the patient with a 31-A2 fracture of his left proximal femur

Fig. 2 Postoperative anteroposterior roentgenogram of the patient 16 months after treatment with the proximal femoral nail

Postoperatively, the patients were allowed to bear as much weight as they could tolerate. During a mean of 12 months (range: 7–23), the results, as well as the intraoperative and postoperative complications, were followed prospectively.

All patients were evaluated by regular physical and radiographic examinations. Clinical and functional outcomes were assessed according to the Harris hip score and Barthel activity score, respectively. The mean age of our patients was 74 years (range: 39–95), and 14 were women. Of the 24 fractures, 8 were 31-A1 and 16 were 31-A2.

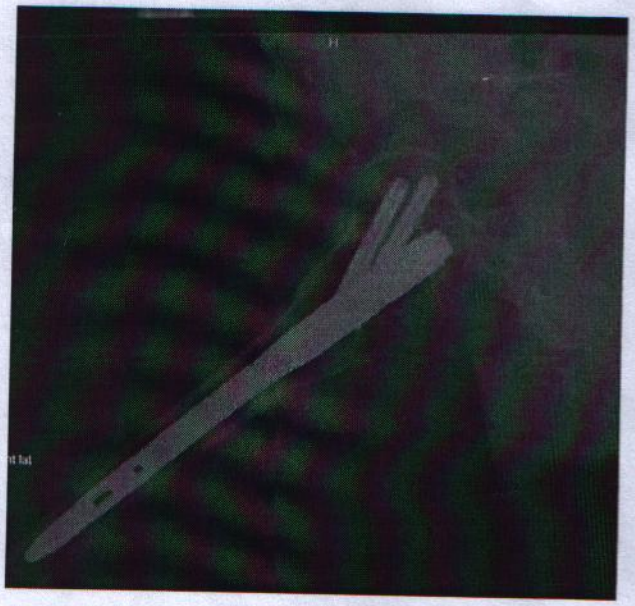

Fig. 3 Postoperative lateral roentgenogram of the patient 16 months after treatment with the proximal femoral nail

Results

There were acceptable reductions in two patients and anatomical reductions in the rest. The mean duration of surgery was 48 min. The fractures healed in all patients; the average consolidation time was 14 weeks (range: 9–28). No intraoperative complications occurred. One patient suffered from a postoperative complication: the reversed Z-effect occurred with movement of the lag screw toward the lateral side. This patient had elective removal of the side pins because of the pain. No patient had lag screw cut-outs, either non-union or malunion. Stress shielding was not detected, as evidenced by the lack of cortical hypertrophy at the level of the tip of the PFN. The mean Harris hip score was 83 (range: 52–98) and the mean Barthel activity score was 17.55 (range: 11–20). Fourteen patients had excellent and good results, 9 patients had fair results and 1 patient had poor results according to the Harris hip score; 17 patients had a high range of mobility according to the Barthel activity score. The initial and the follow-up roentgenograms of a sample case are presented in Figs. 1, 2 and 3.

Discussion

The treatment of proximal femoral fractures with sliding screw implants involving an extramedullary or an intramedullary device is universally accepted [1]. Although clinical investigations have failed to show superiority of one type over the other, there have been reports indicating that intramedullary devices possess a greater degree of biomechanical stability [10–12]. In addition, intramedullary fixation also allows minimum soft tissue dissection, blood loss, infection and wound complications [6, 13]. At present, the PFN is considered to be a good minimally invasive implant for treating proximal femoral fractures, especially where closed reduction is possible. However, neck screw cut-outs, Z-effect with migration of the pin into the joint, reversed Z-effect, femoral fracture at the nail tip or at the distal screw insertion site, thigh pain due to iliotibial tract irritation or cortical hypertrophy and difficulty in distal screw insertion are among the possible complications that can be encountered [2, 9].

We used two lag screws in our PFN design in order to enhance stability and to decrease the incidence of lag screw cut-outs. Apart from the nail design, the surgical technique is also important in determining the rates of occurrence of the above-mentioned complications. Anatomical fracture reduction and the insertion of the inferior lag screw as close as possible to the inferior cortex of the femoral neck is strongly recommended because the compression trabeculae and tensile trabeculae of the proximal femur intersect at the inferior part of the femoral neck, constituting the strongest architecture. Further, the lag screws should be inserted 10 mm into the subchondral bone to enhance stability. Increased stresses at the distal nail tip have also been reported. These stresses may lead to local cortical hypertrophy, mid-thigh pain and fractures around the distal locking screws. Distal cortical hypertrophy is a radiological sign of proximal stress shielding with load concentrations at the tip of the nail [8]. Hardy et al. stated that using two static locking screws during intramedullary fixation of intertrochanteric fractures is correlated with a high rate of cortical hypertrophy, while the use of a dynamically locked nail significantly reduces the rate of this complication [2]. On the basis of these data, we abandoned the use of locking screws in 31-A1 and 31-A2 intertrochanteric femoral fractures. By avoiding the use of distal locking screws, we had the added advantage of decreased operation and fluoroscopy exposure time, increased patient mobility due to less tissue dissection and a low probability of iliotibial tract irritation due to the presence of a distal screw.

Our results suggested that the PFN can be successfully implanted without distal interlocking in 31-A1 and 31-A2 fractures. However, further biomechanical studies are needed to determine whether 31-A3 fractures can be treated similarly.

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