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Intramedullary osteosynthesis of instable intertrochanteric femur fractures with Profin® nail in elderly patients

Ramazan Erden ERTÜRER[1], Mesut Mehmet SÖNMEZ[1], Seçkin SARI[2], Mustafa Faik SEÇKİN[1], Adnan KARA[1], İrfan ÖZTÜRK[1]

[1]Department of Orthopedics, Şişli Etfal Training and Research Hospital, İstanbul, Turkey;
[2]Baltalimanı Bone DiseasesTraining and Research Hospital, İstanbul, Turkey

Objective: The aim of this study was to retrospectively analyze the radiologic and functional results of patients with instable intertrochanteric femur fractures treated with Profin® nails.

Methods: This study included 32 patients (24 female, 8 male; mean age: 70.7 years; range: 65 to 96 years) who were treated with Profin® nails for instable intertrochanteric fractures. Fractures were caused by a simple fall in 30 patients and pedestrian accident in two. Eleven patients had Type 31-A2 and 21 patients had Type 31-A3 fractures according to the AO/OTA classification. Results were evaluated clinically and radiologically. Mean follow-up period was 17.3 (range: 12 to 23) months.

Results: Good or acceptable reduction was achieved in 93.7% of our patients. Mean surgery duration was 28.2 (range: 22 to 75) minutes and mean blood loss was 215 (range: 150 to 320) cc. Complete union was achieved in all patients at a mean of 17.6 (range: 15 to 22) weeks. Postoperative mean collodiaphyseal angle was 125.5 (range: 122 to 130) degrees and there was no significant difference with follow-up values ($p>0.05$). Twenty-two patients were able to walk with support and 10 without support after surgery. Mean Oxford hip score was 23.70 (range: 14 to 39) points. One year mortality rate was 18.75%.

Conclusion: Good functional and radiologic results can be achieved using Profin® nails for unstable intertrochanteric femur fractures in elderly patients.

Key words: Intertrochanteric femur fracture; proximal femoral nail; surgical treatment.

Prolonged hospitalization following surgical treatment of hip fractures in elderly patients can cause complications and increase mortality. Main treatment goals of stable fracture fixation are early mobilization and restoration of functional status.[1-3]

According to the Association for Osteosynthesis/ Orthopaedic Trauma Association (AO/OTA) classification, intertrochanteric hip fractures are divided into three groups: two fragmented simple fractures with medial cortical continuity (31-A1), comminuted fractures without medial cortical continuity (31-A2), and reverse oblique and transverse fractures (31-A3).[4] Comminution in the posteromedial cortex, subtrochanteric or reverse oblique fracture lines cause instability.[5]

Correspondence: Mesut Mehmet Sönmez, MD. Şişli Etfal Eğitim ve Araştırma Hastanesi, 2. Ortopedi Kliniği, İstanbul, Turkey.
Tel: +90 532 - 334 11 55 e-mail: mdmesutsonmez@yahoo.com

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Osteosynthesis and arthroplasty are the main treatment options for intertrochanteric fractures. Fixation weakness due to poor bone quality and difficulty in obtaining acceptable fracture reduction, especially in instable fractures, are frequent problems in osteosynthesis. Arthroplasty, the first choice for treatment of femoral neck fractures in the geriatric population, has the advantage of early weight-bearing.[6,7] Intramedullary fixation implants, developed in recent years for this type of fracture, are increasingly being used due to the preservation of fracture hematoma through indirect reduction techniques and medial transport of the lever arm. Proximal femoral nails have been shown to be superior, especially in instable intertrochanteric femur fractures. With a more stable fixation, early weight-bearing is allowed and the complications resulting from arthroplasty can be avoided.[1,2,8-11] This study aimed to report the radiologic and functional results of elderly patients with instable intertrochanteric femur fractures treated with Profin® (TST Tıbbi Aletler San. ve Tic. Ltd. Şti, İstanbul, Turkey) nails.

Patients and methods

Among the 36 patients treated with Profin® nails for instable intertrochanteric femur fractures between May 2007 and August 2008, 32 (24 female, 8 male; mean age: 70.7 years: range: 65 to 96 years) were included in this study. Patients who died within the first postoperative year or with insufficient follow-up were excluded.

Fracture instability is a major indication for intramedullary nailing. Nails were chosen in these elderly patients because of the indirect reduction techniques, avoidance of opening of the fracture site according to biologic fixation principles, and lower blood loss and soft tissue trauma. Sixteen fractures were of the right hip and 16 of the left. Fractures were caused by a simple fall in 30 patients and pedestrian accident in 2 patients (Fig. 1). According to AO/OTA classification, 11 patients (34.4%) had 31-A2 and 21 (65.6%) had 31-A3 fractures. Preoperative anesthesiologic evaluation showed 5 patients (15.6%) classified as ASA-2, 21 patients (65.6%) as ASA-3 and 6 patients (18.8%) as ASA-4 (Fig. 2).

Fig. 1. Preoperative anteroposterior radiograph of AO/OTA 31-A3 type intertrochanteric hip fracture due to simple fall in a 76-year-old female patient.

All surgeries were performed on a traction table, with the patient in the supine position and under fluoroscopy. Closed reduction was achieved in all patients.

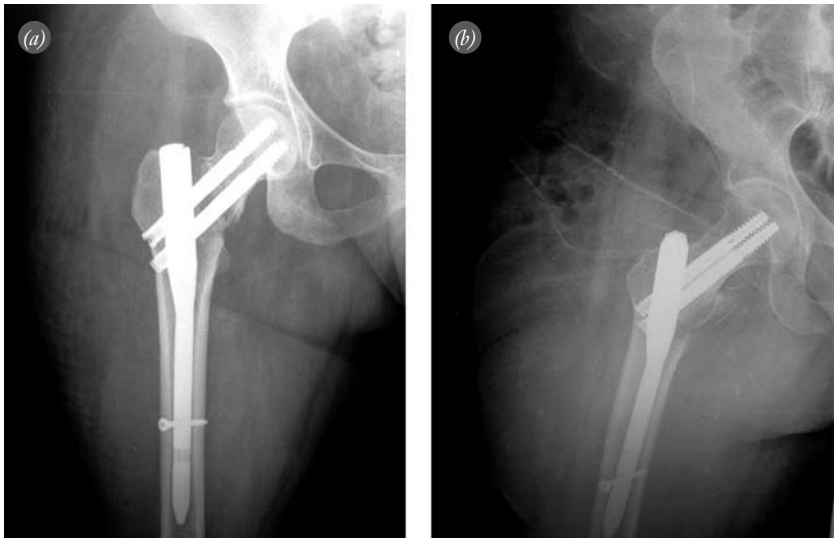

Fig. 2. Postoperative **(a)** anteroposterior and **(b)** lateral radiographs of the same patient.

No open reduction was performed in the first operation of those patients who underwent revision.

A postoperative prophylaxis of one gram of intravenous first generation cephalosporin (cephazolin sodium, Sefazol®; Mustafa Nevzat İlaç Sanayii A.Ş, İstanbul, Turkey), was administered four times a day for 48 hours in all patients. Low-molecular-weight heparin (enoxaparin sodium 0.6 ml, Clexane®, Sanofi-Aventis İlaçları Ltd. Şti, İstanbul, Turkey) was used as a venous thromboembolism prophylaxis after hospitalization in all patients. Prophylaxis was discontinued 12 hours before surgery, restarted 6 hours after surgery and continued during hospitalization. Prophylaxis was administered for up to three weeks postoperatively in patients with risk factors. Ankle and quadriceps exercises were started, and weight-bearing with two crutches or a walker was allowed the postoperative first day in all patients. Mean hospital stay was 3.4 (range: 2 to 7) days. The Baumgaertner criteria, modified by Fogagnolo et al.,[1] were used for reduction evaluation (Table 1).

Clinical results were evaluated with the Oxford hip score.[12] Postoperative and follow-up collodiaphyseal angles were compared. Paired t-test was used for statistical analysis. Mean follow-up duration was 17.3 (range: 12 to 23) months.

Table 1. Modified Baumgaertner criteria used for reduction evaluation.

Alignment	Anteroposterior	Normal collodiaphyseal angle or slight valgus
	Lateral	Angulation less than 20°
Displacement	Apposition more than 80% in two planes	
	Shortening less than 5 mm	
Good	Two criteria were met	
Acceptable	Only one criterion was met	
Poor	No criterion was met	

Results

Good or acceptable reduction was detected in postoperative radiographs in 93.7% of patients. Poor reduction was detected in the radiographs of two patients with reverse oblique fractures and a revision procedure and open reduction were performed for these patients. Durations of these revision surgeries were not added to the calculated mean operation duration, which was defined as the time between incision and last suture. Mean operation duration was 28.2 (range: 22 to 75) minutes and mean blood loss was 215 (range: 150 to 320) cc. Fracture union was achieved at a mean of 17.6 (range: 15 to 22) weeks. Mean postoperative collodiaphyseal angle was 125.5 (range: 122 to 130) degrees and there was no statistically significant difference in the mean follow-up value ($p>0.05$) (Fig. 3).

A greater trochanter fracture caused by severe osteoporosis and selection of incorrect nail insertion site occurred during surgery in three patients. Weight-bearing was limited in these patients although complete union was achieved. Twenty-two patients were able to walk with a support and 10 without support postoperatively. Tenderness was detected over the fascia lata in four patients and proximal screws were removed in one after fracture union. In the other three

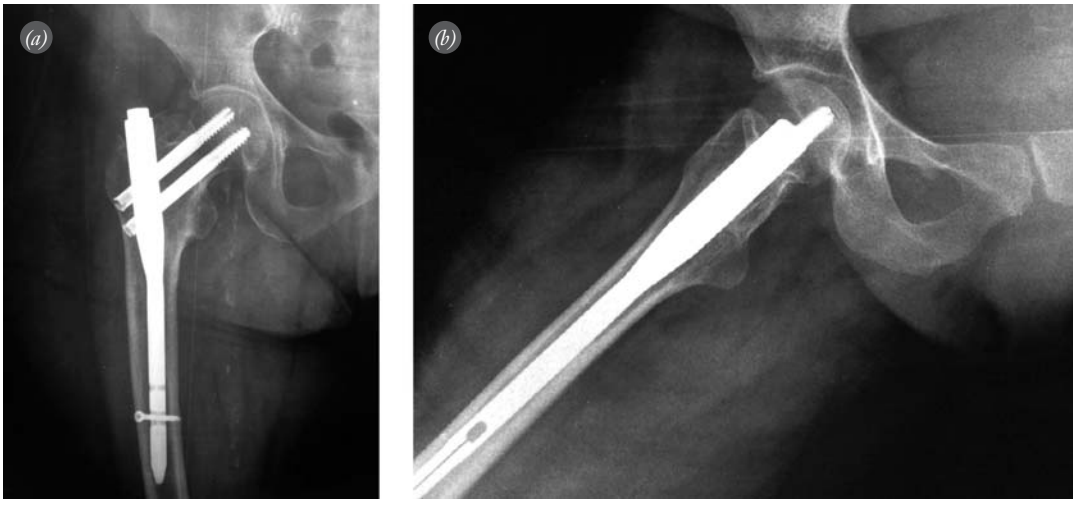

Fig. 3. Postoperative 14th month **(a)** anteroposterior and **(b)** lateral radiographs of the same patient.

patients, the complaint disappeared and further surgical procedures were not needed. Mean Oxford hip score was 23.70 (range: 14 to 39) points. One year mortality rate was 18.75%.

Discussion

Osteosynthesis is the primary treatment option for intertrochanteric fractures. Arthroplasty is also advised for patients with comminuted fractures, systemic disorders, advanced age or for early mobilization.[13-15] With this technique, controlled weight-bearing is easier for patients with Parkinson disease, senile dementia and hemiplegia.[13,16] However, limiting factors of arthroplasty include intraoperative necessity for wide surgical exposure, greater blood loss, risk of hypotension due to bone cement and postoperative luxation, infection, acetabular erosion and prosthetic loosening.[13,15]

Dynamic hip screws (DHS) slide and make compression at fracture site and are accepted as the gold standard for the surgical treatment of stable intertrochanteric fractures.[17,18] However, the optimal modality for the osteosynthesis of unstable intertrochanteric fractures is controversial. Wolfgang et al. reported a post-treatment mechanic complication rate of 9% for stable and 19% for unstable fractures with DHS.[19] The complication rate for reverse oblique fractures is %56.[20] Kim et al. reported DHS failure rates of up to 50% in unstable intertrochanteric fractures and advised against their use as a first option.[21] Intramedullary nails are increasingly being used in the treatment of intertrochanteric femur fractures. Anglen and Weinstein reported an increase in the use of nails in the treatment of intertrochanteric fractures from 3% in 1999 to 67% in 2006.[22] The use of nails in intertrochanteric fractures is related with shorter surgery duration, good union rates, and lower blood loss and postoperative morbidity.

In this study, all procedures were performed under fluoroscopy with traction table and closed reduction was carried out in all patients. Open reduction was performed in a revision session in two patients (%6.25). The frequent complications seen with first generation nails, such as femoral shaft fractures, cut-out of proximal screws and rotational problems, have decreased with the new nails.[23,24] Although different intramedullary nails have similar biomechanical properties, variations occur in the mediolateral bowing of nail, number of proximal screws and their shapes. Profin® nails are 16 mm in proximal diameter and 220 cm in length. The angulation of the proximal portion is 6° and the distal portion is designed with a cleft to decrease stress. Proximal screws are cannulated and 8.5 mm in diameter. Rotational balance is better achieved with two screws and the risk of cut-out is lowered. Screws' diameters are smaller than gamma nails and proximal femoral nails, therefore damage to the lateral cortex is relatively lower. Nails can be locked dynamically or statically. Ozkan et al. reported good results without distal locking and claimed that cortical hypertrophy is thus prohibited.[25] In this study, dynamic locking with single screw was performed in all patients and compression at the fracture site was allowed. Cortical hypertrophy was not seen in any of the patients.

Fracture distal to the nail is an important complication in the use of intramedullary nails. Fogagnolo et al.[1] reported a complication rate of one in 47 and Banan et al.[26] reported a rate of two in 47 cases. There was no fracture in our study.

The term "Z effect" defines a complication of PFN® nails (Synthes, Switzerland) with two different sized proximal screws. The "Z effect" is described as the lateral migration of a screw.[27] Papapismos et al.[28] reported four cases of the "Z effect" and one case with "reverse Z effect" out of 40 cases and Uzun et al.[29] reported five "reverse Z effect" in 35 cases. In this study, there were no such complications and, in our opinion, this resulted from the equal diameter of the proximal screws. Although no biomechanical study has been done, we hypothesized that two screws of the same size share the loads acting on the hip, preventing the "Z effect".

A disadvantage of Profin® nails is the small diameter (2 mm) of the K-wires of the proximal screws. Drilling causes rotation of the fragments despite thin K-wires, especially in basocervical fractures. In order to prevent such problems, wire diameter was increased to 2.5 mm in new generation nails.

Tenderness related with the long proximal screws was seen around the fascia lata in four cases. Proximal screws should not exceed the lateral femoral cortex in order to avoid the occurrence of this complication.

The optimal entry point of the proximal femoral nail is slightly medial to the tip of the greater trochanter.[5] Greater trochanter fractures occurred in three cases which were related to osteoporosis and the positioning of the entry point anteriorly or superiorly in the lateral plane. Therefore, the entry point should be checked with fluoroscopy in two planes. Literature

has shown the relationship between complications and inappropriate fracture reduction or entry point.[5,30]

Although the lack of a control group is a deficiency, this study showed effectiveness of the proximal femoral nail in the treatment of instable fractures in elderly patients.

In conclusion, Profin® nails obtain good results in the treatment of instable intertrochanteric femur fractures. Proper application of the nail following appropriate fracture reduction can prevent complications.

Conflicts of Interest: No conflicts declared.

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