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Expert tibia nail for subtrochanteric femoral fracture to prevent thermal injury

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ABSTRACT

INTRODUCTION: Subtrochanteric femoral fractures are relatively uncommon, accounting for 7–15% of all hip fractures and treatment of these fractures are considered challenge for orthopaedic surgeons. Although several treatment options are reported with up to 90% of satisfactory results, the choice of the appropriate implant is still a matter of debate. Some authors reported thermal injury after reaming for intramedullary nail fixation in patients with narrow medullary canal.

PRESENTATION OF CASE: A 21-year-old female patient was admitted to our hospital because of right subtrochanteric femoral fracture. The narrowest diameter of medullary canal of her femur was about 7 mm but she refused open reduction and internal fixation with plate due to large scar formation. We used expert tibia nail instead of femoral intramedullary nail to prevent thermal injury.

DISCUSSION: Subtrochanteric femoral fractures are difficult to treat because of their biomechanical and anatomical characteristics. Although several implants are reported for the surgical treatment of these fractures, intramedullary nails have been advocated due to their biological and biomechanical advantages. However, under certain circumstances with associated injury or anatomic difference we might consider another treatment options.

CONCLUSION: Expert tibia nail may be considered one of the treatment options for subtrochanteric femoral fracture with narrow medullary canal. We also emphasize the importance of preoperative evaluation of the medullary canal size for these risky fractures.

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1. Introduction

Subtrochanteric femoral fractures are relatively rare and their prevalence account for 7–15% of all hip fractures [1]. Anatomically, subtrochanteric area consists of hard cortical bones with poor vascularity and biomechanically, it is under high compressive and tensile stress [2]. These characteristics can cause high rate of nonunion, malunion, and fixation failure [3,4]. Several treatment options are reported with intramedullary or extramedullary implants and up to 90% of reported outcomes have been satisfactory [1,2,5–10]. Although plating techniques offer some advantages, intramedullary nail have been supported for the fixation of these fractures, because of their biological and biomechanical advantages [2].

There were concerns about thermal injury after reaming for intramedullary nail fixation [11–13]. Leunig and Hertel reported three cases of osteocutaneous necrosis induced by heat during

tibia intramedullary reaming [11]. All of three cases had a narrow medullary cavity. Giannoudis et al. [13], also reported that reaming smaller canals (8 mm) to a larger size may induce a significant heating effect. Now we report a patient with subtrochanteric femoral fracture with narrow medullary canal which was treated uneventfully by using expert tibia nail (ETN; Synthes®, Switzerland) instead of femoral intramedullary nail to prevent thermal injury.

2. Presentation of case

A 21-year-old female patient sustained right subtrochanteric femoral fracture after fall from a height injury (Fig. 1A). Her height was 160 cm, weight was 52 kg and body mass index was 20.3 kg/m². There was no further past or medical history except associated ipsilateral humeral fracture. We planned surgical treatment with cephalomedullary femoral nail but scanogram revealed that narrowest diameter of medullary canal was around 7 mm (Fig. 1B). If we tried to use cephalomedullary femoral nail, more than 3 mm of reaming was needed and the small size solid femoral nails that do not require reaming were not available at the time. We explained about the problem of using cephalomedullary femoral nail (thermal injury) and discussed about open reduction and inter-

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Fig. 1. Anteroposterior view of right femur shows short transverse fracture with butterfly fragment around subtrochanteric area (A) scanogram of left femur shows relatively narrow medullary canal (B).

nal fixation with extramedullary implant or minimal invasive plate osteosynthesis with locking plate. However, she refused all the extramedullary implant because she worried about relatively large scar formation than intramedullary nail. Her job was a dancer.

We finally decided to use ETN for the fixation of her subtrochanteric femoral fracture with closed reduction. Patient was placed on the fracture table and closed reduction was tried under guidance of image intensifier. Greater trochanter could be used as an entry point because this nail had 10 degree angulation on its

proximal part. We also put a diameter 5.0 mm locking screw into the femoral head because five locking options in four planes are allowed in proximal part of this nail. Finally, diameter 8 mm and length 330 mm expert tibia nail was inserted (Fig. 2A and B). The patient was allowed to mobilize on the first postoperative day and to weight bear as tolerated with crutches until postoperative 12 weeks. The postoperative rehabilitation was uneventful and radiographic union was obtained after 8 months of operation (Fig. 2C). Removal of implant was done two years after surgery (Fig. 3).

3. Discussion

Treatment of subtrochanteric femoral fractures constitutes a considerable challenge for orthopaedic surgeon. Anatomically, this area consists of hard cortical bones with a slower healing rate than metaphyseal bones. Biomechanically, the proximal femoral shaft is under high stress (compressive force on medial side and tensile force on lateral side). Furthermore, extensive comminution and fragment devitalisation can compromise bone healing biologically [1]. These characteristics can cause high rate of nonunion, malunion, and fixation failure [3,4]. Although traditional open plating achieves anatomical reduction and rigid fixation, extensive surgical exposure increases delayed union, nonunion, and infection. Open reduction of subtrochanteric femoral fracture is associated with up to 23% of nonunion and with 29% of patients needing bone grafting [1,2]. Accordingly, in case of subtrochanteric femoral fractures, focus should be shift from the mechanical aspects toward the biological aspects [14]. Several authors reported superior results of mini-incision or biologic plating than open plating [1,2,7]. More recently, minimal invasive plate osteosynthesis with locking plate technique was introduced for the treatment of subtrochanteric femoral fractures. Oh et al. [2], reported twenty cases of subtrochanteric femoral fractures treated with minimal invasive plate osteosynthesis with locking plate (LCP-DF, Synthes®, Switzerland). They achieved 100% of bony union without bone graft at an average of 20.1 weeks. They also reported that their technique can be used in patients with narrow medullary canal (7 of 20 patients). We also considered minimal invasive plate osteosynthesis with locking plate for the alternative treatment of our patient, but she refused it because of relatively large scar formation than nail. Compared with extramedullary implant, the advantages of intramedullary

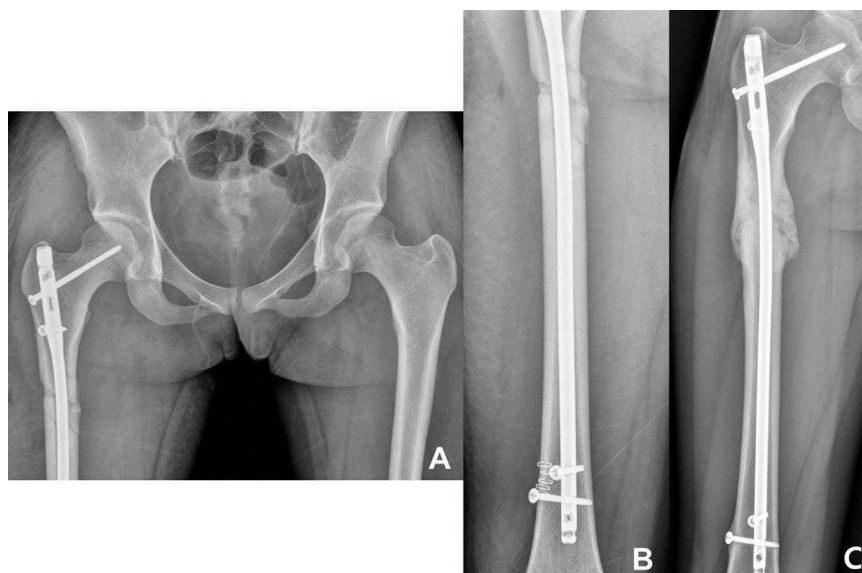


Fig. 2. Postoperative radiographs show well-positioned expert tibia nail greater trochanter was used as an entry point and one locking screw was inserted into the femoral head (A and B). After 8 months of operation, radiographic union was obtained (C).



Fig. 3. After 2 years of operation, removal of implant was done.

nailing consist in a small skin incision, lower operating times, preservation of fracture hematoma, allowance of proximal fixation into the femoral head and the possibility of early weight bearing [5]. Burnei et al. [5], compared intramedullary osteosynthesis with plate osteosynthesis in 75 subtrochanteric femoral fractures, they founded that the need of surgical intervention after primary surgery was significantly higher in plating group and recommend intramedullary nail especially in patient with medial cortical comminution. Forward et al. [6], compared the biomechanical performance of a cephalomedullary nail, a proximal femoral locking plate, and a 95° angled blade plate in a comminuted subtrochanteric fracture model. They concluded that cephalomedullary nail construct was biomechanically superior to either the locking plate or 95° angled blade plate construct and the locking plate construct was biomechanically equivalent to the blade plate construct. Thermal injury after reaming of intramedullary nail fixation in patients with narrow medullary canal was reported [11–13]. Also, Eriksson and Albrektsson [15], reported that exposure to a temperature of 47°C for one minute causes bone resorption and subsequent replacement and also disturb the middle- and long-term anchorage of implant. Giannoudis et al. [13], determined about the temperature rising during reamed tibia nailing in eighteen patient. The tibial medullary canal diameter ranged from 8 to 11 mm and reaming of the medullary cavity ranged from 9 to 12 mm before nail insertion. They found that peak temperature recorded were from 36.1 to 51.6°C and a direct correlation was observed between temperature elevation and amount of reaming. Furthermore, with reaming above 10 mm, tibias with a canal diameter of 8 mm showed a statistically higher temperature rise compared with tibias with a canal diameter of 9, 10, or 11 mm. In our patient, the diameter of medullary canal was around 7 mm and more than 3 mm of reaming was needed if we want to use cephalomedullary femoral nail.

ETN is a new generation of an intramedullary implant with multiple locking options in different planes at the proximal and distal end. This characteristic can extend the indications and increase rotational stability [16]. In our patient, we can put a locking screw



Fig. 4. Photographs show a diagram of using expert tibia nail for the subtrochanteric femoral fracture. Multiple locking options in different planes with aiming arm can be used.

into the femoral head due to this characteristic and use the great trochanter as an entry point due to proximal angulation (Fig. 4).

4. Conclusion

Expert tibia nail may be considered one of the treatment options for subtrochanteric femoral fracture with narrow medullary canal. It can be inserted at the greater trochanter as an entry point and locking screw directed to the femoral head also can be used with aiming arm. We also emphasize the importance of preoperative evaluation of the medullary canal size for these risky fractures.

Conflicts of interest

Nothing to declare.

Sources of funding

Nothing to declare.

Ethical approval

We obtained a written and signed consent for the case, prior to submission. The patient's detail has been kept anonymous in the manuscript.

Consent

We obtained a written and signed consent for the case, prior to submission. The patient's detail has been kept anonymous in the manuscript.

Author contribution

Kyung-Jae Lee – performing the surgery, study concept, writing the paper. Byung-Woo Min – data interpretation, study concept. Jae-Hoon Jung – data analysis and interpretation. Mi-Kyung Kang – data collection. Min-Ji Kim – data collection.

Guarantor

Kyung-Jae Lee.

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