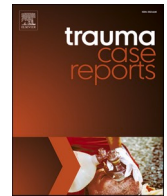




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## Bilateral atypical femoral fractures treated with compression hip screw and intramedullary nail fixation

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### ABSTRACT

Atypical femoral fractures (AFF) are more difficult to treat than typical femoral fractures; they require strong fixation and good reduction. Intramedullary (IM) nailing is the first option for the treatment of complete AFF; however, there are few reports comparing IM nailing and extramedullary fixation. Moreover, there are no reports on the outcomes of bilateral atypical subtrochanteric femoral fractures treated with an IM nail on one side and a compression hip screw (CHS) on the other. We report the case of a 69-year-old woman who had been on risedronate sodium once a month since she was 58 years old. She reportedly felt pain in both her thighs due to an undiagnosed cause. Six months later, she fell and was diagnosed with bilateral complete atypical femoral subtrochanteric fractures (right side: Seinsheimer type IIC; left side: Seinsheimer type IIA). Four days later, she underwent CHS on the right side and IM nailing after open reduction surgery on the left. The reduction was successful. The left side healed 6 months after surgery, but the right side healed only after 14 months, despite assistance with low-intensity pulsed ultrasound. In atypical femoral subtrochanteric fractures, good reduction is important for healing, but, in this case, the CHS side healed slowly despite achievement of good reduction because of the difference in the fixation force between IM nailing and CHS, in addition to a probable occurrence of severely suppressed bone turnover (SSBT). Furthermore, reaming was not done on the CHS side, which may have contributed to the delay in bony union. IM nailing is the first option for atypical femoral subtrochanteric fractures because of faster union and lower reoperation rate than extramedullary fixation. Based on our findings, we recommend IM nailing as the first option for atypical femoral subtrochanteric fractures when good reduction can be achieved.

### Introduction

Atypical femoral fractures (AFF) are noncomminuted, subtrochanteric or diaphyseal fractures associated with either no trauma or minimal trauma. Long-term bisphosphonate therapy causes severely suppressed bone turnover (SSBT), a known factor contributing to the occurrence of AFF. AFF are more difficult to treat than typical femur fractures and require strong fixation and good reduction. Intramedullary nailing is the preferred method for surgical fixation of complete AFF, but extramedullary fixation methods may be considered depending on the fracture location [1]. There are few reports comparing the outcomes of IM nailing and extramedullary

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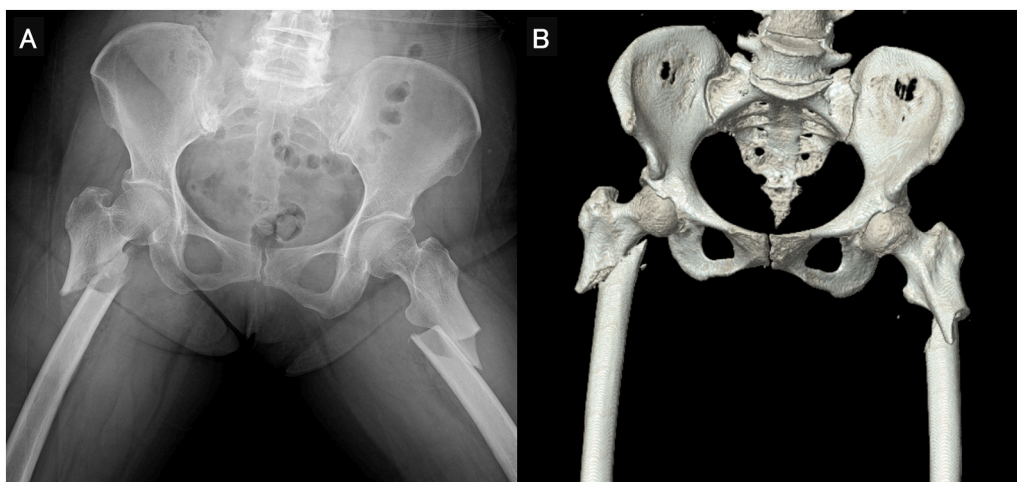
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**Fig. 1.** Pre-operative radiograph and computer tomography (CT).

(A) Radiograph showing atypical femoral subtrochanteric fractures on both sides, classified as Seinsheimer type IIC (right)/IIA (left). The fracture line originates at the lateral cortex and is substantially transverse in its oblique course, as it progresses medially across the femur. Localized periosteal thickening of the lateral cortex is seen at the fracture site.

(B) CT showing noncomminuted fractures on both sides.

**Table 1**

ASBMR Task Force 2013 Revised Case Definition of AFFs.

To satisfy the case definition of AFF, the fracture must be located along the femoral diaphysis from just distal to the lesser trochanter to just proximal to the supracondylar flare. In addition, at least four of five Major Features must be present. None of the Minor Features is required but have sometimes been associated with these fractures.

Major features

1. The fracture is associated with minimal or no trauma, as in a fall from a standing height or less
2. The fracture line originates at the lateral cortex and is substantially transverse in its orientation, although it may become oblique as it progresses medially across the femur
3. Complete fractures extend through both cortices and may be associated with a medial spike; incomplete fractures involve only the lateral cortex
4. The fracture is noncomminuted or minimally comminuted
5. Localized periosteal or endosteal thickening of the lateral cortex is present at the fracture site (“beaking” or “flaring”)

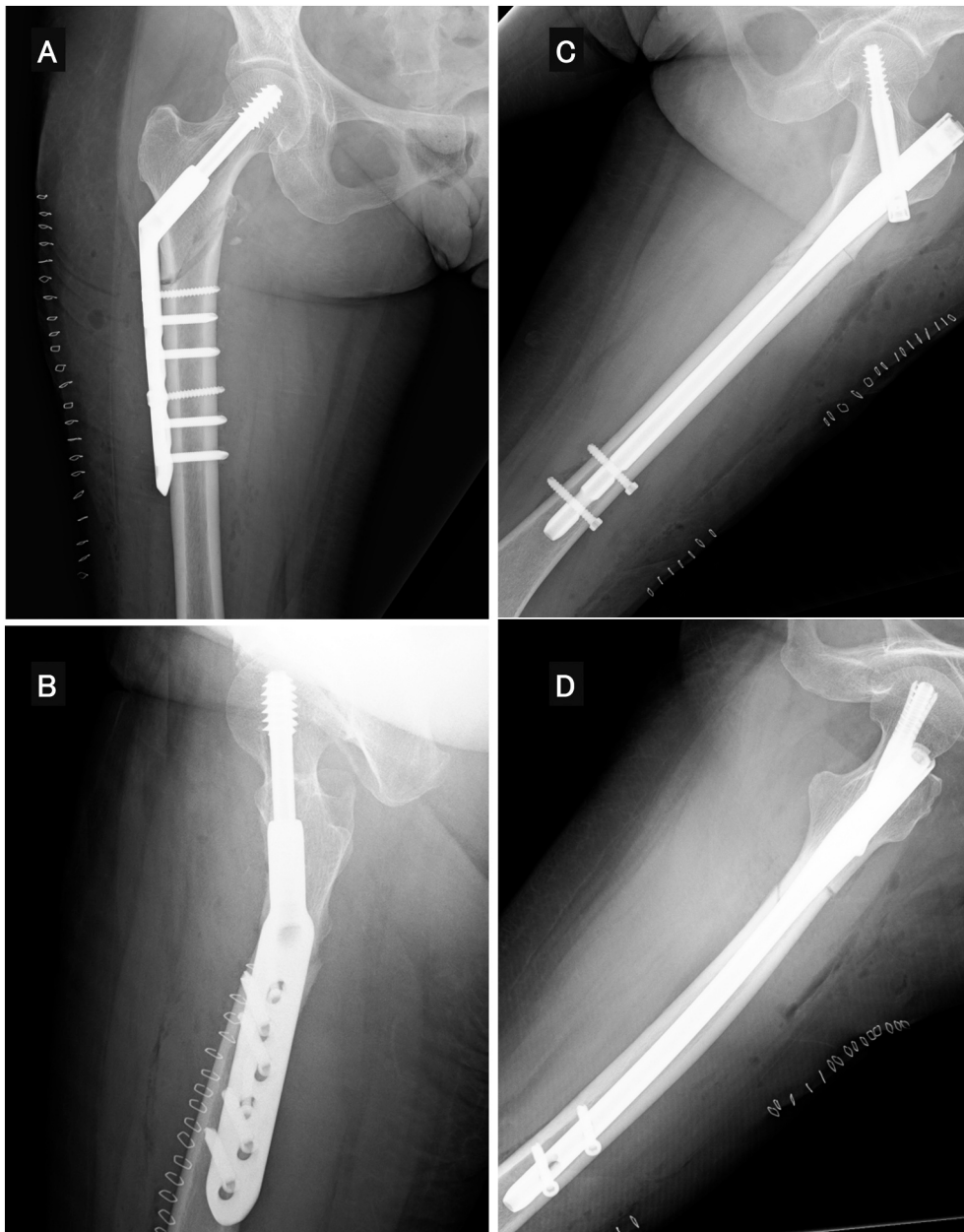
Minor features

1. Generalized increase in cortical thickness of the femoral diaphyses
2. Unilateral or bilateral prodromal symptoms such as dull or aching pain in the groin or thigh
3. Bilateral incomplete or complete femoral diaphysis fractures
4. Delayed fracture healing

fixation. Moreover, there are no case reports on bilateral atypical femoral subtrochanteric fractures treated with an IM nail on one side and a compression hip screw (CHS) on the other; therefore, we report this case.

### Case presentation

A 69-year-old woman (height: 151.0 cm; weight: 55.3 kg; body mass index: 24.3 kg/m<sup>2</sup>; bone mineral density: 0.819 g/cm<sup>2</sup>; and T-score: −2.0 at the lumbar spine) had been taking risedronate sodium 75 mg once a month for 11 years. Six months prior to presentation, she reported pain in both her thighs owing to an unknown cause. She adopted a “wait and watch” approach, but no improvement, was noted. Upon visiting a hospital, no abnormality was detected. However, she subsequently experienced a fall from a standing height and was unable to walk. She was transported to our hospital by an ambulance. An X-ray scan showed bilateral femoral subtrochanteric fractures (right side: Seinsheimer type IIC; left side: Seinsheimer type IIA) (Fig. 1). A diagnosis of atypical femoral subtrochanteric fracture was made since all major diagnostic criteria were met [2]. (Table 1) After 4 days, she was operated upon in a traction bed under general anesthesia. On the right side, the reduction was successful in the abduction position, but it was difficult to maintain good reduction for implantation of the IM nail since we used a CHS. On the left side, we implanted an IM nail after open reduction. The reduction was successful on both sides (Fig. 2). After the surgery, the patient was permitted 50% weight bearing on the right side and full weight bearing on the left side. The postoperative course was uneventful. Full weight bearing was allowed on the right side 1 month postoperatively. We stopped risedronate sodium and started parathyroid hormone (PTH) daily for one week postoperatively. She was able to walk at 3 months postoperatively. At 6 months after the surgery, the left side achieved bone union, but the right-sided union was delayed. Low-intensity pulsed ultrasound was used to promote right-side bone union, which was



**Fig. 2.** Postoperative radiographs.

Radiograph showing compression hip screw fixation in the (A) anterior view and (B) lateral view on the right side.

Radiograph showing intramedullary nail fixation in the (C) anterior view and (D) lateral view on the left side. Both sides have achieved good reduction.

subsequently achieved at 14 months postoperatively (Figs. 3 and 4).

Written, informed consent was obtained from the patient for the publication of this report and its accompanying images.

## Discussion

IM nailing and extramedullary fixation are used to manage atypical subtrochanteric femoral fractures. Teo et al. [3] reported that the mean time to radiological union was 7.7 months in the IM nailing group and 10.9 months in the extramedullary group among patients with AFF. Koh et al. [4] reported that the percentage of reoperation in AFF treated with extramedullary fixation (31.3%) was greater than that with IM nailing (12.9%). Several reports suggest that IM nailing is the first line of treatment for AFF owing to the higher rate of union and lower rate of reoperation than extramedullary fixation. However, IM nailing is difficult to perform in cases



**Fig. 3.** Sequential anteroposterior radiographs showing delayed, but eventual bone union on the right side (figures show 1, 3, 6, and 14 months postoperatively, from left to right).



**Fig. 4.** Sequential anteroposterior radiographs showing satisfactory bone union on the left side (1, 3, 6, and 14 months postoperatively, from left to right).

with a bowed femoral shaft and type of fracture. Thus, a detailed fracture classification is essential to choose an appropriate fixation device.

Saarenpää et al. [5] reported that an IM nailing group experienced more frequent intraoperative complications and difficulties in reduction than an extramedullary fixation group among patients with Seinsheimer type IIC fracture. Wang et al. [6] reported that extramedullary implants could provide good stability for subtrochanteric femoral fractures, in which the medial cortex is restored.

Stability is an important requirement for bone union, but the quality of reduction is also important. Cho et al. [7] reported that in atypical femoral fractures treated with a cephalomedullary nail, the quality of reduction was the most important consideration for bony union and time to union. Egol et al. [8] reported that the mean healing time for an anatomically reduced group was 7.1 months, while non-anatomically reduced fractures healed in 10.8 months. Anatomical alignment is essential even when using IM nailing. In this case, we achieved good reduction in the abduction position, but it was difficult to maintain this reduction in the adduction position for implanting an IM nail. The medial cortex was restored, thus necessitating CHS in the abduction position. The surgery was successful, but bone union was prolonged, possibly because CHS provides less stability than IM nailing. The prolonged bone union could also be due to SSBT. Odvina et al. [9] performed bone biopsy in nine patients who were on long-term alendronate treatment and reported that surface osteoblasts were either lost or reduced, and consequently, bone formation was extensively reduced. Oh et al. [10] reported that AFF treated with a long course of drugs causing bone turnover suppression showed suppressed biological activity on histological examination, and these cases had a high risk of delayed bone union. In this case, the patient was exposed to long-term bisphosphonate therapy causing SSBT.

We reamed the fractured part on the IM nail side, but not on the CHS side, which may have affected bone union. Reaming activates a periosteal vascular reaction. The increase in periosteal blood flow promotes new bone formation, which, in turn, stimulates bone union. The operative results in this patient support previously reported findings in that IM nailing is the first option for treating subtrochanteric AFF, although there were differences in the fracture type and postoperative treatment.

## Conclusion

IM nailing provides stronger fixation, faster bone union, and lower reoperation rates than extramedullary fixation. If the fracture can be adequately reduced, IM nailing can be considered the first option for treating AFF.

## Informed consent

The patient provided written informed consent to publish the case report.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that have influenced the work reported in this paper.

## References

- [1] M.S. Larsen, H. Schmal, The enigma of atypical femoral fractures: a summary of current knowledge, *EFORT Open Rev.* 3 (2018) 494–500.
- [2] E. Shane, D. Burr, B. Abrahamsen, et al., Atypical subtrochanteric and diaphyseal femoral fractures: second report of task force of the American Society for Bone and Mineral Research, *J. Bone Miner. Res.* 29 (2014) 1–23.
- [3] B.J.X. Teo, J.S.B. Koh, Goh.SK, et al., Post-operative outcomes of atypical femoral subtrochanteric fracture in patients on bisphosphonate therapy, *Bone Joint J.* 96B (2014) 658–664.
- [4] A. Koh, E. Guerado, P.V. Giannoudis, Atypical femoral fractures related to bisphosphonate treatment. Issues and controversies related to their surgical management, *Bone Joint J.* 99B (2017) 295–302.
- [5] I. Saarenpää, T. Heikkinen, P. Jalovaara, Treatment of subtrochanteric fractures. A comparison of the Gamma nail and the dynamic hip screw: short-term outcome in 58 patients, *Int. Orthop.* 31 (2007) 65–70.
- [6] J. Wang, X.L. Ma, J.X. Ma, et al., Biomechanical analysis of four types of internal fixation in subtrochanteric fracture model, *Orthop. Surg.* 6 (2014) 128–136.
- [7] J.W. Cho, C.W. Oh, L. Frankie, et al., Healing of atypical subtrochanteric femur fractures after cephalomedullary nailing: which factors predict union? *J. Orthop. Trauma* 31 (2017) 138–145.
- [8] K.A. Egol, J.H. Park, Z.S. Rosenberg, et al., Healing delayed but generally reliable after bisphosphonate-associated complete femur fractures treated with IM Nails, *Clin. Orthop. Relat. Res.* 472 (2014) 2728–2734.
- [9] C.V. Odvina, J.E. Zerwekh, D. Sadhaker, et al., Severely suppressed bone turnover: a potential complication of alendronate therapy, *J. Clin. Endocrinol. Metab.* 90 (2005) 1294–1301.
- [10] Y. Oh, K. Yamamoto, J. Hashimoto, et al., Biological activity is not suppressed in mild-shaft stress fracture of the bowed femoral shaft unlike in “typical” atypical subtrochanteric femoral fracture; a proposed theory of atypical femoral fracture subtypes, *Bone* 137 (2020), 115453.