CASE REPORT

Traumatic subchondral fracture of the femoral head in a healed trochanteric fracture

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Accepted 28 June 2014

SUMMARY

An 82-year-old woman sustained a trochanteric fracture of the left femur after a fall. Fracture fixation was performed using proximal femoral nail antirotation (PFNA) II, and she was able to walk with a T-cane after 3 months. Eleven months following the operation, the patient presented with left hip pain after a fall. Radiographs showed a subchondral collapse of the femoral head located above the blade tip. The authors removed the PFNA-II and subsequently performed cemented bipolar hemiarthroplasty. Histological evaluation of the femoral head showed osteoporosis with no evidence of osteonecrosis. Repair tissue, granulation tissue and callus formation were seen at the collapsed subchondral area. Based on these findings, a traumatic subchondral fracture of the femoral head in a healed trochanteric fracture was diagnosed. A traumatic subchondral fracture of the femoral head may need to be considered as a possible diagnosis after internal fixation of the trochanteric fracture.

BACKGROUND

Hip fracture is the most serious consequence of osteoporosis. As life expectancy increases, the incidence of hip fracture rises drastically. Treatment of trochanteric fractures with intramedullary fixation devices is a well-established method because of the biological and biomechanical advantages of these devices.¹ The proximal femoral nail antirotation (PFNA; Synthes, Oberdorf, Switzerland) is an intramedullary device with a helical blade, which was

developed by AO/ASIF (Davos, Switzerland) in 2004.² Recently, the AO/ASIF developed the PFNA-II (also known as PFNA-Asia) with sizes and geometry adapted to the femoral geometric proportion of Asians.³ The helical blade has been claimed to compact the cancellous bone to provide increased stability,⁴ and several studies have shown good clinical results with these devices.^{2 3 5} This article describes a rare case involving traumatic subchondral fracture of the femoral head without osteonecrosis after successful treatment of a trochanteric fracture using PFNA-II.

CASE PRESENTATION

An 82-year-old woman sustained a trochanteric fracture (AO/OTA classification: 31-A3) of her left femur after a fall (figure 1A, B). She was diagnosed with rheumatoid arthritis and treated with oral prednisolone (7.5 mg/day) for 2 years. The patient's height was 147 cm; weight 39.1 kg; and body mass index 18 kg/m². The bone mineral density (BMD) of the right femoral neck was 42% of the mean in young adults. Closed reduction and internal fixation were performed without difficulty using the PFNA-II (Synthes, Oberdorf, Switzerland). The diameter and length of the nail were 10 and 170 mm, respectively. The length of the helical blade was 90 mm. The blade was inserted into the centre of the femoral head, with a tip-apex distance (TAD)⁶ of 19 mm. The patient's postoperative course was uneventful, and she followed a full

Figure 1 Initial post-traumatic anteroposterior (A) and lateral (B) radiograph of the left hip.

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To cite: Lee SY, Niikura T, Iwakura T, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2014-205161

Figure 2 Anteroposterior (A) and lateral (B) radiographs at 3 months after surgery.

weight-bearing regimen. She was able to walk with a T-cane without pain after 3 months (figure 2A, B).

Eleven months following the operation, the patient presented with left hip pain after she had fallen from a bed and landed onto her left hip. Radiographs of the hip showed a healed left trochanteric fracture with the blade in good position. Fractures of the superior and inferior pubic rami were also noted, along with subchondral collapse of the femoral head located above the blade tip (figure 3A, B). The patient underwent removal of the PFNA-II and cemented bipolar hemiarthroplasty. On gross examination, the superolateral portion of the removed femoral head appeared to be flattened (figure 4A). Histological evaluation of the femoral head showed osteoporosis with no evidence of osteonecrosis (figure 4B). Repair tissue, granulation tissue and callus formation were seen at the collapsed subchondral area. Based on these findings, traumatic subchondral fracture of the femoral head was diagnosed.⁷

OUTCOME AND FOLLOW-UP

At the latest follow-up (21 months after surgery), the patient was able to walk with a T-cane without pain. There was no loosening of the prosthesis in her left hip.

DISCUSSION

The use of PFNA/PFNA-II allows a minimally invasive approach and provides stable fixation, thereby allowing early full weight-bearing mobilisation. Most of the complications documented in the literature associated with PFNA/PFNA-II were helical blade cutout, acetabular perforation or backout.^{2 5 8 9} To the best of our knowledge, subchondral fracture of the femoral head after treatment of trochanteric fracture with PFNA/PFNA-II has not been reported. The most commonly encountered subchondral fractures of the femoral head are those associated with osteonecrosis.¹⁰ However, subchondral fracture of the femoral head without osteonecrosis is a rare entity. These fractures occur in elderly women

Figure 3 (A) Anteroposterior radiograph and (B) CT image at 11 months after surgery, showing subchondral collapse of the femoral head which was located above the tip of the blade.

Figure 4 (A) A photograph obtained during operation of the retrieved femoral head showing flattening of the superolateral portion of the femoral head. (B) A photomicrograph of a specimen from the collapsed subchondral area showing repair tissue, granulation tissue and callus formation with no evidence of osteonecrosis. Scale bar=500 μ m.

with severe osteoporosis and/or obesity, who experience acute hip pain with no apparent trauma.^{7 11–13} Wittstein *et al*¹⁴ recently reported a case of traumatic subchondral fracture of the femoral head in a thin, elderly woman, who sustained a direct fall on the hip, concluding that this fracture should be included in the differential diagnosis of new onset hip pain after trauma in thin, elderly, osteoporotic women. In the present case, histological examination of the femoral head revealed osteoporosis with no evidence of osteonecrosis. Repair tissue, granulation tissue and callus formation were seen at the collapsed subchondral area. To the best of our knowledge, this is the first report of a traumatic subchondral fracture of the femoral head without osteonecrosis in a healed trochanteric fracture after internal fixation.

The present case revealed good postoperative reduction and correct blade position. The TAD of 19 mm appeared to be within an appropriate distance, considering that Baumgaertner *et al*⁶ reported a higher complication rate in patients with TADs of more than 25 mm. The trochanteric fracture had uneventfully healed, and the patient was able to walk with a T-cane 3 months after initial surgery. Therefore, it is unlikely that the cause of the subchondral fracture of the femoral head is a surgical error. Our patient sustained a subchondral fracture of the femoral head after a direct blow to the hip. She had a history of steroid intake (7.5 mg of prednisolone/day) for 2 years. The BMD of the right femoral neck was 42% of the mean in young adults. Furthermore, histological examination of the femoral head showed osteoporosis without any sign of osteonecrosis. These findings emphasise that the cause of fracture was bone fragility due to osteoporosis.

One possible cause of the subchondral fracture in the current case is the stress concentration effect of a stiff metallic blade. This is referred to as the 'stress riser' fracture.¹⁵ Several cases of subcapital fracture of the femoral head occurring at the tip of the lag screw or blade in a healed trochanteric fracture have been reported as 'stress riser' fractures.^{15 16} This complication occurred because of the inappropriate position of the blade or lag screw or because of large TAD (>25 mm). In the current case, since the position of the blade and the TAD were adequate, a subchondral fracture instead of a subcapital fracture may have occurred secondary to the stiff blade acting as a stress riser through the osteoporotic bone.

Because of the rarity of a traumatic subchondral fracture of the femoral head in a healed trochanteric fracture, it is not yet

determined if this phenomenon occurs only in patients who are treated using PFNA/PFNA-II with a helical blade. We speculate that this fracture may also occur in those who are treated using other devices with a lag screw. There may be a possible relationship between the implant and the fracture biomechanically. However, accumulation of more cases is necessary to confirm this. This case report identifies a new type of postoperative complication associated with trochanteric fractures.

Learning points

- ▶ Traumatic subchondral fracture of the femoral head without osteonecrosis in a healed trochanteric fracture is rare.
- ▶ This case identifies a new type of postoperative complication associated with trochanteric fractures.
- ▶ A traumatic subchondral fracture of the femoral head may need to be considered as a possible diagnosis in patients with internal fixation of a trochanteric fracture.

Contributors All the authors have contributed towards analysis and interpretation of data, revising of the manuscript critically and final approval of the version published. SYL drafted the article.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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