CASE REPORT

Implant failure caused by non-union of bisphosphonate-associated subtrochanteric femur fracture

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Accepted 10 March 2014

SUMMARY

Bisphosphonate use has been identified as a contributory factor in atypical subtrochanteric fracture of the femur. These fractures are commonly treated with an intramedullary device. We present a case of implant failure of an intramedullary device caused by non-union of an atypical subtrochanteric fracture.

BACKGROUND

Alendronate, a bisphosphonate, is a potent inhibitor of bone resorption, and is widely used in the treatment of osteoporosis. A number of randomised clinical trials have shown that it significantly increases bone density of spine and hip and reduces the incidence of fractures in patients with osteoporosis.¹⁻⁴ Atypical subtrochanteric femur fracture associated with alendronate therapy was first reported in 2005.⁵ This report identified alendronate therapy as a potential cause of delayed fracture union.⁵ Delayed fracture union can lead to failure of orthopaedic implants through metal fatigue and implant fracture.⁶ We describe a case of implant failure of an intramedullary device caused by non-union of an alendronate-related subtrochanteric femur fracture. We believe that this is the first documented case of orthopaedic implant failure resulting from alendronate-related fracture non-union.

CASE PRESENTATION

A 63-year-old woman underwent cephalomedullary nailing of her left femur after sustaining a subtrochanteric fracture in a minor fall (figure 1). Review

of her clinical history revealed that she had been started on alendronate therapy for osteoporosis 4 years prior to her fracture. She also confirmed that she had been suffering from low-grade thigh pain in the 4 months preceding her injury. Radiographs of the proximal femur demonstrated a thickening of the lateral cortex of her femur at the level of the fracture. An association was made between her prodromal thigh pain, bisphosphonate use and radiographic findings, and after assessment of her overall health status the decision was taken to discontinue the alendronate therapy.

Initial postoperative rehabilitation was uneventful and the patient was discharged home after 6 days. She was reviewed routinely in our outpatient department with clinical examination and radiographic assessment. At her 6-month assessment, she reported minimal thigh and leg pain, and excellent function in the leg, and was advised to return for further review at 9 months postoperatively. At the 9-month review, the patient reported increasing thigh pain on the operated side. Radiographs demonstrated delayed healing of the fracture, and the patient was scheduled for exchange nailing of her femur (figure 1). Unfortunately, 1 month later the patient presented to the accident and emergency (A&E) department following spontaneous collapse and severe pain in her left leg.

INVESTIGATIONS

Radiographs taken in A&E department revealed fatigue fracture of her cephalomedullary nail at the level of the lag screw aperture (figure 2).

Figure 1 (A) Anteroposterior radiograph of the left hip demonstrating subtrochanteric fracture. (B and C) Anteroposterior and lateral radiograph of the left hip 9 months later demonstrating intramedullary nail in situ and delayed union of the fracture.

To cite: O'Neill BJ, O'hEireamhoin S, Morrissey DI, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2013-203519

Figure 2 (A) Anteroposterior radiograph of the left hip demonstrating fracture non-union and failure of intramedullary nail at the aperture for lag screw. (B and C) Anteroposterior and lateral radiographs of the left hip after exchange nailing and insertion of morsellised bone allograft.

TREATMENT

The patient was taken to the operation theatre the next day and all metalwork was removed from her left femur using an open approach. The removed implant can be seen in [figure 3](#). After consultation with her original operation note, identical implants to those removed were inserted into the femur using the original entry points. The fracture site was augmented with a morsellised allograft femoral head from the local bone bank ([figure 2](#)).

OUTCOME AND FOLLOW-UP

The patient developed a Trendelenburg-type gait postoperatively. This was felt to be due to scarring and weakness of her abductor musculature caused by the extensive dissection necessary to remove the fractured implant and insert the revision device. After 9 months of intensive physiotherapy her gait had returned to normal, but she still reported pain in her thigh. She returned to the operation theatre for a third time for removal of her distal locking screws in order to dynamise the fracture to aid bone healing. After a further 6 months she finally achieved resolution of her pain, and radiographs confirmed union of her fracture ([figure 4](#)).

DISCUSSION

Atypical insufficiency fracture of the subtrochanteric region of the femur associated with bisphosphonate therapy was first described in 2005.⁵ Subsequent reports from around the world have identified certain common radiological and clinical features associated with these fractures. Most patients had been receiving bisphosphonate therapy for five or more years and have prodromal thigh pain.^{7–10} Radiographic features include cortical thickening in the lateral side of the subtrochanteric region, a transverse fracture and a medial cortical spike.⁸

Figure 3 Clinical photographs of the removed fractured intramedullary nail and lag screw.

Histological analysis of these fractures shows over-suppression of bone turnover.⁵ Bisphosphonates have a considerable inhibitory effect on tyrosine phosphatase, an enzyme that is important in the regulation of osteoclast formation and function.¹¹ They promote osteoclast acid activation and subsequent inhibition of bone resorption without osteoclast destruction.¹² This leads to improved bone mineral density in the lumbar vertebrae, femoral neck, trochanter and globally throughout the body¹ and reduces the incidence of fractures in patients with osteoporosis.^{1 2 13} It has been speculated, however, that bisphosphonates may inhibit normal repair of microdamage through suppression of bone turnover, which in turn results in accumulation of microdamage.^{14 15} In areas of high stress, such as the subtrochanteric region of the femur, this accumulated microdamage may result in pathological fracture.

The ongoing use of bisphosphonate therapy in the presence of a non-united fracture is controversial. Based on their inhibition of bone formation and resorption, there are theoretical risks that the use of bisphosphonate therapy in the presence of a non-united fracture may inhibit callus formation, and potentially lead to non-union.^{16 17} Solomon *et al*¹⁸ demonstrated that use of bisphosphonates in the presence of a humerus fracture doubled the risk of non-union. They concluded, however, that because non-union of humerus fractures is so rare, the risk of non-union should be balanced with the potential benefits of bisphosphonate therapy in patients with osteoporosis.¹⁸ Contrary to the findings of Solomon *et al*, Bosemark *et al*¹⁹ demonstrated in an animal model that bisphosphonates can be combined with bone morphogenic protein and autograft bone to improve the healing rate of fractures. They conclude that this combination may be of benefit in the treatment of fracture non-unions.¹⁹

The link between bisphosphonate therapy and subtrochanteric femur fractures remains somewhat controversial.²⁰ However, epidemiological studies seem to support a link between bisphosphonate use of more than 5 years and an increased risk of subtrochanteric femur fractures, although the absolute risk remains low.²¹ This has led to some authors recommending that the use of bisphosphonates be restricted in high-risk patients, and that the use of bisphosphonates be reviewed in all patients after 5 years of treatment.^{13 22} Patients who continue on bisphosphonate therapy should be advised of the prodromal thigh pain that may precede subtrochanteric fracture, and routine radiographic imaging of proximal femora may also be warranted.^{5 9 23}

Figure 4 (A) Anteroposterior radiograph of the left hip 9 months after revision surgery. (B) Distal aspect of the left femur postremoval of static locking screws and insertion of dynamic locking screw. (C) Anteroposterior radiograph of the left hip 6 months postdynamisation demonstrating healed fracture.

Learning points

- ▶ The overall risk of bisphosphonate-related subtrochanteric femur fracture is low, but the outcome can be catastrophic.
- ▶ All patients on bisphosphonate therapy should be advised of the prodromal thigh pain that precedes subtrochanteric fracture.
- ▶ Bisphosphonate use should be reviewed after a period of 5 years.
- ▶ Patients who remain on bisphosphonate therapy for more than 5 years should have annual screening radiographs of both proximal femora, regardless of the presence or absence of symptoms.

Acknowledgements The authors would like to acknowledge Ms Sharon Molloy, who took the clinical photographs used in figure 3.

Contributors BJON and SOE performed the revision procedure and cowrote the manuscript. DIM performed the initial procedure and provided details regarding this procedure. PK is the consultant in overall charge of the case. All authors proof-read and edited the manuscript prior to submission.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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