Trauma Case Reports 26 (2020) 100290

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Unexpected iatrogenic fracture of the femoral neck during subtrochanteric fracture fixation in a patient on bisphosphonate treatment for osteoporosis: Case report

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ARTICLE INFO

Keywords:
Case report
Orthopedic surgery
Bisphosphonate
Subtrochanteric fracture

ABSTRACT

Osteoporotic patients being treated with bisphosphonates present an interesting dilemma when removing hardware such as dynamic hip screws "DHS". In this paper, we describe the case of a 66-year-old osteoporotic patient who was placed on long term bisphosphonate therapy after sustaining an intertrochanteric hip fracture which was stabilized with a DHS. She presented with a subtrochantric fracture on the ipsilateral side. She was planned for DHS removal and intramedullary nailing. Removal of the dynamic hip screw proved to be difficult, likely due to possible cold welding of the DHS to the barrel of the side plate and sclerotic bone formation around the hardware secondary to the extended bisphosphonate use. The patient had an intraoperative femoral neck fracture while attempting the DHS removal. We had to convert to an unanticipated total hip replacement. Careful considerations should be taken when removing hardware from patients on long term bisphosphonate treatment.

Introduction

Second hip fractures are common, affecting approximately 10% of those with previous fractures [1]. The risk factors for these subsequent fractures are limited to intrinsic qualities such as age, cognitive impairments and low bone mass [2]. In contrast, there has been interest in the association between long-term bisphosphonate (BP) therapy and risk for subsequent fracture [3]. BP therapy is often commenced in patients with osteoporosis, as they increase bone density and reduce risk of future fractures. However, among other side effects such as osteonecrosis of the jaw, recent evidence from epidemiological studies suggests that BPs may also increase the risk for atypical femoral fractures due to the accumulation of micro damages and alteration in the bone turnover rate [3]. A BP-induced osteopetrosis model has been described previously [4], however to our knowledge, this implication has not yet been studied in adults.

There is limited literature on the removal of hardware from patients, especially following long term BP use, with possible BP-

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https://doi.org/10.1016/j.tcr.2020.100290
Accepted 17 February 2020
Available online 07 March 2020

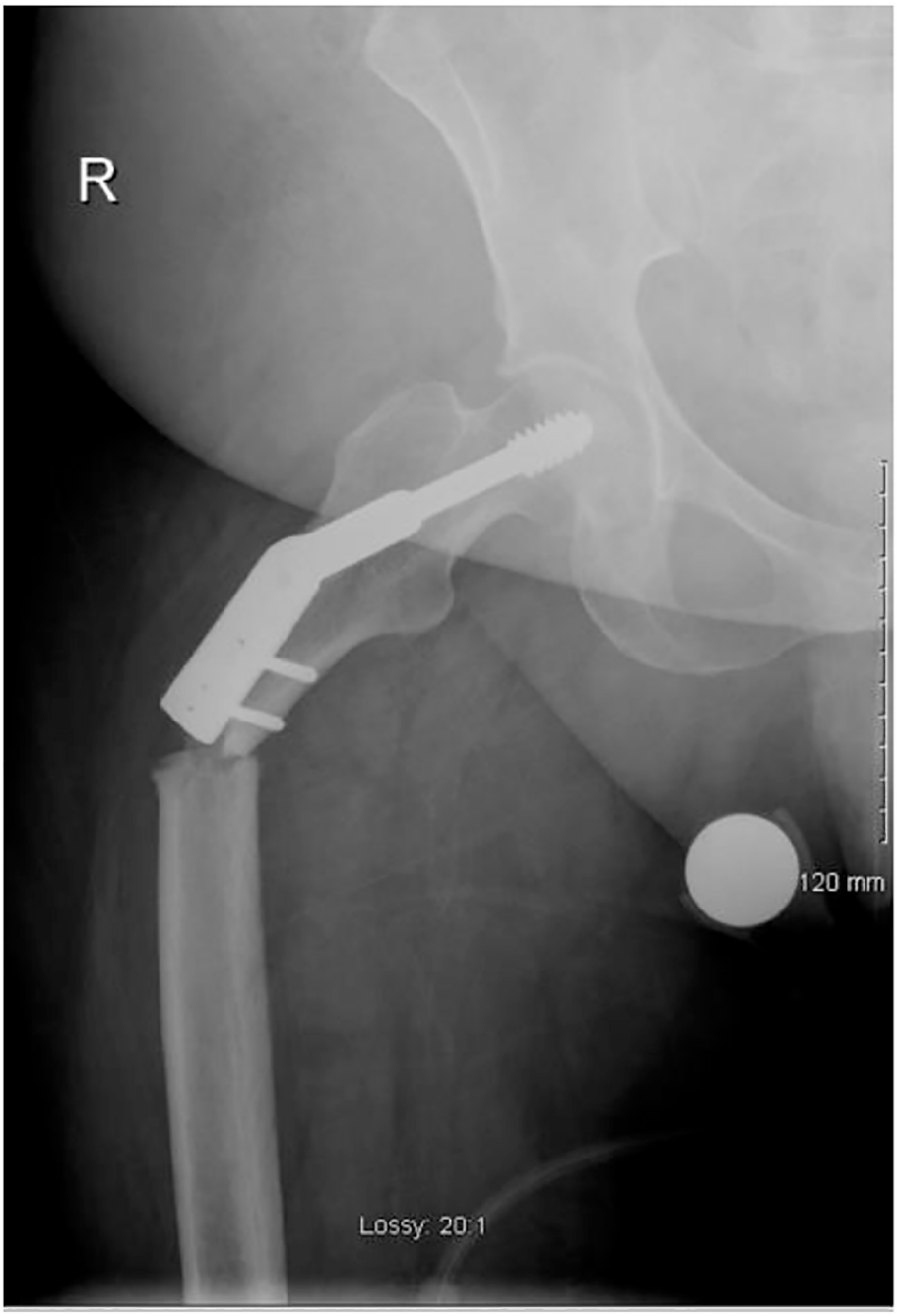

Fig. 1. Anteroposterior x-ray of right hip with periprosthetic subtrochanteric fracture distal to DHS with lateral angulation of bony fragments.

induced osteopetrosis leading to unforeseen complications. In this case report, we discuss an unusual complication in a 66-year-old osteoporotic female on long term BP (Alendronate) therapy that presented with an atypical subtrochanteric fracture 10 years after sustaining an intertrochanteric fracture treated with a dynamic hip screw (DHS).

Case presentation

A 66-year old osteoporotic woman presented to the emergency room with right sided hip pain following a mechanical fall. The patient provided informed consent, which followed the McGill University Health Centre guidelines for experimental investigation. The patient was exiting her car when she slipped on the ice and landed on her right side. 10 years prior to her presentation, she sustained a right intertrochanteric femur fracture which was treated with a DHS. Since then, she has been on alendronate for her

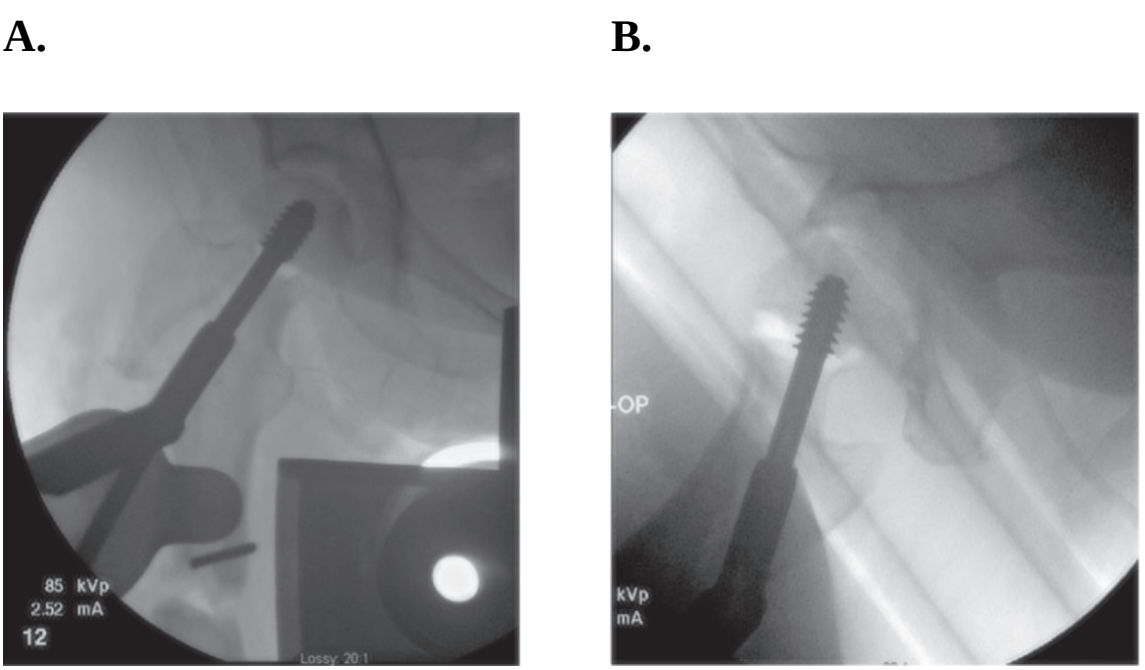

Fig. 2. Anteroposterior (A) and lateral (B) intraoperative fluoroscopy images of the right hip showing a subcapital femoral neck fracture.

osteoporosis. On examination, there was clear shortening and external rotation of the right leg, but she was neurovascularly intact. She did not sustain any head trauma or loss of consciousness.

The patient's x-ray showed a subtrochanteric fracture distal to the DHS plate (Fig. 1). She was booked for removal of the DHS followed by antegrade femoral nailing. During the operation, removal of the DHS failed with the usual technique as the side plate was cold welded to the hip screw. We resorted to using a diamond burr to cut the top of the barrel on the DHS to assist with its removal. This technique also failed and the final method attempted was helicoptering the plate out with the screw as a single unit in a counter-clockwise direction. During that maneuver, we applied excessive torque and subsequently felt a sudden give. The possibility of a fracture was confirmed by fluoroscopy and the x-ray showed an iatrogenic subcapital femoral neck fracture (Fig. 2A, B). Failure to remove the hardware and the unexpected femoral neck fracture in conjunction with the unavailability of an arthroplasty surgeon, the procedure was decided to be aborted as we were not prepared for a complex total hip arthroplasty. The incision was closed in layer and skin traction was applied. The next day and after thorough planning, the DHS was removed using a standard posterior approach with the morselization of the femoral head. The difficulty experienced with the removal of the DHS is evident by its aesthetics following removal. Subsequently a total hip replacement was performed using a long fully porous coated stem prosthesis and periprosthetic cerclage wires were added to bypass the fracture site, with good implant positioning on post op x-ray (Fig. 3).

Following definitive management of her hip fracture, Alendronic acid treatment was stopped. Instead, the patient was started on vitamin D, calcium, denosumab and teriparatide as for patients who have failed typical osteoporosis therapy with a follow up in 3 months with the patient's family doctor and rheumatologist. The patient was followed up in arthroplasty clinic and was mobilizing well with no difficulties or complications. Her 2-year follow-up x-ray is shown with satisfactory position of the hardware (Fig. 4).

Discussion

In this report, we present an unusual case of a femoral neck fracture during subtrochanteric fracture fixation. The patient presented with symptoms of hip pain after a fall and x-ray imaging concluded a subtrochanteric fracture distal to the DHS plate previously inserted. Multiple attempts to remove the DHS device failed, with the final attempt to remove it, she had an unexpected iatrogenic femoral neck fracture leading to an eventual total hip replacement.

Hardware implantation is likely to cause pain post-surgery, and removal seems to be the only option for some of these patients [5]. In patients with long term BP use, the abnormal thickening of the bone makes it especially difficult to remove hardware, as seen with our patient. Hardware removal in these patients has been shown to lead to femoral neck fracture [6], likely due to osteoporosis-induced limb fragility. In our case, we report unique complications that may be associated with hardware removal on a patient being treated with long term BP use. The BP-induced osteopetrosis promoted infusion of the thickened bone around the DHS threads, making removal of the hardware very difficult.

Atypical hip fractures post-BP treatment are becoming more common [3]. BPs are synthetic analogues of inorganic pyrophosphate which reduce osteoclastic bone resorption and thus reduce bone turnover. Although BPs are well known to aid in the rejuvenation of bone in osteoporotic patients, they are also associated with adverse side effects such as osteonecrosis of the jaw, musculoskeletal pain,

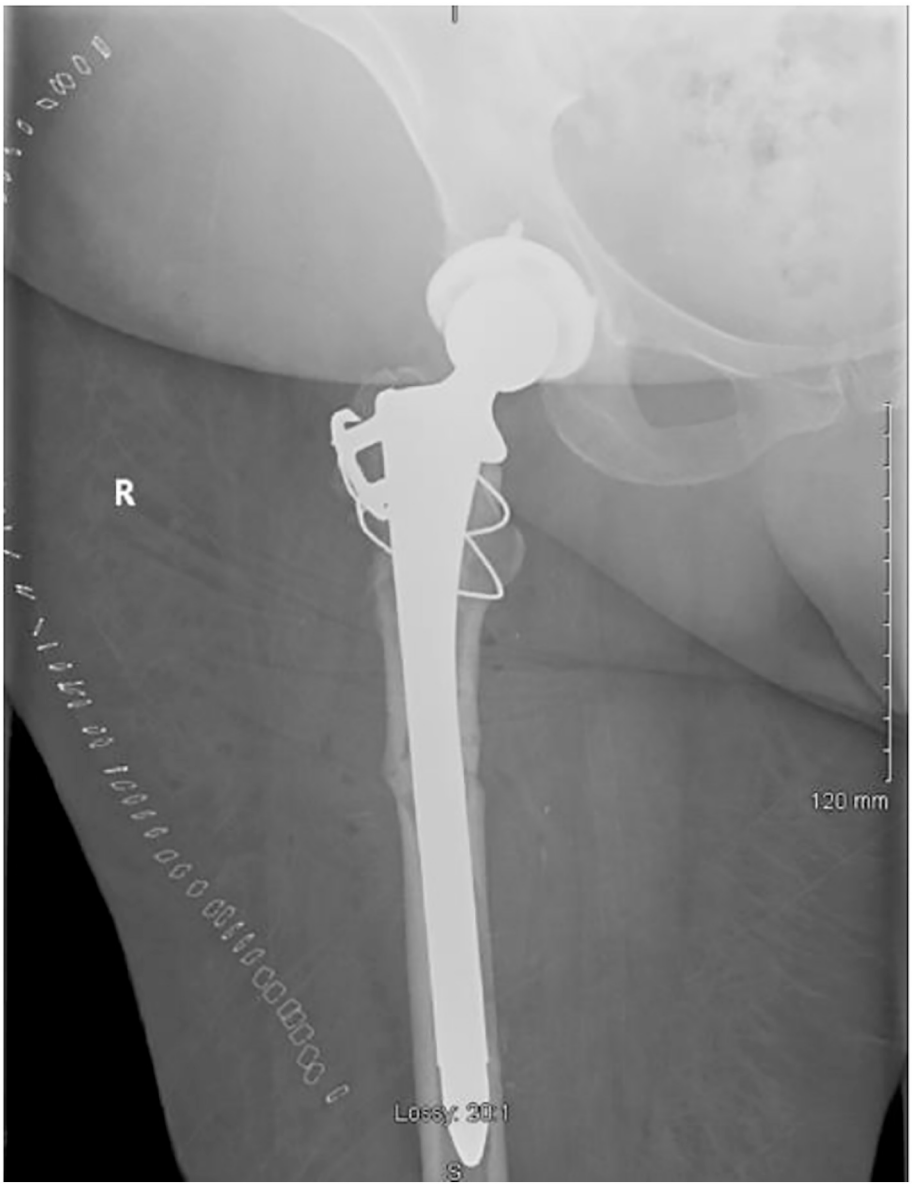

Fig. 3. Anteroposterior x-ray of right hip post-total hip arthroplasty with long stem, fully porous stem and cerclage wiring.

atrial fibrillation and BP induced osteopetrosis [3,4], which increases the risk of atypical femoral fractures as seen with our case. The increased risk of femoral fractures with this drug may be due to the increased bone thickening found in the lateral cortex of these patients. In a recent case report, histological analysis of this thickened cortex found no tertrate-resistant acid phosphatase-positive osteoclasts, indicative of impaired bone resorption [7]. This may suggest that complete bone remodeling is necessary to protect the bone from atypical breaks. As BPs adhere avidly to bone, it has been found that a large reservoir of the drug accumulates with long term use. 'Drug holidays' every 5 years have been proposed by various studies in an attempt to reduce side effects experienced by patients on long term BPs [8].

Multiple reports have been made of subtrochanteric fractures associated with long term BP use [9]. Aside from prodromal pain experienced, fractures associated with prolonged BP use have been reported to have characteristic features consisting of cortical thickening lateral to the subtrochanteric region, transverse in nature, with a medial cortical spike [7]. Kwek et al. reviewed 17 patients who sustained subtrochanteric fractures following long term BP use characteristic in nature as described above, with 9 of these patients (53%) having bilateral stress fractures [9]. Lenart et al. found distinct radiological patterns, which they described as simple oblique ($< 30^{\circ}$) fractures of the proximal femoral shaft with breaking of the cortex and thickening of the cortex [10]. Furthermore, if CT imaging is available prior to atypical femoral fractures in these patients, the findings are not consistent, but may show cortical thickening. These findings are similar to those seen in stress fractures, with evidence of callus formation and evidence of an

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Fig. 4. 2-year follow up anteroposterior x-ray of right hip post-total hip arthroplasty showing satisfactory position and no radiological evidence of malfunction.

attempt at bone repair. The most important imaging modality prior to such fractures occurring is an MRI which will show, similar to stress fractures, characteristic periosteal high signal and normal bone marrow on STIR of the lateral aspect of the femur. Additionally, increased periosteal changes and bone marrow edema with possible cortical thickening can be seen.

Conclusions

This case explains the difficulties associated with the management of periprosthetic fractures following long term BP therapy. BP induced osteopetrosis makes bone abnormally dense and increases the risk of atypical fractures. The thickening of the bone is also found to engross hardware making its removal extremely difficult as found with our case. The management of such cases require extensive pre-operative planning and anticipation of difficult removal to ensure safe and successful outcomes. Surgeons should not only consider the risk of femoral neck fractures during hardware removal, but also prepare for a different treatment option with patients on BPs.

Source of funding

No funding was provided for this work.

Declaration of competing interest

All authors declare that there are no sources of actual or potential conflicts of interest.

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