

Bilateral bisphosphonate-induced atypical femur fractures

Published on 14.03.2017

DOI: 10.1594/EURORAD/CASE.14100

ISSN: 1563-4086

Section: Musculoskeletal system

Area of Interest: Bones Geriatric Musculoskeletal bone

Procedure: Perception image

Imaging Technique: Digital radiography

Special Focus: Demineralisation-Bone Drugs / Reactions

Case Type: Clinical Cases

Authors: Stacie Gilmore, Star Ye, Jayanth

H.Keshavamurthy MD

Patient: 69 years, female

Clinical History:

A 69-year-old female with scoliosis and osteoporosis, on ibandronic acid for years and with right thigh pain for months, presented after her "foot gave out" while walking. She heard a crack and fell down onto her left side. On exam, she had a severe right upper leg deformity.

Imaging Findings:

X-ray of the right femur (AP) showed a transverse "chalk stick" fracture of the proximal femoral diaphysis with lateral displacement of the distal fragment, shortening, slight overlapping, varus angulation, and internal rotation.

X-ray of the left femur (AP) was initially read as unremarkable. However, follow-up imaging and re-inspection of the first x-ray showed a non-displaced hairline cortical fracture of the lateral femoral shaft with cortical thickening.

Discussion:

A. Background:

Bisphosphonates are used to prevent hip and vertebral fractures in patients with osteoporosis but on rare occasions may paradoxically contribute to atypical femoral fractures (AFF). "Typical" femoral fractures in osteoporosis occur at the weaker femoral neck or intertrochanteric regions. "Atypical" femoral fractures occur in stronger bone areas such as in the sub-trochanteric area or at the femoral diaphysis [1]. A 2013 meta-analysis found that bisphosphonate users have an increased risk of AFF, although the complication is rare and more studies are needed [2]. The FDA recommends using bisphosphonates no longer than 3-5 years, but there is significant controversy regarding the appropriate duration of treatment [1].

B. Clinical Perspective:

This patient had bilateral AFF, although the left side pathology was initially missed on x-ray reads. The right femur fracture was complete and more obvious, especially given the clinical presentation. The left femur fracture was subtle, with the most noticeable feature being the callous formation.

C. Imaging Perspective:

The American Society of Bone and Mineral Research has established diagnostic features for AFF to help with

identification. For all 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, four out of five major features are required:

Major Features Summarized (See ASBMR article [3] for full major and minor features):

- fall with minimal or no trauma
- transverse fracture starting at lateral cortex
- complete fracture through both cortices or incomplete only through lateral cortex
- noncomminuted or only minimally comminuted
- localized periosteal/endosteal thickening at the fracture site

D. Outcome:

The patient's fractures were fixed by open reduction and internal fixation with bilateral intramedullary nails. Ibandronate was discontinued.

E. Take Home Message:

In patients with a femoral fracture suggestive of AFF from bisphosphonates, it is important to obtain an x-ray of the contralateral femur to look for hairline fractures, callus formation, or other key features. AFF are "insufficiency fractures" that occur due to normal stresses on abnormally structured bone, so the two femurs may be equally involved due to systemic bisphosphonate therapy. The contralateral femur may show subtle radiographic findings suggestive of AFF that require immediate surgical fixation before the fracture worsens. In addition, stop bisphosphonate therapy.

When in doubt, a nuclear medicine bone scan can be performed to identify a "hot spot" of healing. An MRI can also be done to look for edema.

Differential Diagnosis List: Bilateral bisphosphonate-induced atypical femur fractures, Pathologic fracture, Stress fracture

Final Diagnosis: Bilateral bisphosphonate-induced atypical femur fractures

References:

Miller PD, McCarthy EF (2014) Bisphosphonate-associated atypical sub-trochanteric femur fractures: Paired bone biopsy quantitative histomorphometry before and after teriparatide administration. *Seminars in Arthritis and Rheumatism* 44(5):477-482. (PMID: [25312241](#))

Gedmintas L, Solomon DH, and Kim SC (2014) Bisphosphonates and Risk of Subtrochanteric, Femoral Shaft, and Atypical Femur Fracture: A Systematic Review and Meta-analysis. *J Bone Miner Res* 28(8):1729-1737. (PMID: [23408697](#))

Shane E, et al. (2014) Atypical subtrochanteric and diaphyseal femoral fractures: second report of a task force of the American Society for Bone and Mineral Research. *J Bone Miner Res* 29(1):1-23 (PMID: [23712442](#))

Figure 1

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Description: An AP X-ray of the right femur showed a transverse "chalk stick" fracture of the proximal femoral diaphysis. **Origin:** Negron-Rubio E, Department of Radiology, Medical College of Georgia, Augusta, GA, USA.

Figure 2

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Description: An AP X-ray of the left femur showed a hairline fracture through the lateral cortex of the mid-femoral diaphysis. Prominent cortical thickening is visible at the fracture site. **Origin:** Department of Radiology, Medical College of Georgia, Augusta, GA, USA.

Figure 3

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Description: A magnified view of the left femur AP x-ray showed more clearly, at the lateral femoral shaft, the hairline cortical fracture with cortical thickening. **Origin:** Joe C, Department of Radiology, Medical College of Georgia, Augusta, GA, USA.