Bisphosphonates are the most widely used medication to treat osteoporosis. Recent reports have documented an association between chronic bisphosphonate use and femoral insufficiency fractures. This article describes an 84-year-old woman with a diagnosis of osteoporosis treated with bisphosphonate medications for 9 years. She presented with left groin pain, and magnetic resonance imaging revealed a subtrochanteric femoral stress fracture. Operative and nonoperative management was discussed with the patient, and she chose to undergo prophylactic intramedullary nailing of the left femur. Six months postoperatively, she was asymptomatic and ambulating without assistive devices.

This article describes successful management of a bisphosphonate-related femoral insufficiency fracture. The presence of groin or thigh pain in a patient taking bisphosphonates should alert the physician to the possibility of insufficiency fracture of the proximal femur, and plain radiographs should be obtained. If these radiographs show lateral cortical thickening, consideration should be given to prophylactic intramedullary femoral nailing. The risks and benefits of prophylactic fixation vs conservative management should be discussed with the patient. A recent series showed a high failure rate with conservative treatment of these fractures. A dialogue with the primary care physician should be initiated to determine the necessity of bisphosphonate therapy, and, if deemed necessary, an alternative class of medications should be considered.
Osteoporosis, defined by the World Health Organization as a bone mineral density >2.5 standard deviations below that of a healthy young adult, is a public health crisis affecting >75 million people worldwide.\(^1,2\) Osteoporosis is manifested by deterioration of bone microarchitecture, resulting in increased bone fragility and fracture risk.\(^1\) Bisphosphonates, which act by inhibiting the formation of GTPase and therefore osteoclastic bone resorption, have become the most clinically important class of antiresorptive medications used to treat osteoporosis.\(^2,3\) Several randomized, controlled trials have demonstrated the ability of bisphosphonates to increase bone mineral density and to decrease the incidence of hip and vertebral fractures;\(^4,6;\) however, recent reports have indicated an increased incidence of femoral insufficiency fractures in patients on long-term bisphosphonate therapy.\(^7,14\)

Patients with femoral insufficiency fractures have been reported to have prodromal thigh pain.\(^7\) Radiographs often demonstrate cortical hypertrophy on the tension side of the femur.\(^7,9,11-13\) In patients with prodromal thigh pain and evidence of femoral stress fracture, an argument can be made to proceed with prophylactic intramedullary fixation of the femur to prevent fracture and its associated morbidity. However, these patients may also have significant comorbidities and may be best treated with limited weight bearing and cessation of bisphosphonate therapy.

This article describes the diagnosis and management of a patient with a bisphosphonate-related subtrochanteric stress fracture that was diagnosed and treated prior to complete fracture.

**CASE REPORT**

An 84-year-old woman with a diagnosis of osteoporosis was treated with bisphosphonate medications for 9 years. She presented to her primary care physician reporting left groin and thigh pain after sustaining a twisting movement to her left leg when the bus she was riding stopped suddenly. The patient did not fall, and no other overt trauma was identified. She reported no preexisting hip pain. On examination by the primary care physician, the patient had no tenderness to palpation about the left hip and no pain with provocative measures, such as log roll, axial load, and flexion/internal rotation of the hip. She reported an aching feeling in the groin with rest but sharp pain in the groin with weight bearing. Radiographs of the pelvis and hip were read as unremarkable by the radiologist.

However, on further inspection, radiographs demonstrated the classic lateral cortical thickening of the proximal femur seen in bisphosphonate-related femoral insufficiency fractures (Figure 1). This radiographic finding has been documented in multiple reports to be associated with chronic bisphosphonate use.\(^13,15,16\) The lateral cortical thickening is presumed to be a result of the inability of osteoclasts to remodel bone secondary to inhibition by bisphosphonates.\(^16\) Although cortical thickening in the subtrochanteric femur could be indicative of a stress fracture, this pattern in association with bisphosphonate use is nearly pathognomonic for a bisphosphonate-related stress fracture.

Given the unremarkable radiographs and the patient’s continued pain with weight bearing, the primary care physician ordered magnetic resonance imaging (MRI) without contrast of the left hip. The primary care physician sent the patient to the emergency department after radiology read the MRI as a likely subtrochanteric femur fracture. The patient was evaluated by orthopedists in the emergency department. She continued to report mild left groin pain with rest and increasingly severe left groin pain with ambulation. On examination, the patient had mild pain with log rolling and flexion/internal rotation. The remainder of the physical examination was essentially unremarkable. Magnetic resonance imaging revealed edema of the subtrochanteric femur, especially laterally (Figures 2, 3). No evidence of complete fracture existed.

The risks and benefits of operative intervention were discussed with the patient. She was told that she had an impending insufficiency fracture of the left proximal femur, although it was impossible to predict if or when the fracture could occur. If she were to choose surgical fixation, she...
would be able to bear weight the evening of surgery without restriction. The patient was given the alternative option of prolonged protected weight bearing with the understanding that future operative intervention could still be required if the stress fracture did not heal or if fracture occurred. The patient consented to proceed with prophylactic intramedullary fixation of the left femur. Consultation with the patient’s primary care physician was obtained, and medical clearance for the planned surgery was given.

The patient was placed under general anesthesia and positioned on the fracture table. The Synthes Reamer-Irrigator-Aspirator (Synthes, Paoli, Pennsylvania) was used for reaming to vent the intact femur and decrease the risk of fat embolism. A piriformis-start antegrade intramedullary nail in recon mode was placed without complication. The patient was told to weight bear as tolerated postoperatively and was prescribed enoxaparin for deep venous thrombosis prophylaxis for 14 days after discharge. Bisphosphonates were discontinued, and the patient was started on a regimen of vitamin D and calcium. The patient ambulated well with physical therapy and was discharged from the hospital on postoperative day 2 in minimal discomfort.

Two-week follow-up clinical examination revealed no further groin pain and minimal incisional discomfort with ambulation. The patient completed a 6-week course of physical therapy designed to strengthen the quadriceps and hip abductor muscles. Six months postoperatively, the patient was pain free in the left lower extremity. Radiographs demonstrated the hardware in good position and persistence of the lateral cortical thickening.

**Discussion**

The incidence of subtrochanteric and diaphyseal femur fractures has been reported to range from 2% to 10% of all femur fractures.\(^{17,18}\) The overall low occurrence of these fractures makes determining the incidence of atypical femur fractures difficult. Atypical femur fractures associated with bisphosphonate use have been defined by the following radiographic parameters: simple transverse or short oblique fracture in areas of thickened cortices with lateral unicortical beaking.\(^{7,9,13,15,16,18}\) Population-based studies have attempted to demonstrate that the incidence of subtrochanteric and diaphyseal femur fractures are equivalent in patients taking bisphosphonates and those who are not.\(^{15,17}\) These studies have failed to recognize that atypical femur fractures due to bisphosphonate use are a specific subset of subtrochanteric and diaphyseal fractures identified by radiographic examination rather than raw incidence of fracture location.\(^{13,15,17,18}\) The incidence of atypical femur fractures in patients taking bisphosphonates exceeded 75% in the series by Neviaser et al,\(^{13}\) accounting for 27% of all subtrochanteric and/or diaphyseal fractures. Other authors have reported the incidence of these atypical fractures to account for 69% to 100% of fractures.\(^{9,10,16}\) The true incidence of atypical fractures in patients on bisphosphonate therapy is unknown due to the large number of patients taking this class of medications compared with the relative few who sustain these fractures.

Bisphosphonate-related femoral insufficiency fractures present an interesting management problem. The same medications that are intended to prevent insufficiency fractures have been implicated in insufficiency fractures of the proximal femur. The likely mechanism of this association is that osteoclast inhibition results in decreased remodeling and repair potential of microdamage and stress fractures. The long half lives of bisphosphonate medications (months to years) is problematic in the setting of fracture and likely inhibits fracture healing. In the setting of bisphosphonate-related femoral insufficiency fracture, the bisphosphonate should be discontinued and another class of medication chosen (parathyroid hormone analogues), if deemed clinically necessary.

The decision to proceed with prophylactic fixation of bisphosphonate-related stress fractures is dependent on patient factors. The current patient was an active individual who ran her own business and traveled frequently. The prospect of protected weight bearing for 3 to 6 months with no guarantees of successful fracture healing was not desirable for her. Although the risks of surgery should not be underestimated, prophylactic intramedullary fixation of an intact femur is technically easier than after fracture, especially in the subtrochanteric region. In more sedentary individuals, nonoperative management may be more desirable; however, sedentary individuals may also be less able to maintain protected weight bearing and, therefore, be at a higher risk of fracture. Prolonged immobilization and/or recumbency will also increase the risk of...
pressure ulcers and venous thromboembolism. A recent series demonstrated unacceptably high failure rates of nonoperative treatment of these fractures.\textsuperscript{19}

**CONCLUSION**

The current article describes the successful management of a bisphosphonate-related femoral insufficiency fracture. The presence of groin or thigh pain in a patient taking bisphosphonates should alert the physician to the possibility of insufficiency fracture of the proximal femur, and plain radiographs should be obtained. If these radiographs show lateral cortical thickening, consideration should be given to prophylactic intramedullary femoral nailing. The risks and benefits of prophylactic nailing vs conservative management should be discussed with the patient. A dialogue with the primary care physician should be initiated to determine the necessity of bisphosphonate therapy, and, if deemed necessary, an alternative class of medications should be considered. The current patient was switched from bisphosphonate therapy to teriparatide, which has not been reported to be associated with atypical fractures of the femur.\textsuperscript{10}

**REFERENCES**