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CASE REPORT

Bilateral subtrochanteric femur insufficiency fractures after bariatric surgery: a case report

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Abstract

There have been case reports of proximal femur insufficiency fractures in patients who have previously undergone bariatric surgery. We present a follow-up case of a patient who developed bilateral complete proximal femur insufficiency fractures several years after bariatric surgery. Our patient underwent bilateral intramedullary fixation with a satisfactory postoperative outcome. We review and discuss the definition and pathogenesis of atypical femur fractures (AFFs), which may represent a larger category of insufficiency fractures not exclusive to bisphosphonate use, which includes patients with fractures after bariatric surgery.

Keywords Atypical femur fractures · Bariatric surgery · Insufficiency fractures · Malabsorption

Introduction

The association of atypical femur fractures (AFFs) with bisphosphonate use was first described in 2005 [1]. Since that time, this association, as well as the definition and recommended treatment of these fractures, has been well described by the American Society for Bone and Mineral Research (ASBMR) Task Force [2, 3]. This has expectantly led to increased awareness and recognition of AFFs.

There is increasing evidence that AFFs may represent a broader category of insufficiency fractures with a multifactorial etiology related to adverse effects on bone metabolism that is not exclusive to bisphosphonate use [3]. It is common knowledge that deficits in electrolytes and vitamins (i.e., calcium and vitamin D) can lead to deleterious effects on overall bone health, predisposing the bone to a higher risk of fracture. Bariatric surgery, a procedure being performed worldwide in the treatment of morbid obesity, can lead to such deficits via malabsorption. It has been well documented that bariatric surgery can adversely affect bone health and that patients who have undergone bariatric surgery have a higher risk for fracture [4, 5].

While there have been prior reports of insufficiency fractures of the hip after bariatric surgery, the atypical subtrochanteric location along with bilaterality makes this unique. The number of these cases is evidently increasing, and this case supports the notion that AFFs may represent a broader category of insufficiency fractures.

Case report

A 53-year-old female presented to the Emergency Department with complaints of left lower extremity swelling, fatigue, and shortness of breath concerning for deep vein thrombosis (DVT) and/or pulmonary embolus (PE). Her medical history included a Roux-en-Y gastric bypass (RYGB) procedure performed for morbid obesity greater than 10 years prior, for which she had not been taking vitamin supplementation. Her body mass index (BMI) at presentation was 22.92 kg/m^2.

Upon presentation, she was noted to have several electrolyte abnormalities and signs of malnourishment. Her laboratory studies revealed hypomagnesaemia (1.6 [1.8–2.5 mg/dL]), hypophosphatemia (1.4 [2.4–4.7 mg/dL]), hypokalemia (2.5 [3.6–5.1 mmol/L]), anemia (hemoglobin 9.4 [12–16 g/dL]), a low albumin (3.0 [3.5–5.0 g/dL]), a normal ionized calcium, and an elevated alkaline phosphatase (350 [38–126 U/L]). Her work up for DVT and PE were negative. She was admitted for further evaluation.

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The patient subsequently provided a history of severe right greater than left hip pain for several weeks, as well as multiple recent falls secondary to the hip pain. She did not use an assistive ambulatory device. Physical exam revealed tenderness to palpation of the bilateral proximal femurs and groin region. She had symmetric, full range of motion of the hips, although painful on the right side. Her distal motor, sensory, and vascular exams of both lower extremities were normal. She denied a history of cancer or bisphosphonate use.

Plain radiographs demonstrated transverse cortical lucencies in the bilateral proximal femurs at the level of the lesser trochanter. There was an additional cortical lucency in the right iliac wing (see Fig. 1a, b). CT and MRI scans confirmed complete non-displaced proximal femur fractures at the level of the lesser trochanter bilaterally, in addition to a complete non-displaced right iliac wing fracture, an incomplete non-displaced right medial femoral neck fracture, and fractures of the left sacrum, and bilateral superior and inferior pubic rami, consistent with multiple insufficiency fractures (see Fig. 1c, d). There were no osseous lesions concerning for metastatic disease. The patient was transferred to a level 1 trauma center for surgical fixation.

The patient subsequently underwent intramedullary nail fixation of both femurs. She was made weight bearing as tolerated. Her postoperative course was uncomplicated. Nutrition Services were consulted who followed up the patient throughout her admission. A more comprehensive metabolic work-up was performed, which demonstrated an elevated parathyroid hormone (PTH) of 59.8 (1.6–6.9 pmol/L) or 563.9 (10–65 pg/mL) and severely low 25 OH vitamin D levels (total) of < 3 (25–80 ng/mL) or < 1.2 (40–100 nmol/L). Sedimentation rate, C-reactive protein, vitamin B12, folate, and TSH levels were normal.

She was discharged to a skilled nursing facility where she was followed up by Hematology/Oncology and Nephrology, and was placed on 50,000 units of ergocalciferol weekly. There was low concern for malignancy. At her first postoperative follow-up visit, she was doing well and her sutures were removed. Her postoperative radiographs from this visit are shown in Fig. 2a, b. She is scheduled to but has not yet seen Endocrinology as an outpatient.

Discussion

Bariatric surgery is a common and effective surgical treatment option for morbidly obese patients; in fact, RYGB is the most common bariatric procedure performed in the last decade [6, 7]. Due to the nature of a RYGB bypassing the primary sites of calcium absorption and fat-soluble vitamins, it is well known that the procedure can lead to malabsorption [8]. Persistent low levels of both calcium and vitamin D cause secondary hyperparathyroidism, which stimulates osteoclasts to increase bone resorption, leading to a state of osteomalacia [8, 9]. Literature has shown that these patients will have increased bone resorption markers and decreased bone mineral density (BMD) postoperatively [10]. The resultant weight loss has also been theorized to contribute to bone loss due to decreased

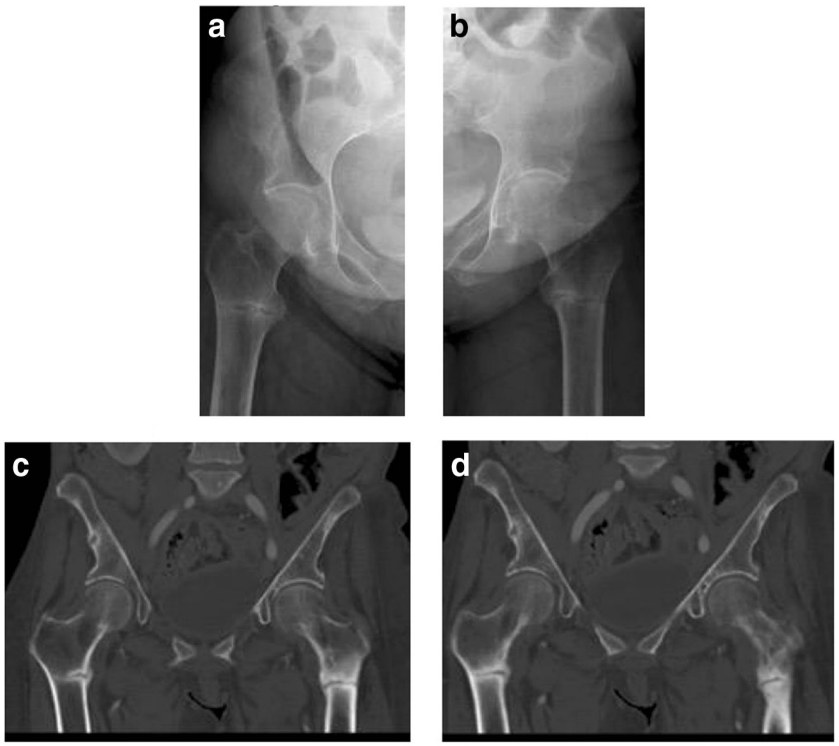

Fig. 1 **a**–**d** The AP radiographs of bilateral hips as well as coronal CT images of the pelvis demonstrating bilateral complete non-displaced proximal femur fractures at the level of the lesser trochanter. These images also demonstrate an incomplete non-displaced fracture of the right medial femoral neck and a complete non-displaced fracture of the right iliac wing

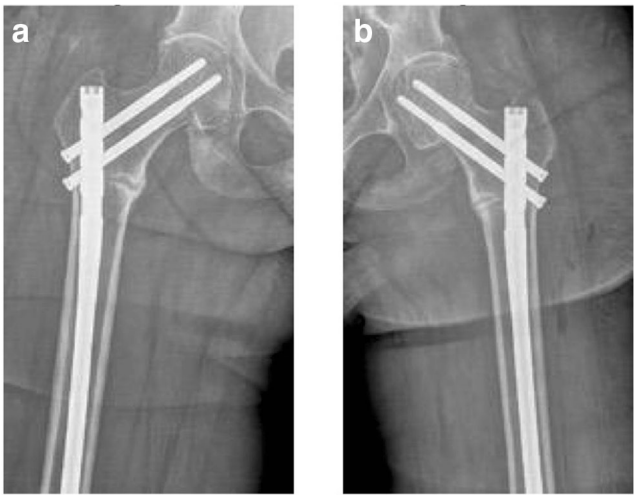

Fig. 2 **a**, **b** The AP postoperative radiographs at 2.5 weeks

weight-mediated mechanical loading [5]. Our patient had not been adhering to vitamin supplementation, as is recommended for patients who undergo bariatric surgery [11].

Axelsson et al. found that patients who had undergone bariatric surgery were at a time-dependent higher risk for hip fractures [5], which is similar to findings in other series [12–14]. Interestingly, increased weight loss and lack of calcium/vitamin D supplementation were not associated with a higher risk for fracture, suggesting that reduced mechanical loading and malabsorption may not be primarily responsible for this increased risk [10, 15–17]. Moreover, the pathogenesis of fractures in patients who have undergone bariatric surgery is poorly understood.

Similarly, the currently understood pathogenesis of AFFs remains unclear. The current consensus is that AFFs are insufficiency fractures, which develop as a result of normal loading of abnormal/deficient bone. They are thought to be separate from fractures that occur in osteoporosis and are commonly associated with bisphosphonate use [3].

Our patient's femur fractures nearly met the criteria for an AFF. The most updated report from the ABMR Task Force defines an AFF as a fracture of the femoral diaphysis just distal to the lesser trochanter to just proximal to the supracondylar flare and having at least four of five major qualifying criteria: (1) minimal or no association with trauma, (2) origination at the lateral cortex with a transverse orientation, (3) complete fractures extend through both cortices with a possible medial spike, (4) minimal or no comminution, and (5) localized periosteal/endosteal thickening of the lateral cortex [3].

Our patient's fractures were at the level of the lesser trochanter as opposed to just distal to it and appeared to originate from the medial cortex with localized periosteal thickening on the medial side instead of the lateral side. While there is no obvious explanation for this latter unique finding, given the duration of her symptoms, her significant metabolic abnormalities (including an altered PTH), her continued weight bearing through both limbs, and the duration of this pathologic process, the medial and lateral sides of the femur may have seen stresses that are not usually accounted for. Although, the fractures were associated with minimal trauma, were complete through both cortices, were transverse, and were non-comminuted, consistent with an atypical femur fracture.

In previous case reports, Barro et al. [20] presented a female patient who had a RYGB several years prior with bilateral medial non-displaced femoral neck fractures; however, these did not meet the definition for an AFF based on their location. Similarly, Mounasamy et al. [21] presented a case report of a female patient who had a RYGB several years prior, who had not been taking vitamin supplementation, with a unilateral incomplete non-displaced subtrochanteric femur fracture, similar in appearance to our patient. Interestingly, all patients presented in these case reports (including our own) had fractures that originated from the medial cortex.

We believe this supports the theory that there is a characteristic pattern of femur fractures that occur in patients with abnormal bone health. For example, some literature has suggested that vitamin D deficiency and genetic predisposition may also be risk factors to develop an AFF [18, 19]. The definition/criteria of an AFF may need to be expanded, pending further exploration and research into their underlying pathogenesis. This should help physicians of all specialties identify patients at risk to help prevent an AFF, and support timely recognition and diagnosis of an AFF for acute treatment. We support previous notions that long-term follow-up and monitoring for patients who have had bariatric surgery should be the standard of care and that there should be a high index of suspicion for fracture or impending fracture in patients with atraumatic bone pain.

Compliance with ethical standards

Conflict of interest None.

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