



Multiple vertebral compression fractures after sleeve gastrectomy and a subsequent pregnancy: a case report

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Abstract

We report that a 33-year-old woman developed multiple compression fractures several years after a sleeve gastrectomy followed by pregnancy. Despite normal areal BMD values assessed by dual-energy X-ray absorptiometry and no family history of osteoporosis, the patient demonstrated low lumbar spine trabecular bone score, as well as low peripheral trabecular volumetric BMD and deterioration of trabecular microarchitecture assessed by high-resolution peripheral quantitative computed tomography. Women of reproductive age should be provided with lifestyle management targeting bone health following bariatric surgery.

Keywords Bariatric · Microarchitecture · Osteoporosis · Pregnancy

Case history

A 33-year-old Caucasian woman presented with multiple vertebral compression fractures. There was a past history of chronic right knee pain from 2012 treated with a tibial tubercle transplant in 2014. In 2014, she also underwent a sleeve gastrectomy for obesity, which resulted in > 50% reduction in body weight over 12 months. She subsequently became pregnant in 2015, giving birth in March 2016 to a healthy baby boy, but weaned after 2 weeks due to her pre-existing medical problems.

Over the next 18 months, her right knee pain recurred, and a spinal cord stimulator was implanted in January 2018 for pain relief, but 8 days later, she developed acute back pain for the first time. The stimulator was subsequently re-sited twice and for the third time in March 2018 at the T12-L1 level. Soon after, she had a violent episode of vomiting, reporting acute and severe lower lumbar back pain. Computerized tomography (CT) of the spine at that time demonstrated vertebral compression fractures of the third, fourth, and fifth lumbar

vertebrae, as well as a left sacral ala fracture. She then reported worsening pain and a second CT performed 6 weeks later demonstrated new vertebral compression fractures at the first and second lumbar vertebrae, in addition to progression of the fourth lumbar vertebral compression fracture to severe with 90% compression.

The patient was referred for review, and 3 months later, on examination, her body weight was 74 kg and height was 162 cm, both decreased from reported peaks of 142 kg and 166 cm, respectively. Electrolytes, liver, kidney and thyroid function, parathyroid hormone, glycated haemoglobin, ferritin, vitamin B12, and folate levels were normal. Spot urinary calcium/creatinine ratio was increased to 0.43 (normal range < 0.20). Her 24-h urinary free cortisol was normal (247 nmol/day), but her early morning serum cortisol was elevated at 683 nmol/L (normal range 138–635 nmol/L). An overnight 1 mg dexamethasone suppression test showed normal suppression of her morning cortisol levels. Her 25-hydroxyvitamin D levels were normal at 79 nmol/L on 2000 International Units (IU) of cholecalciferol per day. She was also taking 600 mg of elemental calcium twice per day and had a background of lactose intolerance restricting her dietary calcium intake. She had intermittent asthma and used salbutamol as required, and also took three to four courses per year of oral prednisolone for 3 days. She also reported gastro-oesophageal reflux and was taking esomeprazole and ranitidine nightly, but an upper gastrointestinal endoscopy with duodenal biopsy was negative for coeliac disease. She reported smoking five to 15 cigarettes per day (8 pack years),

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but did not drink alcohol. She had limited exercise due to her knee and back pain. Her parents (her mother was postmenopausal), brothers, and sister were healthy and there was no family history of osteoporosis. The patient was commenced on treatment with six-monthly subcutaneous injections of denosumab to prevent further vertebral fractures, and referred for bone imaging at our centre.

Methods

Areal bone mineral density (aBMD) was assessed at the left total hip and lumbar spine by dual-energy X-ray absorptiometry (DXA) scans using a Hologic Horizon A densitometer (Hologic Inc., Bedford, MA, USA) running APEX (5.6.0.2) and TBS iNsight (3.0.2.0) (Medimaps, Geneva, Switzerland) software. TBS iNsight quantified the trabecular bone score, an indirect measure of trabecular bone microarchitecture, of the lumbar spine. For all aBMD and TBS measurements, Z-scores comparing values with an age, sex and ethnicity-matched reference population were obtained.

High-resolution peripheral quantitative computed tomography (HRpQCT; Xtreme CT II, Scanco Medical AG, Brüttisellen, Switzerland) was performed to assess left distal tibia trabecular and cortical bone volumetric bone mineral density (vBMD) and microarchitecture. In the absence of reference population data for Xtreme CT II, the patient's results were compared with reference ranges for US Caucasian women aged in their 30s for whom total, trabecular, and cortical vBMD were determined by Xtreme CT I [1]. Excellent agreement has been demonstrated for vBMD measurements between Xtreme CT I and II, but due to the higher resolution of the second-generation system (61 vs. 82 μm), the agreement between microarchitectural properties including cortical porosity and trabecular number and thickness is weaker [2]. As a result, the patient's microarchitectural properties were compared with an age- and sex-matched control imaged in our laboratory using the same scan settings.

Results

Femoral neck and total hip aBMDs were 0.742 and 0.837 g/cm^2 , respectively, both resulting in a normal Z-score of -0.8 . Lumbar spine aBMD (L1-L4) was 1.137 g/cm^2 with a normal Z-score of 0.9. However, the aBMD estimate for the lumbar spine was likely elevated due to artefact from the presence of the spinal cord stimulator and multiple vertebral compression fractures. These issues would also be expected to influence TBS estimates, but it was notable that the lumbar spine TBS raw score was 1.311 (unitless) and the TBS Z-score was -1.4 (Fig. 1), substantially lower compared with the Z-score of 0.9 for lumbar spine aBMD.

At the distal tibia, total vBMD (265.7 $\text{mg HA}/\text{cm}^3$) was in the lowest 25% of the reference population. Trabecular vBMD was disproportionately affected (127.5 $\text{mg HA}/\text{cm}^3$), being in the lowest decile. Cortical vBMD (940.3 $\text{mg HA}/\text{cm}^3$) was in the lowest 25%, but cortical thickness (1.425 mm) was in the highest 25%. Compared with the control subject (Fig. 2), trabecular number (1.143 vs 1.438 mm^{-1}) and thickness (0.232 vs 0.264 mm) were 21% and 12% lower, respectively, and trabecular spacing (0.836 vs 0.624 mm) was 25% higher. Cortical porosity was similar between the patient and control (0.015 vs 0.014, respectively).

Discussion

Despite normal aBMD values and no family history of osteoporosis, this 33-year-old woman with multiple vertebral compression fractures demonstrated low lumbar spine TBS, very low trabecular vBMD, and evidence of deterioration of trabecular microarchitecture following bariatric surgery with a sleeve gastrectomy and recent pregnancy. Studies of bone microarchitecture thus demonstrated trabecular bone loss disproportionate to cortical bone loss. Given that the vertebrae largely comprise trabecular bone [3], poor trabecular bone density and structure may explain the onset of multiple vertebral fractures in this patient.

While the absence of previous scans precludes determination of the cause and magnitudes of trabecular bone loss, the patient's previous pregnancy may be implicated. It has been reported that calcium for foetal skeletal growth is obtained from both maternal cortical and trabecular bone, whereas calcium is predominantly drawn from trabecular bone during lactation [4]. Vertebral fractures were reported in the cases of three young women after pregnancy and during lactation, but unlike our patient, these patients shared risk factors including very low body weight and aBMD, as well as a family history of osteoporosis [5]. Given this patient reported breastfeeding for only 2 weeks, it would appear unlikely that lactation explains her poorer trabecular bone relative to cortical bone structure, although women with pregnancy-associated osteoporosis sustain an average of 2.2 incident fractures over a median of 6 years even when weaning immediately after delivery [6]. Pregnancy-associated osteoporosis, while rare, has been associated with vertebral fractures particularly in first pregnancies [7, 8] and may therefore have contributed to our patient's poor vBMD and deteriorated bone microarchitecture.

Bariatric surgery has been associated with total hip aBMD decreases of up to 10% 12–24 months postoperatively [9, 10]. After Roux-en-Y gastric bypass (RYGB), significant 12-month declines in radius and tibia total vBMD have also been demonstrated by Xtreme CT I, as well as a significant reduction in trabecular number and increase in trabecular spacing at the tibia [11]. Our patient underwent sleeve gastrectomy rather

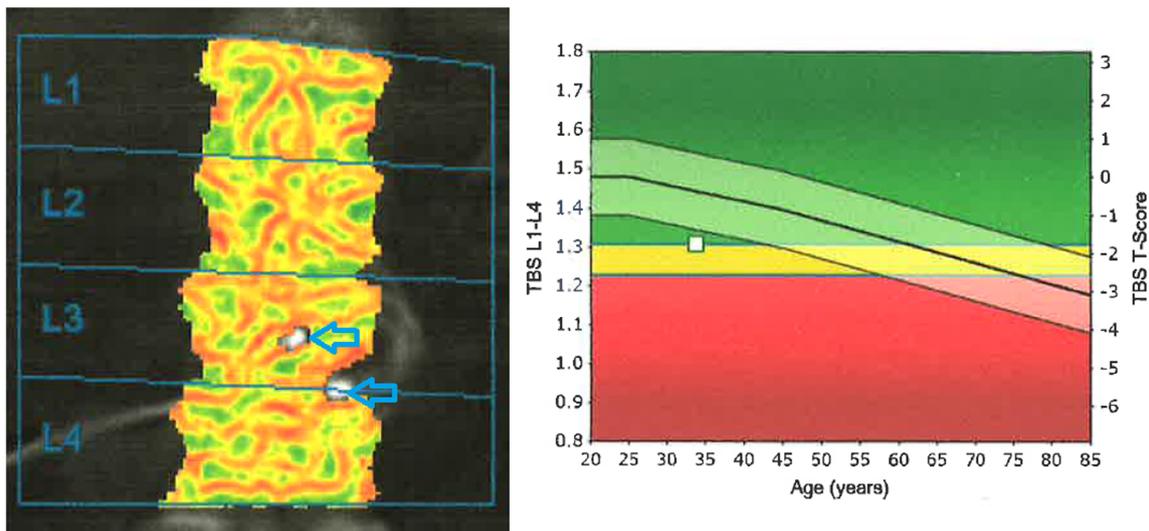


Fig. 1 TBS mapping and reference graph for lumbar spine DXA scan. Blue arrows indicate areas of artefact due to spinal cord stimulator

than RYGB; RYGB is more likely to result in malabsorption of calcium, vitamin D, and other nutrients, as well as greater increases in bone turnover markers [12]. The patient did appear to demonstrate hypercalciuria on a spot urinary calcium/creatinine ratio test, and while a 24-h test is preferable for assessment of hypercalciuria, it has been implicated in accelerated loss of trabecular bone [13].

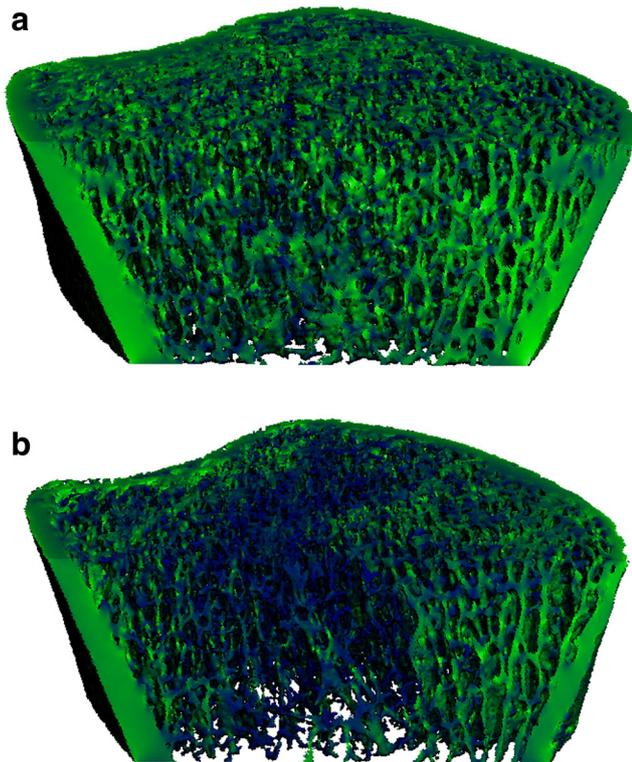


Fig. 2 HRpQCT finite element analysis image of the distal tibia for the control (a) and patient (b). Darker pixels indicate lower bone strength

However, despite differences in malabsorptive effects, aBMD declines appear similar for RYGB and sleeve gastrectomy procedures up to 24 months [14]. TBS has also been reported to decline from 6 to 24 months following both procedures [9], although a smaller study of RYGB patients reported that TBS remained stable and within normal ranges from 12 to 36 months post-surgery despite aBMD declines [15]. Similarly, our patient's TBS Z-score was much lower than that observed for her lumbar spine aBMD (although the latter was potentially elevated due to artefact). It is difficult to comment on potential changes in TBS in our patient given the absence of longitudinal data. Regardless, declines in aBMD and TBS may be attenuated by post-surgical administration of vitamin D, calcium, and protein supplementation in combination with exercise [9].

Indeed, the patient reported lifestyle behaviours which may have impacted her musculoskeletal health, including restricted dietary calcium intake and regular smoking. Smoking has been associated with reduced areal bone mineral density, but disproportionately increased risk of fracture which appears to be explained primarily by microarchitectural deterioration of trabecular bone [16]. It is therefore possible that the microarchitectural deterioration observed in the trabecular compartment in this patient is partly explained by her history of smoking.

In conclusion, we described a young woman experiencing multiple vertebral compression fractures in the setting of bariatric surgery followed by pregnancy. Obese women of reproductive age are increasingly turning to bariatric surgery as an option to increase fertility, and now account for up to half of all bariatric surgery procedures [17]. Given that exercise and nutritional supplementation can substantially reduce bariatric surgery-associated bone loss [9], we strongly recommend that women of reproductive age are provided with lifestyle

management targeting bone health, including smoking cessation, following bariatric surgery.

Compliance with ethical standards

Conflicts of interest None.

References

- Burt LA, Liang Z, Sajobi TT, Hanley DA, Boyd SK (2016) Sex- and site-specific normative data curves for HR-pQCT. *J Bone Miner Res* 31:2041–2047
- Agarwal S, Rosete F, Zhang C, McMahon DJ, Guo XE, Shane E, Nishiyama KK (2016) In vivo assessment of bone structure and estimated bone strength by first- and second-generation HR-pQCT. *Osteoporos Int* 10:2955–2966
- Eastell R, Mosekilde L, Hodgson SF, Riggs BL (1990) Proportion of human vertebral body bone that is cancellous. *J Bone Miner Res* 5:1237–1241
- More C, Bettembuk P, Bhattoa HP, Balogh A (2001) The effects of pregnancy and lactation on bone mineral density. *Osteoporos Int* 12:732–737
- Di Gregorio S, Danilowicz K, Rubin Z, Mautalen C (2000) Osteoporosis with vertebral fractures associated with pregnancy and lactation. *Nutrition* 16:1052–1055
- Kyveritakis I, Reuter TC, Hellmeyer L, Hars O, Hadji P (2018) Subsequent fracture risk of women with pregnancy and lactation-associated osteoporosis after a median of 6 years of follow-up. *Osteoporos Int* 29:135–142
- Phillips AJ, Ostlere SJ, Smith R (2000) Pregnancy-associated osteoporosis: does the skeleton recover? *Osteoporos Int* 11:449–454
- Hadji P, Boekhoff J, Hahn M, Hellmeyer L, Hars O, Kyveritakis I (2017) Pregnancy-associated osteoporosis: a case-control study. *Osteoporos Int* 28:1393–1399
- Muschitz C, Kocijan R, Haschka J, Zendeli A, Pirker T, Geiger C, Müller A, Tschinder B, Kocijan A, Marterer C (2016) The impact of vitamin D, calcium, protein supplementation, and physical exercise on bone metabolism after bariatric surgery: the BABS study. *J Bone Miner Res* 31:672–682
- Maghrabi AH, Wolski K, Abood B, Licata A, Pothier C, Bhatt DL, Nissen S, Brethauer SA, Kirwan JP, Schauer PR, Kashyap SR (2015) Two-year outcomes on bone density and fracture incidence in patients with T2DM randomized to bariatric surgery versus intensive medical therapy. *Obesity* 23:2344–2348
- Schafer AL, Kazakia GJ, Vittinghoff E, Stewart L, Rogers SJ, Kim TY, Carter JT, Posselt AM, Pasco C, Shoback DM, Black DM (2018) Effects of gastric bypass surgery on bone mass and microarchitecture occur early and particularly impact postmenopausal women. *J Bone Miner Res* 33:975–986
- Ivaska KK, Huovinen V, Soinio M, Hannukainen JC, Saunavaara V, Salminen P, Helmiö M, Parkkola R, Nuutila P, Kiviranta R (2017) Changes in bone metabolism after bariatric surgery by gastric bypass or sleeve gastrectomy. *Bone* 95:47–54
- Ryan LE, Ing SW (2012) Idiopathic hypercalciuria and bone health. *Curr Osteoporos Rep* 10:286–295
- Muschitz C, Kocijan R, Marterer C, Nia AR, Muschitz GK, Resch H, Pietschmann P (2015) Sclerostin levels and changes in bone metabolism after bariatric surgery. *J Clin Endocrinol Metab* 100:891–901
- Marengo AP, Guerrero Perez F, San Martin L et al (2017) Is trabecular bone score valuable in bone microstructure assessment after gastric bypass in women with morbid obesity? *Nutrients* 9:1314
- Cusano NE (2015) Skeletal effects of smoking. *Curr Osteoporos Rep* 13:302–309
- Willis K, Lieberman N, Sheiner E (2015) Pregnancy and neonatal outcome after bariatric surgery. *Best Pract Res Clin Obstet Gynaecol* 29:133–144

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