Secondary Osteoporosis with Normal Bone Mineral Density: A Case of Compression Fracture and Spinal Cord Injury in Cushing's Disease

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Appreciation of bone density and osteoporosis is critical for planning instrumented spinal fusions and can influence decisions such as length of construct, material choice, and surgical adjuncts such as cement augmentation or bracing¹.

Dual-energy X-ray absorptiometry (DXA) is considered the gold standard for the quantitative assessment of bone mineral density (BMD)²⁾. There is generally a strong relationship between mechanical bone strength and BMD as assessed by DXA, and BMD scores show a strong inverse correlation with fracture risk³⁾. However, 10%-20% of patients who sustain low-energy osteoporotic fractures have normal BMD measurements⁴⁾, and normal BMD does not equate to normal bone quality⁵⁾. However, once a low-energy, osteoporotic fracture has occurred, this is indication enough that a patient has poor bone quality and should be treated as such regardless of BMD. Here, we present an illustrative case in accordance with the CARE guidelines⁶⁾.

A 47-year-old male presents to the Emergency Department with a one-month history of left-sided chest pain and mid back pain. He had a past medical history of obesity, 20 pack year smoking history, hypertension, type 2 diabetes, and new onset schizophrenia.

The onset of back pain was insidious and without trauma. Chest computed tomography (CT) showed a large left-sided pleural effusion, T4 and T6 compression fractures (Fig. 1). At that time, he was neurologically intact. Thoracentesis did not suggest malignancy or infection. The patient left the hospital against medical advice and before the involvement of the spine team. He returned three weeks later after a minor fall from a standing height. At that point, he presented with complete bilateral motor paralysis of the lower extremities and complete sensory loss at the T6 level. The spine team was consulted, and the patient was transferred to our tertiary care centre.

Magnetic resonance imaging demonstrated mild ventral cord compression at the level of the fracture with a small anterior hematoma (Fig. 2). Clinically, he had a T6-level ASIA A spinal cord injury (SCI) He underwent a posterior decompression, fusion and a transpedicular (Fig. 3) open biopsy with posterior shortening of the T6 vertebra. Intraoperatively, soft bone was appreciated on screw insertion. Results of the biopsy from the vertebral body were negative for malignancy or infection.

Post-operative metastatic workup revealed a right adrenal gland nodule. The patient had a positive dexamethasone suppression test and normal adrenocorticotropic hormone (ACTH) level. The adenoma was confirmed to be a cortisolsecreting tumor. Interestingly, his post-operative BMD (Dis-

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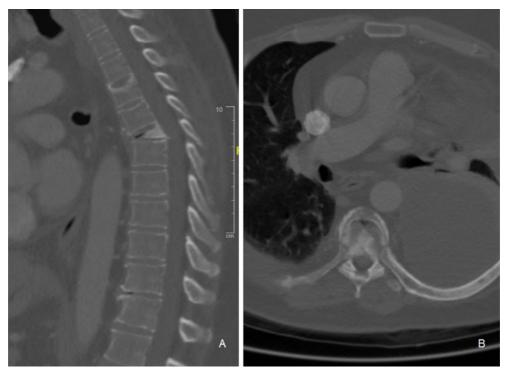


Figure 1. Chest CT scan showing large left-sided pleural effusion, as well as T4 and T6 compression fractures.



Figure 2. T2 sagittal and axial MRI images showing mild ventral cord compression at the level of the compression fractures with a small anterior hematoma.

covery W DXA, Hologic, Massachusetts, USA) was normal with a T-score of -0.8 in the lumbar spine, 0.0 in the left hip and -0.1 in the right hip, with corresponding Z-scores of -0.6, 0.2, and 0.2, respectively (Fig. 4). Interestingly, pre-operative CT scan shows a Hounsfield Unit measurement of 102+/-32 on axial sequences of the L1 vertebral body, sug-

gesting osteopenia⁷⁾. At one year post-operatively, he still had complete spinal cord injury (ASIA A).

Cushing's syndrome is characterized by oversecretion of glucocorticoids and is a well-recognized cause of secondary osteoporosis and pathological fractures⁸. Despite an increased risk of fracture, BMD scores are typically normal or

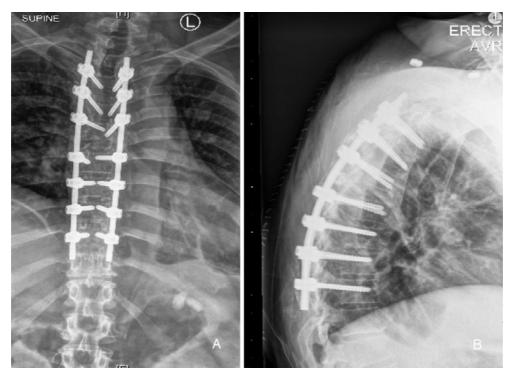


Figure 3. Anteroposterior and lateral postoperative x-rays showing posterior decompression, fusion, and shortening procedure.

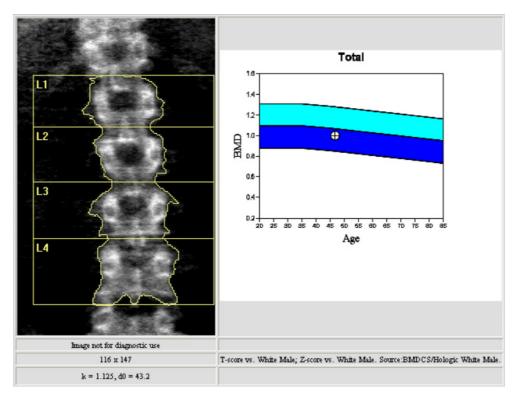


Figure 4. DXA table and image of the lumbar spine.

only slightly decreased in patients with Cushing's Syndrome^{9,10}. It is theorized that glucocorticoids interfere with normal trabecular micro-architecture and can impair structural integrity without a concomitant decrease in density as measured by conventional DXA scan¹⁰. Trabecular Bone Scan (TBS) is a method applied to DXA that allows estimation of bony trabecular microarchitecture¹¹⁾ and has been shown to be a better predictor of fracture than BMD for patients with Cushing's Syndrome¹⁰⁾.

Spinal constructs in osteoporotic spines are often augmented by longer constructs, fenestrated screws with cement injection, or circumferential fixation¹⁾. We caution surgeons to not rely on BMD alone in making these surgical planning decisions. As this case demonstrates, even in the absence of technical error, conditions which affect trabecular architecture may yield normal BMD despite poor bone quality.

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