

# Vertebral Compression Fracture with Bone Marrow Edema

By Kang Chen, RT; Yuanjun Wang, RT; Yilin Huang, RT; Xier Zhang, MD; Zhenping Deng, MD; Xi Zhao\*, MD  
 Department of Radiology, Chengdu No. 2 People's Hospital, Chengdu, P. R. China  
 \*Siemens Healthineers China

## History

A 79-year-old male patient, complaining of increasing lower back pain while turning over, was presented to the hospital. He had undergone surgery, due to lung cancer without known metastases, and had no history of trauma or injury. A Dual Energy (DE) CT was requested for further evaluation.

## Diagnosis

Conventional linear-blended CT images showed a typical osteoporotic texture in the vertebrae, along with a ground plate deformation of the 4th lumbar vertebra (L4). A diffuse signal increase

in the L4 vertebra, consistent with bone marrow edema (BME), was unmasked in the corresponding DE virtual noncalcium (VNCa) images. The BME was confirmed by MRI, which was subsequently performed to evaluate the status of the whole spine. There were no signs of metastasis or other abnormalities found. A fresh vertebral fracture associated with osteoporosis in L4 was suspected.

## Comments

A vertebral compression fracture is usually caused by osteoporosis, trauma

or malignancies. Bone marrow edema (BME), representing an increase of interstitial water content, is shown as a clear increase in bone marrow signal intensity in MRI, which is consistent with acute genesis. The early diagnosis of BME in vertebral compression fractures could help select patients who are eligible for vertebroplasty or those who should cease activity to prevent further complications. Studies have shown that the DE CT VNCa technique can accurately depict BME in osteoporotic vertebral compression fractures, with high accordance to MR imaging. [1,2] This is potentially beneficial for

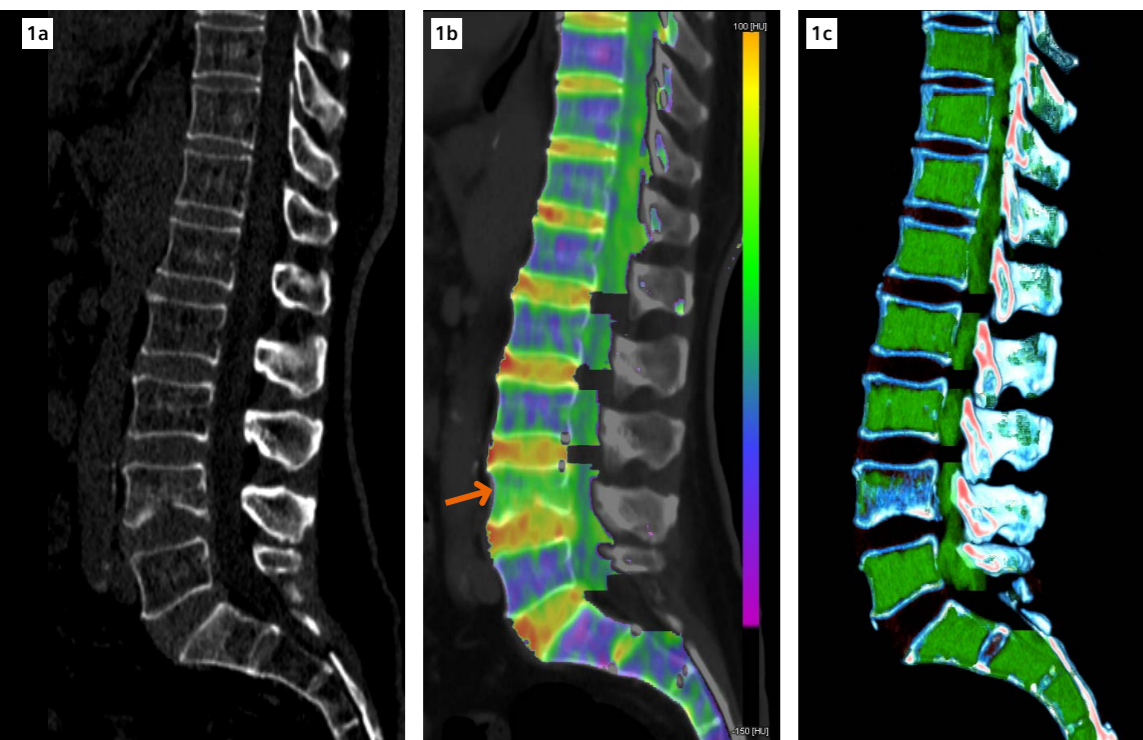
those patients who have a contraindication or limited access to MR imaging. DE CT enables material differentiation by using the knowledge of mass attenuation coefficients at different energy levels. Calcium from cancellous bone is subtracted to unmask BME in vertebral compression fractures. A special filter technique – Selective Photon Shield – increases energy spectra separation at two different kV settings for a better depiction of BME. In this case, a clear visualization of BME helps the physicians to make a confident diagnosis of a fresh vertebral compression fracture which is associated with osteoporosis. ●

## Reference

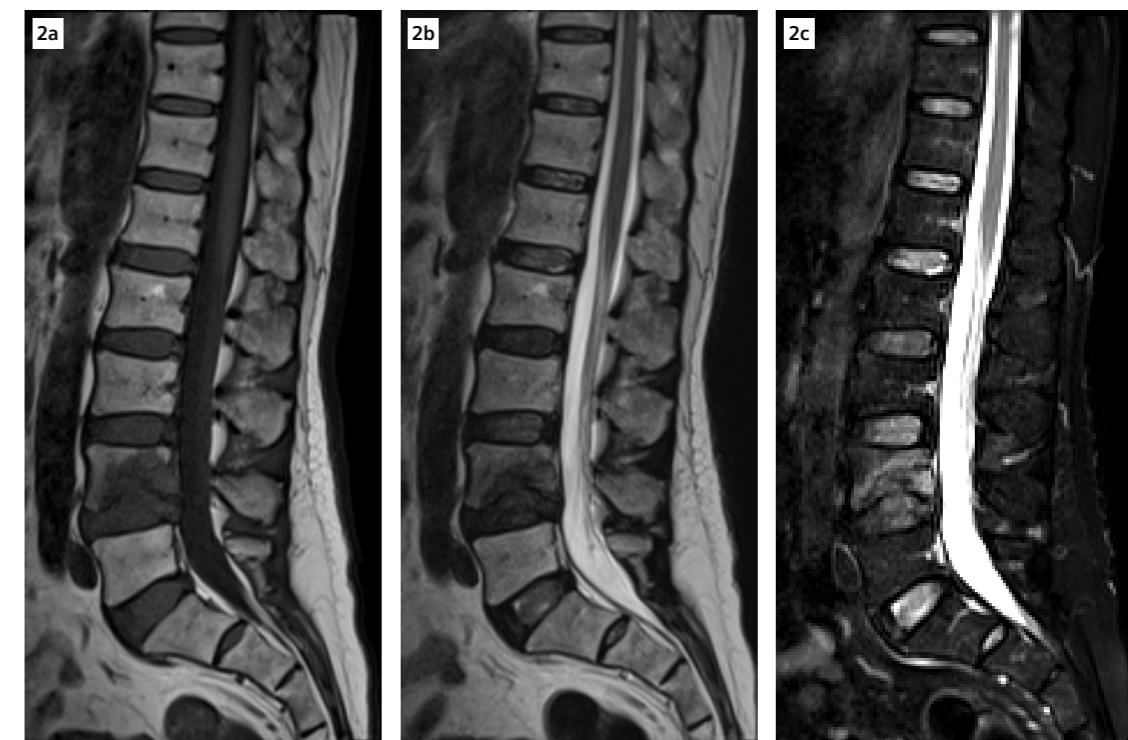
- [1] M. Kaup et al. Dual-Energy CT-based Display of Bone Marrow Edema in Osteoporotic Vertebral Compression Fractures: Impact on Diagnostic Accuracy of Radiologists with Varying Levels of Experience in Correlation to MR Imaging. *Radiology* 2016; 280:510–519
- [2] C-K. Wang et al. Bone Marrow Edema in Vertebral Compression Fractures: Detection with Dual-Energy CT. *Radiology* 2013; 269:525–533

## Examination Protocol

Scanner	SOMATOM Drive
Scan area	Lumbar Spine
Scan mode	Dual Energy
Scan length	318.5 mm
Scan direction	Cranio-caudal
Scan time	14 s
Tube voltage	100 / Sn140 kV
Effective mAs	131 / 105 mAs
Dose modulation	CARE Dose4D
CTDI <sub>vol</sub>	9.56 mGy
DLP	320.2 mGy cm
Rotation time	0.5 s
Pitch	0.6
Slice collimation	32 × 0.6 mm
Slice width	1.5 mm
Reconstruction increment	1.0 mm
Reconstruction kernel	Q34



**1** A sagittal MPR of the conventional linear-blended CT image (Fig. 1a) shows typical osteoporotic texture in the vertebrae and a ground plate deformation of the L4 vertebra. A DE VNCa image (Fig. 1b) shows brighter bone marrow signal in L4 vertebra indicative of edema (arrow), which can also be appreciated in the 3D perspective (Fig. 1c).



**2** MR images acquired in T1-tse (Fig. 2a), T2-tse (Fig. 2b) and T2-tse-fs (Fig. 2c) sequences reveal a clear increase in bone marrow signal intensity in the L4 vertebra, which confirms BME.

The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.