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Cervicothoracic volumetric bone mineral density assessed by opportunistic QCT may be a reliable marker for osteoporosis in adults

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Background

Lumbar volumetric bone mineral density (vBMD) obtained through opportunistic quantitative multi-detector CT (MDCT) has demonstrated high accuracy in diagnosing osteoporosis and predicting incident vertebral fractures (VFs). This study aimed to investigate the performance of cervicothoracic vBMD to discriminate patients with/without osteoporosis and VFs.

Methods

325 patients with clinical routine non-contrast or contrast-enhanced MDCT were included. Trabecular vBMD was automatically extracted using a convolutional neural network (CNN)-based framework with asynchronous calibration and contrast phase correction. The correlations of vBMD between each cervicothoracic vertebra (C2-T12) and the averaged vBMD values at the lumbar spine (L1-L3, or L4 and L5) as the reference site were analyzed before and after assessment of VFs and degeneration. Vertebra-specific linear regression equations were applied to calculate lumbar vBMD approximations at the cervicothoracic spine.

Results

Cervicothoracic vBMD showed good correlation with lumbar vBMD (r=0.79). Additional exclusion of degenerated vertebrae significantly increased the correlation (all $p<0.05$; r=0.89), except for C7-T3 and T9. Predictability of osteoporosis (vBMD <80 mg/cm^3) was high for lumbar vBMD approximations derived from both cervical (AUC=0.94) and thoracic vBMD (AUC=0.97). In non-degenerated vertebrae, the predictability for prevalent VFs was similar for cervicothoracic vBMD (AUC=0.74, AUC=0.72) and for lumbar vBMD (AUC=0.72).

Discussion

This study showed that cervicothoracic cut-off values for osteoporosis may have clinical value based on the strong correlations between both cervical and thoracic vBMD values with lumbar vBMD. We propose diagnostic thresholds of vBMD <190 mg/cm^3 for the cervical spine and <100 mg/cm^3 for the thoracic spine as strong indicators of osteoporosis. Prospective studies are needed to also investigate the predictability of incident VFs for these thresholds.

Survey for radiologists examining bone health on a routinely basis. →

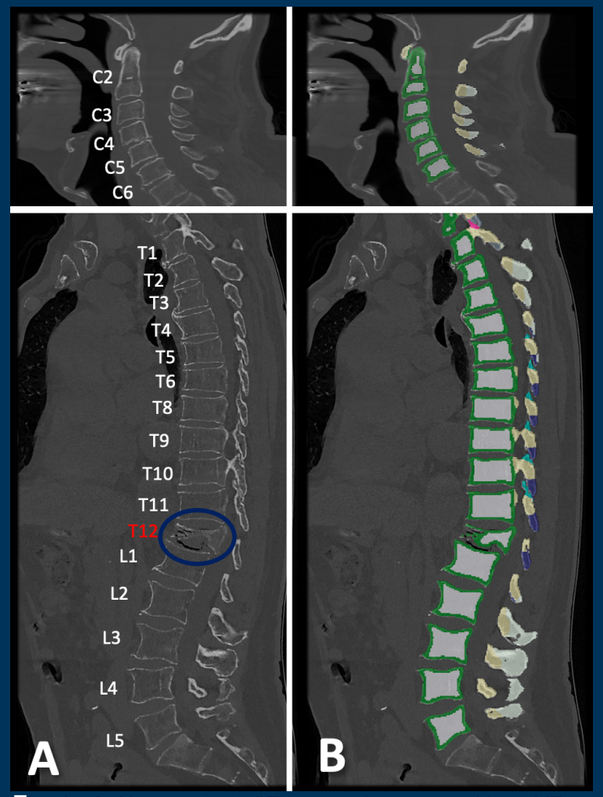

Fig 1: A: Non-contrast CT scan of a man with a VF at T12. **B:** Spine segmentations were obtained. Cervicothoracic vBMD measurements for identifying osteoporosis and prevalent VFs compared to lumbar vBMD as the reference were automatically extracted and analyzed. In this patient, all measurements correctly identified the prevalent VF.

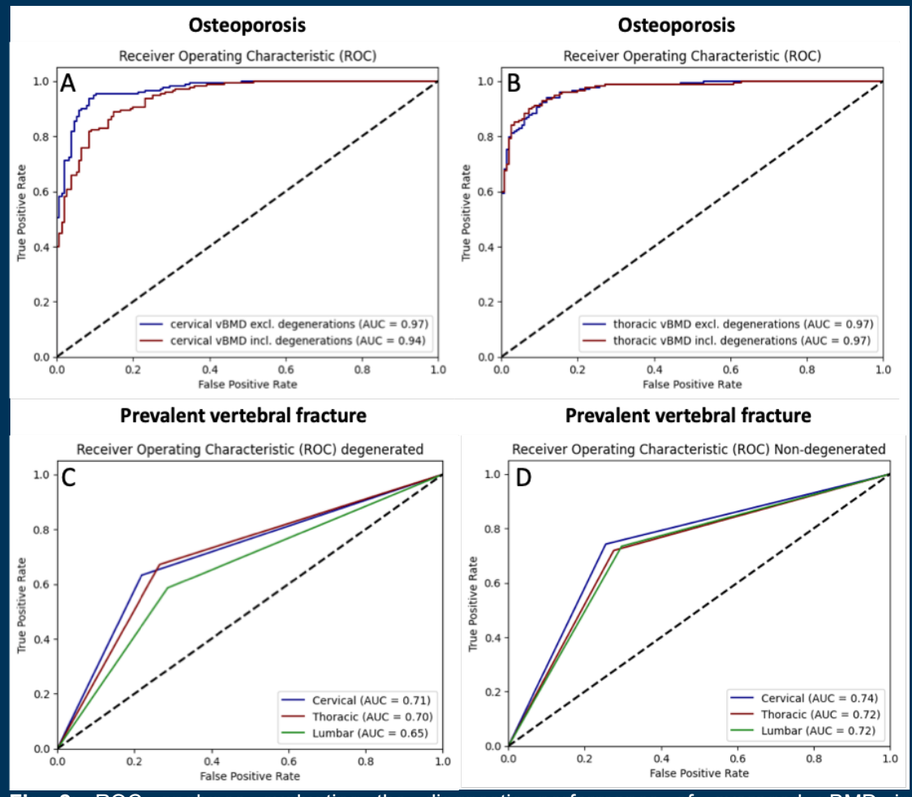

Fig 2: ROC analyses evaluating the diagnostic performance of averaged vBMD in distinguishing patients with and without osteoporosis and vertebral fractures (VFs).
A-B: ROC curves show the ability to discriminate osteoporosis using averaged vBMD from cervical vertebrae (**A**, left) and thoracic vertebrae (**B**, right).
C-D: ROC curves assess the ability to detect prevalent VFs using averaged vBMD from the cervical, thoracic, and lumbar spine, including degenerated vertebrae (**C**, left) and excluding degenerated vertebrae (**D**, right).