Trabecular bone structure analysis of the spine using clinical MDCT: can it predict vertebral bone strength?

Abstract:

Recent technical improvements have made it possible to determine trabecular bone structure parameters of the spine using clinical multi-detector computed tomography (MDCT). Therefore, the purpose of this study was to analyze trabecular bone structure parameters obtained from clinical MDCT in relation to high resolution peripheral quantitative computed tomography (HR-pQCT) as a standard of reference and to investigate whether clinical MDCT can predict vertebral bone strength. Fourteen functional spinal segment units between T7 and L3 were harvested from 14 formalin-fixed human cadavers (11 women and 3 men; age 84 ± 10 years). All functional spinal segment units were examined using HR-pQCT (isotropic voxel size of 41 \( \mu \text{m}^3 \)) and a clinical whole-body MDCT (interpolated voxel size of 146 \( \times \) 146 \( \times \) 300 \( \mu \text{m}^3 \)). Trabecular bone structure analyses (histomorphometric and texture measures) were performed in the HR-pQCT as well as MDCT images. Vertebral failure load (FL) of the functional spinal segment units was determined in an uniaxial biomechanical test. The HR-pQCT and MDCT derived trabecular bone structure parameters showed correlations ranging from \( r = 0.60 \) to \( r = 0.90 \) (p 0.05). In this cadaver model, the spatial resolution of clinically available whole-body MDCT...
scanners was suitable for trabecular bone structure analysis of the spine and to predict vertebral bone strength.