Comparative micro computed tomography study of a vertebral body

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Investigations of bony tissues are often performed using micro computed tomography based on X-rays, since the calcium distribution leads to superior contrast. Osteoporotic bone, for example, can be well compared with healthy one with respect to density and morphology. Degenerative and rheumatoid diseases usually start, however, at the bone-cartilage-interface, which is hardly accessible. The direct influence on the bone itself becomes only visible at later stage. For the development of suitable therapies against degenerative cartilage damages the exact three-dimensional description of the bone-cartilage interface is vital, as demonstrated for transplanted cartilage-cells or bone-cartilage-constructs in animal models. So far, the morphological characterization was restricted to magnetic resonance imaging (MRI) with poor spatial resolution or to time-consuming histological sectioning with appropriate spatial resolution only in two rather arbitrarily chosen directions. Therefore, one should develop mu CT to extract the features of low absorbing cartilage. The morphology and the volume of the inter-vertebral cartilage disc of lumbar motion segments have been determined for one PMMA embedded specimen. Tomograms were recorded using nanotom (R) (Phoenix vertical bar x-ray, Wunstorf, Germany), mu CT 35(TM) (Scanco Medical, Brijtisellen, Switzerland), 1172(TM) and 1174(TM) (both Skyscan, Kontich, Belgium), as well as using the SR mu CT at HASYLAB/DESY. Conventional and SR mu CT can provide the morphology and the volume of cartilage between bones. Increasing the acquisition time, the signal-to-noise ratio becomes better and better but the prominent artifacts in conventional mu CT as the result of inhomogeneously distributed bony tissue prevents the exact segmentation of cartilage. SR mu CT allows segmenting the cartilage but requires long periods of expensive beam-time to obtain reasonable contrast.
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