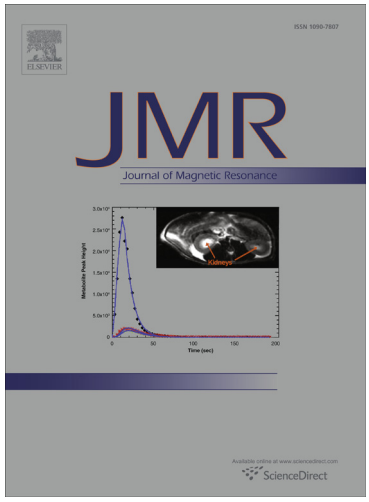

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Feasibility of high-resolution one-dimensional relaxation imaging at low magnetic field using a single-sided NMR scanner applied to articular cartilage

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Abstract

Low field Nuclear Magnetic Resonance increases the contrast of the longitudinal relaxation rate in many biological tissues; one prominent example is hyaline articular cartilage. In order to take advantage of this increased contrast and to profile the depth-dependent variations, high resolution parameter measurements are carried out which can be of critical importance in an early diagnosis of cartilage diseases such as osteoarthritis. However, the maximum achievable spatial resolution of parameter profiles is limited by factors such as sensor geometry, sample curvature, and diffusion limitation. In this work, we report on high-resolution single-sided NMR scanner measurements with a commercial device, and quantify these limitations. The highest achievable spatial resolution on the used profiler, and the lateral dimension of the sensitive volume were determined. Since articular cartilage samples are usually bent, we also focus on averaging effects inside the horizontally aligned sensitive volume and their impact on the relaxation profiles. Taking these critical parameters into consideration, depth-dependent relaxation time profiles with the maximum achievable vertical resolution of 20 µm are discussed, and are correlated with diffusion coefficient profiles in hyaline articular cartilage in order to reconstruct T_2 maps from the diffusion-weighted CPMG decays of apparent relaxation rates.

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