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MR imaging protocols for optimized visualization of a collagen matrix used for cartilage repair

J Gellissen[1], NO Wendler[2], TK Helmberger[1], P Behrens[2]

[1] Department of Radiology, University of Luebeck, Germany
[2] Department of Orthopaedic Surgery, University of Luebeck, Germany

Objective: To compare the performance of different MR pulse sequences for high-contrast and high-spatial-resolution- imaging of collagen matrices.

Material and Methods: Chondral resection 2cm² in size was carried out resembling a grade-IV defect of a porcine femoral condyle. A bilayer matrix consisting of collagen I/III (Chondro-Gide®, Geistlich Biomaterials, Switzerland) was dissected and fixed with fibrin glue. MR-imaging was conducted using a 1.5T machine (Siemens, Germany). 27 pulse sequences were varied with regard to their main properties (T1- and T2-weighted spin-echo or gradient echo), mode of volumetric data acquisition (2D, 3D), image matrix, slice thickness (1.3–2mm) and the choice of fat saturation techniques. Signal intensities were measured in the subchondral layer, collagen membrane, adjacent cartilage and fluid. Contrast-ratios were computed.

Results: Contrast-ratios of the matrix vs. adjacent fluid/subchondral layer were calculated with values 0.05-0.88±0.04 and 0.03-0.99±0.05 respectively. While highest contrast was achieved using PD-weighted TSE-sequences with low Echotime, high image matrix and thin sections without fat saturation, T1-weighted IR-sequences yielded an intermediate contrast-ratio with optimal depiction of the defect depth.

Conclusion: Appropriate MR imaging parameter selection is crucial for optimized visualization of the matrix and has the potential to provide information about matrix integrity and success of cartilage repair.

Keywords: articular cartilage, collagen matrix, MR imaging