Lumbar intervertebral disc pathology: Comparison of quantitative T2 mapping with conventional MR at 3.0 Tesla

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Introduction: Herniated discs and annular tears are common findings in the lumbar spine, however their role in pain production is still a matter of discussion. The objective of our study is to assess the relationship of morphologically defined lumbar disc pathology with quantitative T2 relaxation time measurements. Evaluation included the following questions: (1) Do the mean T2 relaxation time values in the annulus fibrosus (AF) and the nucleus pulposus (NP) differ between patients with disc herniation, bulging, annulus tears and “normal discs”? (2) Do T2 relaxation time measurements have a predictive value for disc herniation or annulus tears?

Materials and Methods: Fifty-three patients aged 15-64a (mean: 38a) with single or recurrent episodes of low back pain and no radicular symptoms and no spine injury or surgery in the past were examined on a whole body 3.0T MR (Magnetom Tim Trio, Siemens Medical Systems, Erlangen, Germany) using a phased array spine coil. The ethics commission of the medical university provided ethical approval for this study, and written, informed-consent was obtained from all patients prior to enrollment. We used sagittal T1-FSE, sagittal, coronal and axial T2-FSE for morphological MRI. For T2 relaxation time measurement a multi echo-spin echo sequence was performed with a TR of 1200 msec, TE 13.8, 27.6, 41.4, 55.2, 69.0 and 82.8 msec, pixel matrix 256 x 256, voxel size 0.9 x 0.9 x 5 mm in 10 sagittal slices. T2 maps were obtained using a pixel-wise, mono-exponential non-negative least squares (NNLS) fit analysis. All discs were classified morphologically by two experienced radiologists into the following categories: focal disc herniation (protrusion or extrusion), annular tears, disc bulging and discs without this type of pathology, referred as “normal discs”. On sagittal T2 maps regions of interest (ROIs) for the AF were drawn anteriorly and posteriorly in the disc herniation portion compared to T2 values in NP as well as in the anterior and posterior AF (all p<0.001). The logistic regression showed significant results for ROI 1 and T2 NP for the prediction of an annulus fissure with a specificity of 100%, but the sensitivity was only 15%. The discrimination analysis demonstrated that using ROI 1, NP T2 and ROI 5 in 58.6% of discs bulging and focal herniation could be accurately defined. The highest values could be achieved by the ROI 5 and NP T2 values.

Discussion/Conclusion: In summary, quantitative T2 mapping in the lumbar spine at 3 Tesla yields additional information about the disc matrix and is a promising noninvasive tool to assess water content and collagen fiber integrity in different disc pathologies. Biochemical MR of the intervertebral disc may provide an early diagnosis of annular tears and disc dislocation and may improve monitoring of different spine therapies.