

Quantitative MR Imaging - T2*-Mapping of the Knee Joint using a Multi-Echo VTE-Sequence at 3 Tesla: Preliminary Results.

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Purpose: Advanced quantitative MR imaging of the human knee using a new multi-echo variable echo time (meVTE) sequence may provide additional information to quantify pathological changes¹. The aim of this study was to investigate the potential feasibility of multi-echo VTE sequence at 3T for T2*-mapping of the patellar tendon (PT), cruciate ligaments (CL) and menisci (ME) in the knee joint, which have very short T2 relaxation times^{2,3}.

Methods: Eighteen patients (eight female; ten male, mean age 35.1 ± 12.7 years) with knee pain were included to this study. All patients were examined at a whole body 3-T unit (Tim Trio; Siemens Healthcare) using an eight-channel dedicated transmit/receive knee coil with a diameter of 16 cm. Beside standard clinical imaging, a 0.7mm isotropic me VTE-sequence (10 TEs from 0.7 to 22.4 ms; TA 12.16 min) was obtained. T2*-maps were calculated using a mono-exponential fit least square analysis. T2*-values were manually assessed by 2 independent scientists using a ROI analysis on 5 consecutive, sagittal slices in the weight bearing region for the anterior and posterior horn of the medial and lateral ME, as well as for the PT. The ACL and PCL were reconstructed by using a multiplanar reconstruction tool and evaluated on 3 slices in the same way. Statistical measures of mean T2*-values included the Intraclass-Correlation (ICC) and the analysis of variance with Duncan post hoc test.

Results: Morphological grading of meniscal lesions had a highly significant impact ($P < 0.001$) on T2*-values of the menisci (normal (N=50) 6.0 ± 0.9 ms, 95% CI 5.7-6.3 ms; degeneration (N=13) 8.0 ± 1.6 ms, 95% CI 7.1-8.9 ms; meniscal tear (N=9) 12.9 ± 3.2 ms, 95% CI 10.4-15.4 ms) with significant differences between all groups ($P < 0.05$). The PT was normal in 15 cases (mean T2*value 2.7 ± 0.6 ms, 95% CI 2.4-3.1 ms), in 3 cases a tendinitis was found (mean T2*-value 3.9 ± 0.9 ms, 95% CI 1.5-6.3 ms). The T2 * values of the PT between patients and healthy volunteers were statistically significant different Mean T2*-relaxation times for the ACL and PCL were 8.4 ± 1.6 ms and 8.9 ± 1.3 ms. No morphological abnormality was found with ACL and PCL. Intra-class correlation between readers for ME, ACL, PCL and PT yielded $R^2 = 0.962$, $R^2 = 0.594$, $R^2 = 0.648$ ($P < 0.01$ for all) and $R^2 = 0.407$ ($P = 0.042$), respectively.

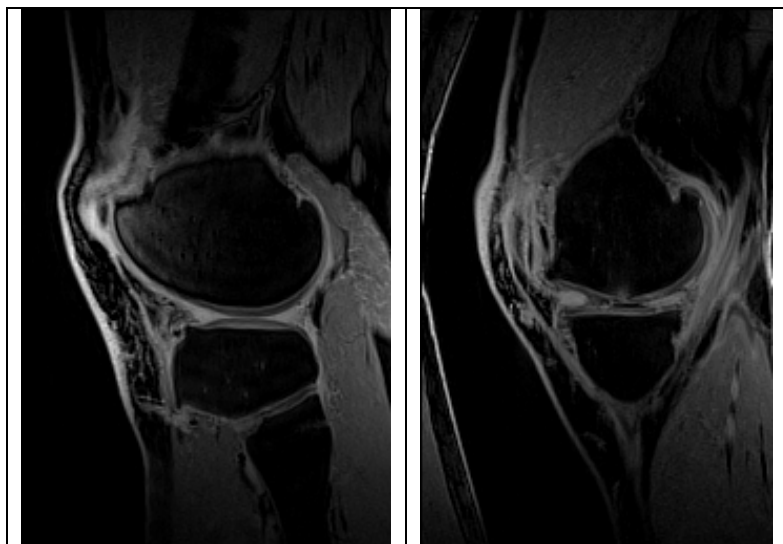


Fig. 1 Sagittal T2* map of a normal meniscus.

Fig. 2 Sagittal T2* map of a meniscal degeneration.

Discussion/Conclusion: Quantitative MR Imaging with a 3D T2*-Mapping technique using a me VTE sequence provides additional information to quantify early pathological changes beyond standard clinical imaging for ME and PT and can be used for the evaluation of several structures of the knee joint in one sequence

References: 1. Deligianni X, Bär P, Scheffler K, Trattnig S, Bieri O. Water selective high resolution imaging of short T2 components of the knee at high and ultra high field strengths. *Proc. Intl. Soc. Mag. Reson. Med.* 2012;20:3315. 2. Henkelman RM, Stanisz GJ, Kim JK, Bronskill MJ. Anisotropy of NMR properties of tissues. *Magn Reson Med.* Nov 1994;32(5):592-601. 3. Williams A, Qian Y, Golla S, Chu CR. UTE-T2 * mapping detects sub-clinical meniscus injury after anterior cruciate ligament tear. *Osteoarthritis Cartilage.* Jun 2012;20(6):486-494.