Precision of T2 relaxation times in healthy and osteoarthritic human tibial cartilage.

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Purpose: T2 relaxation time has high potential as a diagnostic parameter for cartilage, but to date precision errors of T2 measurements are only available for healthy patellar cartilage [1,2]. The purpose of this study was to assess tibial cartilage T2 precision errors in both, patients and healthy volunteers.

Materials and Methods: The dominant knees of 28 healthy volunteers/16 osteoarthritis patients were analysed with 3/2 consecutive measurements using a coronal multiecho-sequence (TR/TE/echoes/resolution 3000ms/13.2ms/8/0.6²x3mm³) at 1.5T. T2 maps were calculated pixel-wise (Levenberg-Marquardt), see Figure 1. Global T2 was averaged over the MRI sections, whereas regional T2 was calculated for 8 ROIs (2 horizontal layers, 4 vertical sectors) per MRI section resulting in 104/80 ROIs for the medial/lateral tibial cartilage plate. Precision errors were calculated as root mean square average (RMSA) of the individual standard deviations (SD[ms]; absolute error) and coefficients of variation (CV=SD/mean[%]; relative error) [3].

Results: Average healthy tibial global section-wise precision error was 2.29ms/7.19% and average regional error was 4.33ms/14%. Distribution of regional precision errors differentiated by layers is shown in Figure 2. In osteoarthritis patients average tibial global section-wise error was 2.58ms/8.16% and average regional error was 4.28ms/13.78%. No significant difference between medial and lateral tibiae was found. Interindividual variability of T2 was 2.8ms/8.79% (section-wise) and 4.97ms/16.06% (ROIs).

Conclusion: Precision errors of tibial cartilage T2 were slightly higher compared to reported patellar cartilage T2 precision errors, possibly related to smaller tibial cartilage thickness and consecutively increased partial volume effects [1,2]. T2 precision errors of both, healthy and diseased tibial cartilage were small compared to reported change in osteoarthritis (up to 180%) [4-6] and did not exceed interindividual variability suggesting a reasonable discriminatory power of the technique. The data may provide a base for sample size calculations to design longitudinal and cross-sectional trials in osteoarthritis.

References:

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Figure 1

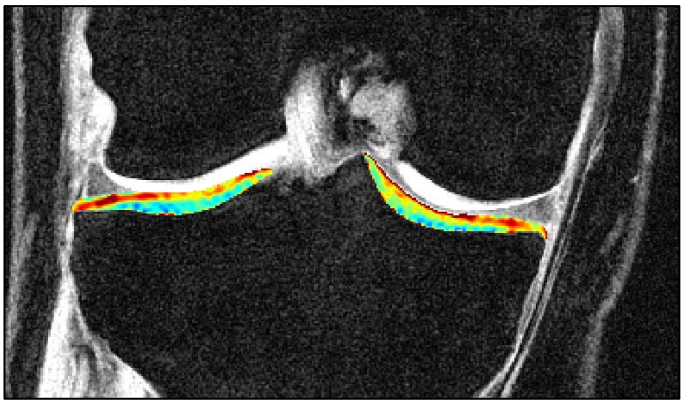

Figure 1: Overlay of the T2 map on the tibial cartilage in one representative coronal section of the multiecho-sequence.

Figure 2

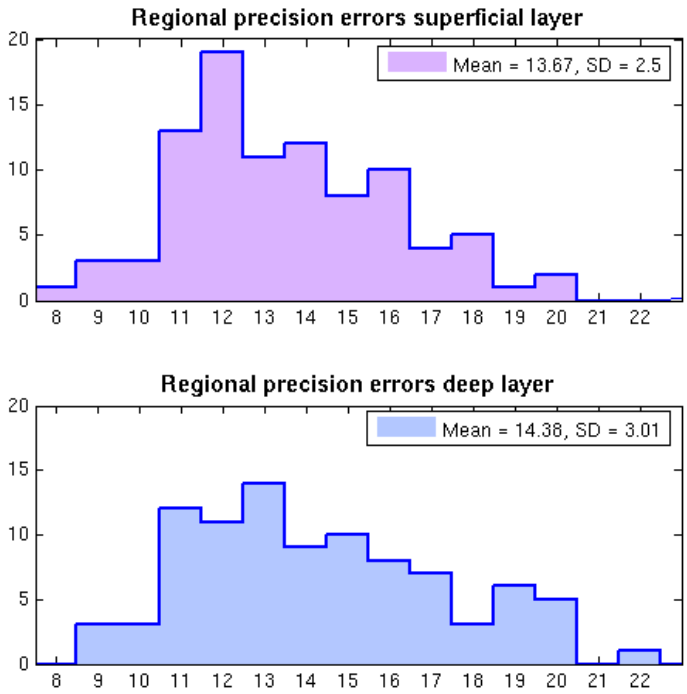

Figure 2: Histogram of regional relative precision errors of the tibial cartilage, showing an asymmetrical distribution in both horizontal layers with a mean value of 13.67% (superficial layer) and 14.38% (deep layer).