method of lesion segmentation. Number of BML lesions correlates less well than WORMS score with their volume. There is a fixed error due to the nature of the WORMS method which biases the results in favour of higher WORMS measurements.

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SENSITIVITY OF CEST MRI OF HUMAN KNEE CARTILAGE IN VIVO AT 3T AND 7T

Purpose: To evaluate the sensitivity of chemical-exchange-saturation transfer imaging of glycosaminoglycans (GAG) (gagCEST) on human knee cartilage in vivo at 3T and 7T.

Methods: The study was conducted under an approved Institutional Review Board protocol of the University of Pennsylvania. With an informed consent CEST imaging was performed on the knees of six healthy human volunteers using 18-cm diameter, eight-channel transmit-receive phased-array (PA) knee coil on Siemens 3T (Magnetom Tim Trio, Siemens Medical Solutions, Malvern, PA) and 7T MR scanner (Siemens Medical Solutions, Malvern, PA). A new pulse sequence was designed to use a frequency selective saturation pulse train followed by a segmented RF spoiled gradient echo (GRE) readout sequence. The sequence parameters were: slice thickness = 5 mm, GRE flip angle = 10°, GRE readout TR = 5.6 ms, TE = 2.7 ms, field of view = 140 × 140 mm², matrix size = 128 × 128, and one saturation pulse and 128 segments acquired every 10 sec to enable full T1 recovery. Multiple CEST images were collected using a saturation pulse with average B1rms of 31 (0.7 mT), 62 (1.4 mT), 93 (2.1 mT) and 124 Hz (2.8 mT) and saturation offsets relative to water ranging from −3.0 to +3ppm in steps of 0.1ppm. The total scan time was ~30 minutes. To alleviate B0 and B1 inhomogeneity contribution from CEST effect, B0 and B1 maps from the same imaging slices were obtained.

Results: Without any corrections for B0 inhomogeneity a clear shift (~0.5–0.6ppm) in the Z-spectra was observed in the human knee cartilage. This shift in the human data is removed after correcting for the B0 inhomogeneity. Without any correction for B0 large gagCEST effect (~20–25%) was observed on cartilage (Figures 1, 2). After B0 correction, with the imaging and saturation pulse parameters used, the calculated average gagCEST from cartilage was ~1% at 3T (Figures 1, 2) and 7.4±0.3% at 7T (Figure 3). The effect of B1 inhomogeneity was minor in the current study.

Conclusion: Because of the uneven geometry of human knee, despite extensive shimming of B0 field, there is a substantial B0 field variation in knee cartilage. Without correction for the B0 field inhomogeneity, spuriously large (20–30%) gagCEST effect is observed in knee cartilage in vivo. Correction of the B0 inhomogeneity has shown that there is only a very small (~1%) gagCEST observable in cartilage in vivo at 3T and a significantly larger gagCEST of ~7% at 7T. Since GAG loss from cartilage is expected to result in further reduction in gagCEST, this method is not expected to lead to accurate quantification of GAG content in healthy as well as in degenerated cartilage at 3T. However, given the magnitude of gagCEST measured at high fields such as 7T, this technique holds promise for studying cartilage degeneration at 7T and higher fields.

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THE MINIMAL CLINICALLY IMPORTANT DIFFERENCE (MCID) IN CARTILAGE VOLUME AND THICKNESS CHANGE IN PERSONS WITH KNEE OSTEOARTHRITIS
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Purpose: Investigators use quantitative cartilage morphometry to document longitudinal changes in osteoarthritic knees. With rapid evolution in the capacity of MRI to detect small changes, clinicians confront the question of how much change is clinically meaningful. We sought to establish the minimal clinically important difference in MRI-based longitudinal cartilage evaluation of persons with knee OA.

Methods: We used data from one knee per person of 429 participants of the Progression Cohort of the Osteoarthritis Initiative (OAI), defined by the presence of frequent symptoms and definite radiographic knee OA, who had baseline and 24 month quantitative MRI assessment. Manual tracing of the total subchondral bone area of the medial/lateral tibia (MT/LT) and central (weight-bearing) medial/lateral femoral condyle (cMF/CLF) was performed by Chondrometrics GmbH (Anning, Germany) and publicly released. We considered the mean cartilage thickness over the entire subchondral bone area with (ThCtAB) and without (ThCcAB) denuded areas. Results for the medial and lateral femorotibial compartments were obtained by summing values of MT + cMF and LT +cLF respectively. We defined the MCID in cartilage volume and thickness changes from baseline to 24 months using the indirect anchor approach of Mahomed et al (1999). We included median and lower quartile change on the anchor was defined by worsening by at least 13 points on WOMAC Function scale (Angst, 2001). MRI-based morphologic measures were compared between knees that showed discrimination between those who did and who did not achieve the MCID at a 0.05 significance level.

Results: Among 429 knees, 43% had K-L grade 2 and 54% K-L grade 3. 68% had OA in medial compartment. 11% worsened by at least 13 points in WOMAC Function score over 24 months. A limited set of MRI-based cartilage morphology measures discriminated (at p < 0.05) between those who did and those who did not worsen in WOMAC Function by the MCID. These included cartilage volume, cartilage thickness (including and excluding denuded area) as well as the area of subchondral bone covered by cartilage – all measured in the central (weight-bearing) medial femur.