LONGITUDINAL CHANGES IN THE SPATIAL DISTRIBUTION OF CARTILAGE MR T2 IN A SUBSET OF PATIENTS FROM THE OSTEOARTHRITIS INITIATIVE

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Purpose: The Osteoarthritis Initiative (OAI) is a multi-center, longitudinal study aimed at assessing biomarkers in osteoarthritides (OA) including those derived from magnetic resonance (MR) imaging. The purpose of this study is to examine the spatial distribution of cartilage MR T2 in a subset of patients from the OAI at baseline and at 1-year follow-up using grey level co-occurrence matrix (GLCM) texture parameters.

Methods: Thirty subjects from the OAI were included in this study, and representative MR data were analyzed from fourteen subjects with radiographic OA at baseline (mean age = 57±11.2 years, Kellgren-Lawrence grade = 2-3, right knee, progression cohort). MR images including sagittal 3D DESSwe (TR = 16.5 ms, TE = 4.7 ms, interpolated in-plane resolution = 0.365x0.365 mm, slice thickness = 0.7 mm) and sagittal 2D MSME (TR = 2700 ms, TE1-TE7 = 10–70 ms) images from baseline and 1-year follow-up were analyzed in this study. Articular cartilage was segmented from the DESSwe images in six regions: medial and lateral tibia, medial and lateral femur, trochlea, and patella using a spline-based, semi-automatic technique. 3D cartilage thickness was calculated from the DESSwe images in six regions: medial and lateral tibia, medial and lateral femur, trochlea, and patella using a spline-based, semi-automatic technique. 3D cartilage thickness was calculated from the DESSwe images in six regions: medial and lateral tibia, medial and lateral femur, trochlea, and patella using a spline-based, semi-automatic technique. Cartilage parameter Longitudinal trend Cartilage region Orientation (degrees) Significance GLCM T2 contrast Increase Lateral femur 0, 45, 90 p < 0.05 GLCM T2 homogeneity Decrease Trochlea 0, 45 p < 0.05 GLCM T2 entropy Increase Lateral femur 0, 45, 90, 135 p < 0.05

Conclusions: The results of this study indicate that the spatial distribution of cartilage T2 in patients with radiographic knee OA changes longitudinally, as evidenced by significant increases in GLCM contrast and entropy, and significant decreases in homogeneity. Global-scale parameters including cartilage thickness and median cartilage T2 did not change significantly, focal-scale GLCM parameters showed significant changes. These results suggest that the changes in the extracellular matrix are spatially heterogeneous throughout degenerated cartilage, and may precede global cartilage loss, as demonstrated in a small subset of subjects from the OAI dataset.
Results: Precision errors of CT-OAM and CT-TomasD bone density measures were less than 4.2% (Table 1). OA was identified in four compartments of three tibiae (1 late OA+valgus, 1 late OA+varus, 1 early OA+neutral). Larger density differences between OA and normal knees were noted using CT-TomasD compared with CT-OAM (Table 1, Figures 1). CT-TomasD demonstrated that the two knees with late OA demonstrated M/L BMD ratios differing by more than 3.4 SD compared with normals, with peak cores higher than normals across all depths. The knees with early OA and neutral alignment did not demonstrate M/L ratios dramatically different from normals though core differences were highest proximally, with density becoming lower than normals with increasing depth.

Conclusions: Both CT-OAM and CT-TomasD are capable of precise measures of subchondral cortical and/or trabecular bone density distribution in osteoarthritic and normal subjects. Peak density measures using CT-OAM principally assess subchondral cortical bone and overlook density changes in nearby subchondral trabecular. Analysis of the entire subchondral cortical endplate and nearby trabeculae can be assessed using CT-TomasD. These preliminary results demonstrate the potential of both CT-OAM and CT-TomasD analyses to quantify subchondral bone density differences that may be associated with OA progression.

413 QUANTITATIVE T2, T2*, CONTRAST-ENHANCED T1 ASSESSMENT OF PORCINE KNEE CARTILAGE: CORRELATION WITH KNEE POSITION AND BIOCHEMICAL COMPOSITION

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Purpose: Knee imaging using quantitative MR imaging techniques, such as delayed gadolinium enhanced MRI of cartilage (dGEMRIC), T2 and T2* has shown usefulness in non-invasive assessment of physiological or degenerative changes of the articular cartilage. Those MR assessments in vivo, however, may be influenced by magic angle effect and intra-articular biomechanical environment, especially at various knee positions such as flexed knee. The purpose of this study is to examine influence of knee flexed positions on cartilage assessment by T2, T2* and contrast-enhanced T1 using cadaver porcine femoral-tibial joints, and to correlate with biochemical composition.

Methods: Eight porcine knee joints were imaged using 1.5T MR equipment (Siemens, Germany). Before imaging, a small cylindrical bone defect was made as a fiducial mark (Fig 1), to enable reproducible identification of the same imaging plane and definitions of regions of interest (ROIs). First, sagittal T2 and T2* maps were obtained in the medial and lateral joints, with knee extended position (Position A: flexion 0º and the femoral shaft in parallel to B0), at Position B (flexion 40º and the femoral shaft oriented 40º to B0) and at Position C (flexion 0º and the femoral shaft oriented 40º to B0). Blue arrows indicate fiducial marks. Dots lines are perpendicular to the femoral and tibial shaft.

Figure 1. Sagittal Gd-DTPA2− enhanced MRI maps at Position A (flexion 0º and the femoral shaft in parallel to B0), at Position B (flexion 40º and the femoral shaft oriented 40º to B0) and at Position C (flexion 0º and the femoral shaft oriented 40º to B0). Blue arrows indicate fiducial marks. Dots lines are perpendicular to the femoral and tibial shaft.

Figure 2. Change of T2/T2*/contrast-enhanced T1 values on the medial femoro-tibial joint.

414 EVALUATION OF THE EXTRACELLULAR MATRIX OF THE ANKLE ARTICULAR CARTILAGE USING DELAYED GADOLINIUM ENHANCED MRI IMAGING OF CARTILAGE

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Purpose: In recent years, delayed gadolinium enhanced MR imaging of cartilage (dGEMRIC) and T2 mapping, as non invasive diagnostic techniques, have been used to evaluate the quality of articular cartilage of the knee. However, these techniques are rarely applied to other joints, such as the ankle. The purpose of this study were to evaluate the articular cartilage lesion due to the chronic lateral ankle instability using dGEMRIC, and correlate between MRI and arthroscopic examination.

Methods: Two cases of anterior talofibular ligament (ATFL) reconstruction using gracilis tendon graft, which were operated for the chronic lateral ankle instability, were examined. After injection of the gadolinium, dGEMRIC was performed to show the color image of the articular cartilage layers of distal tibia and talus, pre and post operation. GAG concentrations of cartilage lesions were calculated by gadolinium (MRI) concentrations. Arthoscopic examination was performed prior to ATFL reconstruction with ICRS articular cartilage injury grading system.

Results: In both cases, cartilage lesion could be detected using dGEMRIC before the operation. GAG concentrations of cartilage lesions were lower than surrounding normal cartilage and showed yellow to orange color image. Arthoscopic findings showed ICRS grade II and grade III...