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+valgus, 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 measurements 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 trabeculae. 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.

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.

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 cartilage compositions and 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), knee flexed position (Position B: flexion approximately 40º and the femoral shaft oriented 40º to B0), and oblique-placed knee extended position (Position C: flexion 0º and the femoral shaft oriented 40º to B0) for evaluation of the isolated influence of magic angle effect. Then, contrast-enhanced T1 maps after equilibrium in 1mM Gd-DTPA2− for 3 hours, were obtained in the same plane at Position A, B and C. In each mapping at Position A, three ROIs were manually defined on the femoral cartilage (Figure 1); ROI 1 was covered by the anterior meniscus at the weight-bearing area and parallel to B0, ROI 2 and 3 were free from that area and oriented 25º and 50º to B0, using the fiducial mark. T2, T2*, and contrast-enhanced T1 values with knee extension and flexion in each ROI were compared using a paired t-test. Full thickness cartilage disks (diameter of 4 mm) were removed at each ROI, and proteoglycan (PG) and hydroxyproline (HP) content of cartilage were measured by spectrophotometric assay.

Results: At Position A, the average values of ROI 1/2/3 were 81/89/81/113 ms of T2, 33/46/49 ms of T2* and 150/210/247 ms of contrast-enhanced T1 values. Those values were not correlated with PG and HP content. At ROI 1, T2/T2*/contrast-enhanced T1 values at Position B increased by 24%/8%/24% and those values at Position C increased by 6.6%/11%/9.7% averagely, as compared with Position A (Figure 2). At ROI 3, those values at Position B decreased by 18%/2.8%/2.4% and at Position C decreased by 12%/6.7%/12% averagely, as compared with Position A. There was significant increase of T2 value in ROI 1 on the lateral and T2* value in ROI 1 and 2 on the medial joint at Position B, and decrease of T2 value in ROI 3 on the lateral joint at Position B. (p < 0.05) At Position C, T2, T2* and contrast-enhanced T1 values showed less changes in ROI 1 and 3 than at Position B.

Conclusions: The finding concerning absence of correlation between quantitative MR values and biochemical analysis may be caused from influence of magic angle effect and variation of infiltration of contrast medium among ROIs. Our results may suggest that quantitative MR measurements allow intra-articular biomechanical assessment in association with knee flexion, after excluding factors of magic angle effects. Clinically, attention should be paid on knee positions, to achieve reliable assessments of the knee cartilage in comparative or longitudinal studies.

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 MR 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. Arthroscopic 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. Arthroscopic findings showed ICRS grade II and grade III