Collagen matrix integrity and increase in water content observed in the structure in cartilage. It is known that T2 increases with the loss of T2 mapping is an MR imaging technique that can evaluate the collagen cartilage. be a useful and non-invasive method of assessing the quality of articular critical to mechanical support function of cartilage. Thus, dGEMRIC could have been known to have a potential to evaluate degenerative changes as the cartilage loses water after running. Running appears to alter the collagen matrix structure, composition, and water content which is shown by reduction in T2 and cartilage thickness. Larger reduction in T1rho, T2 values and thickness in the MTP may suggest that the medial compartment shares more load while large reduction in PAT and TRO indicate that greater traction of patella during running results in dehydration of cartilage tissue. The biochemical response of the articular cartilage to functional loading could potentially be a more sensitive biomarker of cartilage than morphological measures in the early phase of degeneration.

Conclusions: Significant decrease in T1rho and T2 values indicates the change in composition of the cartilage after running exercise. Reduction in T1rho values suggest an overall increase in proteoglycan concentration as the cartilage loses water after running. Running appears to alter the collagen matrix structure, composition, and water content which is shown by reduction in T2 and cartilage thickness. Larger reduction in T1rho, T2 values and thickness in the MTP may suggest that the medial compartment shares more load while large reduction in PAT and TRO indicate that greater traction of patella during running results in dehydration of cartilage tissue. The biochemical response of the articular cartilage to functional loading could potentially be a more sensitive biomarker of cartilage than morphological measures in the early phase of degeneration.

400 dGEMRIC AND T2 MAPPING OF REPAIR CARTILAGE AFTER MICRO FRACTURING PROCEDURE: A GOAT STUDY
A. Watanabe1, K. Matsuki1, S. Ochiai1, T. Obata2, C. Boesch3, S.E. Anderson3, P.M. Varlet3, T. Sasho4, Y. Wada1. 1Tokyo Univ. Chiba Med. Ctr., Ichihara, Japan; 2Natl. Inst. of Radiological Sci., Chiba, Japan; 3Univ. of Bern, Bern, Switzerland; 4Chiba Univ., Chiba, Japan

Purpose: Delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) and T2 (transverse relaxation time) mapping have been known to have a potential to evaluate degenerative changes of articular cartilage. dGEMRIC has been developed as a sensitive and specific method for monitoring glycosaminoglycan (GAG) in articular cartilage. GAG is a major solid constituent of articular cartilage and is critical to mechanical support function of cartilage. Thus, dGEMRIC could be a useful and non-invasive method of assessing the quality of articular cartilage.

T2 mapping is an MR imaging technique that can evaluate the collagen structure in cartilage. It is known that T2 increases with the loss of collagen matrix integrity and increase in water content observed in the early stage of osteoarthritis. Thus, T2 mapping can be an ideal marker of cartilage degeneration.

The aim of this study is to investigate the ability of delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) and T2 mapping to evaluate the quality of repair cartilage after micro fracturing procedure.

Methods: Six knees of 6 goats (6 females; aged 2–3 years) were studied. An osteochondral defect (6 mm in diameter) was created at both medial femoral condyle and lateral femoral condyle of the left hind leg. Six months after the surgery, MR imaging was performed using a 3 Tesla magnet.

Quantitative T1 measurements for dGEMRIC were performed on the slice which passed through the center of both medial and lateral osteochondral defects using the inversion recovery (IR) method. Quantitative T2 measurements for T2 mapping were performed on the same slice using the multi-spin-echo (MSE) method. T1 and T2-calculated maps were generated using MATLAB software (Mathworks, Natick, MA) with a mono-exponential curve fit. Using MATLAB, a color-coded T1 and T2-calculated maps of the femoral cartilage, segmented manually, was overlaid on the morphological image that had an inversion time of 1600 ms and echo time of 20.6 ms, respectively.

Immediately after MR imaging, the goats were euthanized and the repair cartilage and adjacent native cartilage were extracted. The cartilage samples were assessed for general histology using modified O'Driscoll score, and the collagen orientation of these samples were also assessed by means of polarized light microscopy (PLM). The concentration of GAG as well as hydroxyproline (HP) was also studied.

Results: Repair cartilage was classified as mixed cartilage or fibrocartilage. A significant correlation was observed between GAG concentration and T1 value (ρ<0.05) as well as HP concentration and T2 value in repair cartilage (ρ<0.05). However, there seemed to be no correlation between histological grading and T1 value as well as T2 value in repair cartilage. There seemed to be no correlation between T2 and collagen orientation assessed by PLM.

With dGEMRIC technique, repair cartilage at medial condyle had higher GAG concentration than that at lateral condyle. With T2 mapping technique, repair cartilage at medial condyle had higher collagen matrix integrity than that at lateral condyle. These MRI findings were in good agreement with the results of histological evaluation.

Conclusions: dGEMRIC and T2 mapping technique might have a potential to evaluate GAG concentration and HP concentration respectively in not only degenerative cartilage but also in repair cartilage after micro fracturing procedure. These quantitative MR imaging techniques of cartilage might correlate closely with macromolecular concentration, but not with comprehensive histological grading.

401 INTER AND INTRA SITE VARIABILITY IN T2 RELAXATION TIME MEASUREMENTS
L.K. Riek. VirtualScopics, Inc. Rochester, NY, USA

Purpose: T2 relaxation times in cartilage show differences according to variations in macromolecular concentration, collagen orientation and structure, and tissue hydration. Thus, T2 mapping has become a common method for analyzing the quality of cartilage tissue using magnetic resonance imaging (MRI). In a multi-center clinical trial, it is difficult to ensure that consistent T2 values are obtained across the different sites. Many scanners now provide T2 mapping sequences and the ability to generate a T2 map. These sequences and maps provide valuable information to the clinician, especially when looking at cartilage and cartilage repair tissue. This paper looks at the utility of these sequences and maps in the context of a multi-center clinical trial. Specifically, intra-site variability in the site-calculated T2 maps, intersite variability of the site-calculated T2 maps, and a comparison of these values with centrally calculated values from the same imaging sequences.

Methods: Ten sets of four vials containing varying concentrations of copper sulfate (CuSO4) | 5mM, 10mM, 20mM and 40mM | were imaged in a GE 1.5T HDx magnet using a head coil to determine reference T2 values.

Five single-slice, spin-echo series were collected (TR=2000 ms, TE=12, 20, 40, 60, 80 ms, thickness=1 mm, matrix=256x256, FOV=17 cm, NEX=2). Reference values of 30 ms, 60 ms, 121 ms and 231 ms were calculated using a linear regression on the natural log of the signal intensities. A different set of four vials was used for each magnet in this study. The