**Texture Analysis of T1ρ Relaxation Times in Knee Osteoarthritis**

J. A. Schoeller1, S. P. Yap1, G. B. Joseph1, X. Li1, T. M. Link1, and S. Majumdar1

1Musculoskeletal and Quantitative Imaging Research, Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States

**Introduction**

The structural and biochemical compromise of hyaline articular cartilage knee compartments (lateral femoral condyle (LFC), medial femoral condyle (MFC), lateral tibia (LT), medial tibia (MT)) were segmented on a sagittal SPGR sequence (matrix 512x512, FOV = 16cm, slice thickness = 1mm) using MATLAB (MathWorks, Natick MA) based in-house software. T1ρ maps were then registered to the SPGR images using an in house registration algorithm. Segmentations were then superimposed upon T1ρ maps to extract relaxation time mean values per compartment. GLCM texture parameters for the four compartments were defined using in-house MATLAB developed software. Eight GLCM texture parameters including Contrast, Dissimilarity, Homogeneity, ASM, Energy, Entropy, Mean, and Variance were calculated along four angles (0°, 45°, 90°, and 135°) and at one pixel offset. The differences in T1ρ parameters (mean T1ρ and GLCM measurements) between the controls and OA patients were assessed using mixed random effect regression models (independent variable: group, compartment and their interactions, dependent variable: T1ρ parameters), treating the subject as the random effect. All statistics were performed using JMP software version 8 (SAS Institute, Cary NC).

**Results**

 Representative T1ρ maps in an OA patient and a control are illustrated in Figure 1. A significant correlation in mean T1ρ, GLCM mean, GLCM variance, and GLCM correlation was evident between OA patients and controls (Figure 2). GLCM variance is an indicator of the distribution of pixel values around the mean (8). GLCM mean values are a weighted measure of pixel frequency of occurrence with certain neighbor pixels and GLCM correlation is a gauge of linear dependency of grey levels on those of neighboring pixels. In areas of biochemically degraded cartilage we would expect elevated T1ρ relaxation times and in areas of especially high degradation it would be logical to expect GLCM variance, mean, and correlation values to fluctuate significantly from the mean.

**Discussion**

This study used GLCM texture analysis to quantify the heterogeneity of biochemical cartilage degeneration in OA patients compared to controls. Our results demonstrate that mean T1ρ as well as 3 of the 8 GLCM texture parameters (variance, mean, correlation) are elevated in OA patients compared to controls. These results are consistent with the findings Carballido-Gamio et al. (7) with respect to T1ρ texture analysis of OA patients. Further investigation tracking a longitudinal OA cohort, of the remaining texture measurements warrants investigation and will be performed.

**References**


**Acknowledgements**

This research was supported by the NIH RO1 AR46905