

## GRAY LEVEL CO-OCCURRENCE MATRIX (GLCM) APPROACH FOR T2 ANALYSIS OF CARTILAGE IN KNEE OSTEOARTHRITIS

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**BACKGROUND:** Knee osteoarthritis (OA) is common chronic disease that is not only limiting physical functionality and quality of individual's life, but also causing high socio-economic burden. OA is characterized by several processes altering morphology of the joint: Cartilage is degenerated, subchondral bone and menisci are degraded, joint space is narrowed and osteophytes appear. OA patients often report knee pain, joint stiffening and tenderness. At the moment, no cure for OA is known. Progression of OA can be slowed down with pre-emptive measures such as exercise and weight loss. OA drug development has been mostly suspended as no sensitive enough method exists to monitor the efficiency of the proposed treatments. MRI T2 relaxation has been linked to cartilage structure and degeneration and is widely recognized and accepted research tool in OA studies [1]. Calculation of second order textural features from T2 maps is a novel approach to refine relaxation time analyses [2].

**OBJECTIVE:** To develop GLCM [3] texture analysis based biomarkers for cartilage degeneration based on MRI relaxation time maps.

**METHODS:** 64 asymptomatic volunteers and 80 symptomatic patients were scanned on 3T Siemens Skyra clinical magnet. T2 relaxation time mapping was performed with a multi-slice multi-echo spin echo sequence. Haralick's GLCM texture features were calculated for each region of interest: central region on medial femoral condyle (mCF) and medial central tibia (mcT), and their lateral counterparts (ICF and lcT). Difference entropy, energy, homogeneity, and information measure of correlation, as determined by GLCM, and mean T2 were calculated for these ROIs and compared between subject groups. Spearman's correlations between texture and mean T2 values were determined.

**RESULTS:** Mean T2 values of ROIs differentiated subjects with OA from asymptomatic subjects only in ICF. Homogeneity and information measure of correlation were significantly lower and difference entropy was significantly higher in patient group in all compartments. Energy was significantly lower in patient group in mCF and ICF. While the mean T2 relaxation time differed significantly between groups in ICF, texture analysis further increased that differentiation. Mean T2 values were weakly correlated with the structure parameters, suggesting that GLCM analyses can provide complementary information on articular cartilage.

**CONCLUSION:** Texture analysis can reveal underlying information from T2 relaxation time maps and may detect cartilage degeneration more sensitively than mere mean T2 values.

[1] F. Eckstein, et al., [NMR in Biomedicine 19, 822-854 \(2006\)](#).

[2] J. Carballido-Gamio, et al., [Magnetic Resonance in Medicine 65, 1184-1194 \(2011\)](#).

[3] R. M. Haralick et al., [IEEE Transactions on Systems, Man, and Cybernetics 3, 610-621 \(1973\)](#).