

# Cartilage Homogeneity from MRI for Quantifying Osteoarthritis Progression

## Summary

- Fully automatic computer-based method evaluated using 3D T1 on a 0.18T scanner.
- Evaluated on 159 subjects (288 knees at baseline, 245 at follow-up after 21 months).
- The homogeneity measurement has a scan-rescan precision of CV 2.6%, and is suitable as a Diagnostic, Prognostic, and possibly also as Efficacy of Intervention biomarker.

## Background and Methods

Cartilage loss is preceded by loss of structural integrity during the early stages of OA. The quality and composition – notably in terms of hydration and proteoglycan distribution – is reflected by the cartilage intensity distribution in MRI. We evaluated the measurement of the entropy, a measure of tissue homogeneity, for the medial compartments of Tibial and Femoral articular knee cartilage using our fully automatic computer-based framework. The subjects aged  $56 \pm 16$  years with BMI  $26 \pm 4$ . At baseline the count of knees with KL scores 0-4 were 145, 88, 30, 24, 1. Of the healthy knees, 101 remained healthy and 25 were progressors at follow-up.

## Results

The scan-rescan precision was 2.6% (mean CV). The abilities to diagnose level of OA (KL score) cross-sectionally (Figure 1), to predict early radiographic progression (Figure 2), and to monitor longitudinal progression (Figure 3) were as illustrated.

## Conclusions

The entropy quantification was precise and proved to be suitable as a Diagnostic biomarker for both OA ( $p < 0.001$ ) and early OA ( $p < 0.001$ ). It was also suitable as a Prognostic biomarker since the baseline entropy could separate the healthy non-progressors from the early progressors ( $p = 0.002$ ). Finally, the longitudinal change was significantly higher for the early progressors than the non-progressors ( $p < 0.05$ ) so entropy may also be suitable as an Efficacy of Intervention biomarker.

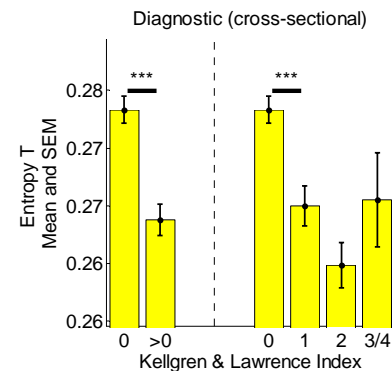


Figure 1

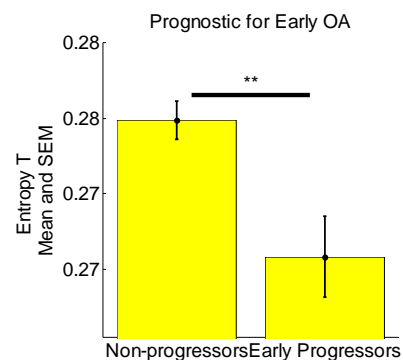


Figure 2

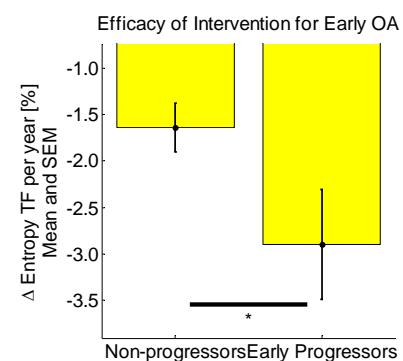


Figure 3

## Key Publications

*Segmenting articular cartilage automatically using a voxel classification approach*  
Folkesson, Dam, Olsen, Pettersen, Christiansen. IEEE Trans Med Imaging. 2007, 26(1):106-15

*Separation of healthy and early osteoarthritis by automatic quantification of cartilage homogeneity.* Qazi, Folkesson, Pettersen, Karsdal, Christiansen, Dam. Osteoarthritis Cartilage. 2007, 15(10):1199-206

*Pathology Indicating Measure related to Cartilage Structure and Automatic Quantification Thereof.*  
Patent: PCT/EP2007/059899