CORRELATION TIME MAPPING OF DEGENERATED BOVINE AND HUMAN SAMPLES

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Osteoarthritis (OA) is a widespread musculoskeletal disorder which is considered as a major cause of disability. The progressive loss of articular cartilage is the main cause of OA. Magnetic resonance imaging (MRI) is one of the most suitable imaging modalities to assess and observe the progression of OA, as it can provide data related to the whole joint structure in three dimensions.

The purpose of this study was to develop a new macromolecular specific MRI contrast, correlation time (τ_c), as an indicator of the structural changes in articular cartilage. We propose that τ_c changes continuously over cartilage as the local microenvironment of the water molecules is altered due to different macromolecular and water content and structural characteristics within this environment. By computing a local τ_c value from MRI images, pixel by pixel, the dynamics of water protons in cartilage may be accurately revealed. We obtained τ_c maps by fitting $T_{1\rho}$ relaxation dispersion measurements of both collagen and proteoglycan (PG) digested bovine cartilage samples, as well as human cartilage specimens [1], into a mathematical model [2] based on the measured relaxation dispersion.

Correlation time maps of bovine control samples revealed different zones in the cartilage. In collagen digested group, the degradation of superficial zone was apparent as observed from the τ_c maps. The tri-laminar structure of cartilage clearly appeared in τ_c maps of early OA samples, but it was missing from maps of advanced OA samples.
These findings propose that τ_c, which represents a fundamental physical property of the cartilage tissue, can be a novel MRI contrast due to the structural information it contains about the cartilage, as well as its disorders and changes.

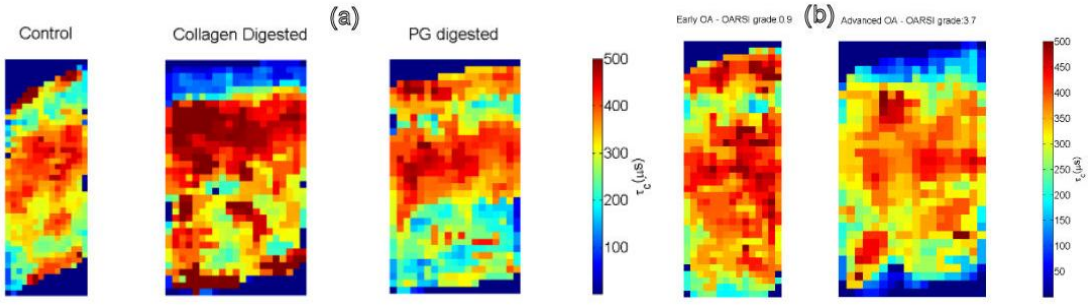

Figure 1: τ_c maps of bovine samples (a) and human samples (b)

[1] J. Rautiainen et al, Magn. Reson. Med., 74, 1 (2014).
[2] B. Blicharska et al, J. Magn. Reson., 207, 2 (2010).