Osteoarthritis (OA) is a common disease that results in cartilage degeneration in the joints and is a disabling condition for millions of individuals. Poor sensitivity and specificity of standard diagnostic methods have relegated treatment options to mitigating pain or surgical replacement. The advent of disease-modifying drugs holds the potential for reversing the normal course of OA and rebuilding cartilage. To aid these therapies, novel MRI-based tools are required for detecting subtle early changes in cartilage physiology due to OA that may provide improved diagnoses and clinical management of patients. Some of the techniques reviewed here such as T1_ρ and delayed Gadolinium-enhanced MRI of cartilage (dGEMRIC), both biomarkers of cartilage pathology that are sensitive to early biochemical changes in the extracellular matrix of cartilage.

The presentation will include the following:

- **Principles and mechanisms of T1_ρ relaxation and dGEMRIC contrast in cartilage**
  T1_ρ MRI utilizes a long-duration, low-power radiofrequency (RF) pulse applied to the magnetization in the transverse plane. This “spin-locked” magnetization undergoes relaxation in the presence of a B_1 field in the rotating frame, a situation analogous to T1 relaxation in the B_0 field. However the lower B_1 field sensitizes the MRI signal to low-frequency molecular processes of interest in cartilage tissue that is not possible with conventional MRI (1). The dGEMRIC technique is based on the premise that the negatively charged contrast agent Gd(DTPA)_2 will distribute in cartilage in inverse relation to the negatively charged glycosaminoglycan concentration (2,3).

- **T1_ρ and dGEMRIC MRI protocols**
The primary challenge in implementing T1ρ pulse sequence in multi-slice mode is due to the nonselective nature of the spin-lock pulse, which saturates the longitudinal magnetization from non-excited regions. Several pulse sequences have been developed over the years to overcome this problem on clinical scanners (4-8). The dGEMRIC utilizes MRI pulse sequences for time-efficient T₁ mapping along with contrast administration (9). The practical implementation of the technique requires exercise immediately after contrast administration, double-dose contrast, and a time for penetration of the contrast agent into cartilage.

- **Application in MSK MRI**

Several studies have demonstrated the efficacy of dGEMRIC and T1ρ MRI in detecting early cartilage pathology during OA (10-15). These techniques have the potential to non-invasively detect early pathological changes with the goal of aiding clinical decision-making as well as contributing to development and evaluation of potential disease modifying therapies.

**A short reading list of papers and reviews:**


