Quantitative Magnetic Resonance Arthrography in Patients with FAI

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Cartilage loss and OA symptoms are preceded by damage to the collagen-proteoglycan matrix.

Proteoglycan content increases while collagen content decreases during degeneration.

$T_{1p}$ and $T_2$ mapping are QMRI sequences used to probe proteoglycan content and collagen network integrity.

- Utilize variations in proteoglycan response to detect early cartilage injury.

QMRI in the Knee
Current State of Hip QMRI

- $T_{1\rho}$ and $T_2$ mapping of acetabulum and femoral head performed at UCSF
  - QMRI used in both healthy and FAI cohorts
  - Differences in femoral and acetabular cartilage composition in the anterior superior region of the hip for FAI patients
  - $T_{1\rho}$ also able to detect acetabular cartilage changes in FAI patients
MR Arthrography

- MR arthrography (MRA) is highly used in evaluating FAI pathology
- Intra-articular injection of gadolinium enhances MR ability to detect labral injury in the hip
  - Clinically valuable for localization of an intra-articular source for hip pain
- However, ability of MRA in assessing cartilage damage lacks sensitivity
- Use of QMRI in combination with contrast-based imaging in the hip joint is not well validated or understood
Purpose

- Use of QMRI in combination with MRA may prove beneficial in assessing cartilage degeneration in FAI patients.

- The purpose of this study was to compare $T_{1\rho}$ and $T_2$ values in an FAI population, using both MRA and MRI.
Methods

- 10 FAI patients with hip pain presented for MRA of hip between 11/2014 and 8/2015.
  - 7 males, 3 females
  - Average age- 35, avg BMI-22
  - Avg Alpha angle- 58, avg LCEA- 34
- A combined $T_1\rho/T_2$ sequence was incorporated into sagittal plane scan in 3T scanner after arthrography
- Patients returned within 1 month to complete a standard QMRI of same hip without contrast for comparison
Cartilage Segmentation/Quantification

- Femoral and acetabular cartilage were segmented on the first echo of the $T_{1\rho}/T_2$ images
  - 4 slices near the center of the hip
  - Similar slices segmented in both the MRA and MRI
- Assessment of both global and sub-regional femoral and acetabular $T_{1\rho}/T_2$ values
- Agreement of $T_{1\rho}/T_2$ relaxation times in both the MRA and MRI were assessed using the Krippendorff’s alpha coefficient and linear regression
Results

$T_{1e}$

$T_2$

QMRA

QMRI
Sub-region Relaxation Times

![Acetabular T1rho](image1.png)

![Femoral T1rho](image2.png)

![Acetabular T2](image3.png)

![Femoral T2](image4.png)
Results Summary

- All patients demonstrated elevated $T_{1\rho}/T_2$ relaxation times in the anterior-superior region of the femoral head and anterior-superior region of the acetabulum near the chondrolabral junction
  - Indicates early cartilage injury in these regions

- The average global and sub-regional $T_{1\rho}/T_2$ relaxation times in the acetabular and femoral cartilage layers demonstrated strong agreement, independent of intra-articular contrast
  - Krippendorff’s alpha values of 0.83 – 0.97
  - Linear regression analysis slopes of 0.85 – 1.0
Conclusion

- This study demonstrated the feasibility of $T_{1\rho}$ and $T_2$ mapping for use in MRA with FAI patients.

- The inclusion of $T_{1\rho}/T_2$ mapping in MRA provides a quantitative assessment of the effects of FAI on hip joint articular cartilage while allowing for detailed assessment of labral pathology with the use of intra-articular contrast.
References


