Validation of T1ρ MRI as a Biomarker in Hips with Cam-type FAI

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INTRODUCTION

- Cam-type femoroacetabular impingement (FAI) is a major cause of hip osteoarthritis (OA)
- T1ρ Magnetic Resonance Imaging (MRI) has the potential to detect early cartilage degeneration at the biochemical level due to its sensitivity to proteoglycan (PG) content.[1,2]

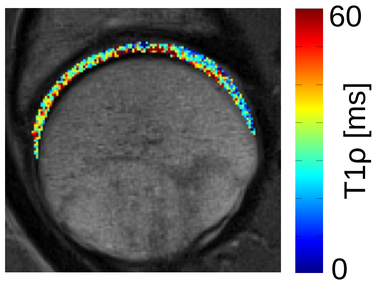


***Figure 1**: Typical example of a color-coded segmented hip cartilage T1ρ map.
The map is shown as an overlay on top of an anatomical MRI reference image.*

- T1ρ sensitivity to cartilage changes

→ early cartilage breakdown
→ loss of proteoglycans (PG)
→ changes in water content
→ content changes in collagen

T1ρ MRI can evaluate changes in concentration and structure of macro molecules (PG) within cartilage

PURPOSES

- **Correlation of hip cartilage T1ρ with the clinical scores in subjects with Cam-type FAI**
- **Evaluation of hip cartilage T1ρ changes pre- and post hip preserving surgery (2 years)**
- **Evaluation of T1ρ changes and changes in clinical scores (2 years)**

METHODS

- **Subjects**
- 21 hips (21 patients)
- Cam-type FAI defined on CT scans with an alpha angle at 1:30 o'clock position >60° and/or at 3:00 o'clock position >50.5°
- 11 patients were treated conservatively, 10 underwent hip preserving surgery
- T1ρ MRI of the symptomatic hip, pre- and post-operatively (2 years)
- WOMAC scores were assessed preoperatively and two years after surgery

- **MRI Protocol**
- 1.5T MRI (Siemens, Erlangen, Germany)
- flexible four channel receive coil
- T1ρ sequence: TR = 274ms, TE = 13ms, FOV = 180x180mm^2, matrix = 384x384, resolution = 0.47x0.47mm^2, slice thickness = 3mm, number of slices = 22, B_1 = 400Hz, TSL= 12, 18, 25, 35, 45ms, scan time = 21min

- **Post processing**
- Pixel-wise fitting method implemented in Matlab (Mathworks, USA)
- Semi-automatic division of the femoral head into six regions of interest (Figure 2):
  - Anterosuperior (12-3 o'clock) and posterosuperior (9-12 o'clock)
  - lateral, medial and intermediate third
- Ratio of anterosuperior to posterosuperior quadrant

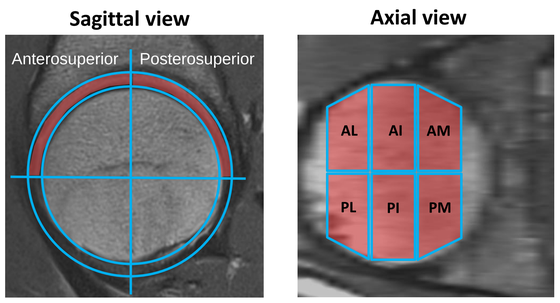
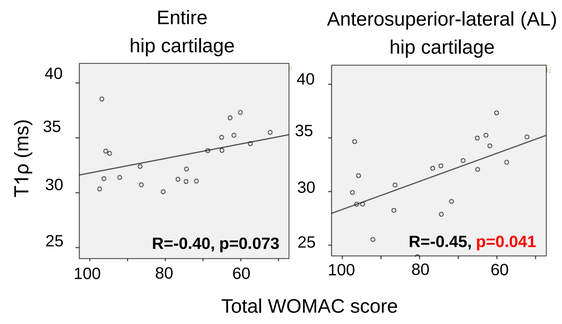


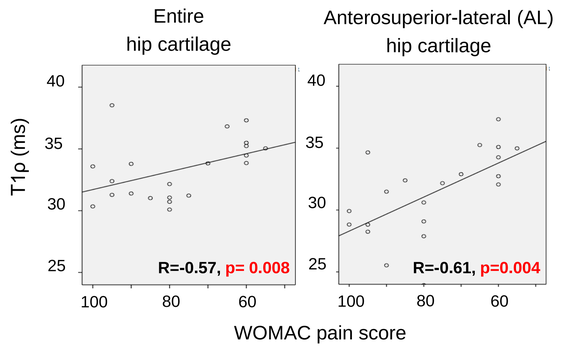
***Figure 2**: Illustration of the six regions of interest for cartilage T1ρ analysis. Anterosuperior-Lateral (AL), -Intermedaite (AI), -Medial (AM). Posterosuperior-Lateral (PL), -Intermedaite (PI), -Medial (PM).*

RESULTS

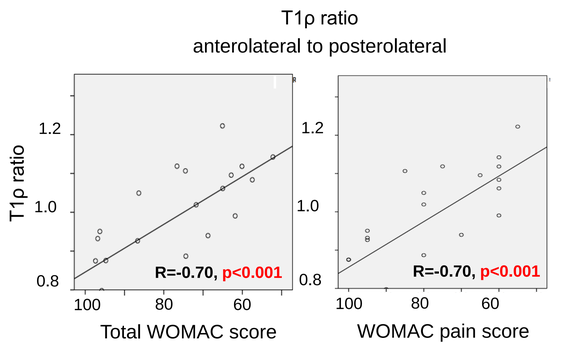
- Significant correlation between T1ρ in the Anterosuperior-Lateral (AL) region and WOMAC



- Significant correlations between T1ρ in hip entire hip cartilage / AL region and WOMAC pain score



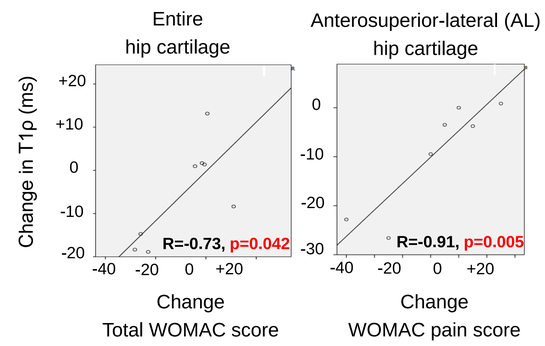
- Significant correlations between T1ρ ratio (anterolateral to posterolateral) and total WOMAC / WOMAC pain score



- T1ρ decreased 2 years postoperative in:
- (1) entire hip cartilage (all regions)
- (2) anterolateral (AL) region

ROI	T1ρ (ms)		
	Preoperative	Two years postoperative	Healthy controls
Entire hip cartilage	33.9 ± 2.8	32.0 ± 4.2	31.4 ± 2.9
Anterolateral (AL)	31.8 ± 3.3	28.7 ± 4.8	29.4 ± 4.1

- Significant correlations between change in T1ρ (all regions and AL) and change in WOMAC (total and pain score)



DISCUSSION

- **The decrease of T1ρ postoperative indicates the potential of restoring cartilage after hip preserving surgery**
- **T1ρ cartilage mapping has the potential to become a validated, entirely non-invasive test for diagnosis and monitoring of early cartilage damage**

REFERENCES

1. Akella et al, Proteoglycan-induced changes in T1rho-relaxation of articular cartilage at 4T. Mag Reson Imag, 2001
2. Rakhra et al, Can T1-rho MRI detect acetabular cartilage degeneration in femoroacetabular impingement?: a pilot study. JBJS 2012