

Evaluation of bone remodeling and cartilage proteoglycan content in cam impingement and healthy controls using PET-MRI

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Disclosures:

INTRODUCTION: Cam morphology of the hip may predispose to Femoroacetabular Impingement (FAI) and osteoarthritis (OA). Understanding the biological and functional changes in FAI may provide insight into the early stages of OA and allow for the development of a biomarker. Magnetic Resonance Imaging (MRI) T1 ρ mapping gives information on proteoglycan loss in cartilage, while Positron Emission Tomography (PET) allows for functional imaging of bone turnover. In this study, simultaneous PET-MRI was performed to analyze bone and cartilage in hips with cam impingement and healthy controls.

METHODS: 3T PET-MRI was used to study three groups: Asymptomatic cam morphology (n=7), symptomatic cam morphology (n=12), and healthy controls (n=13). MRI T1 ρ maps were acquired as markers for cartilage proteoglycan content, 18F-NaF-PET Standard Uptake Values (SUVs) for bone turnover in the acetabulum and femur. The cartilage was divided into 6 regions: anterior lateral, anterior intermediate, anterior medial, posterior lateral, posterior intermediate, and posterior medial. The same regions were defined in the acetabulum, and the femoral head and femoral head neck junction regions were divided into four subregions. Baseline Patient Reported Outcome Measures (PROMs) were collected using the Hip Disability and Osteoarthritis Outcome Score (HOOS), EQ-5D-5L, and the International Hip Outcome Tool (iHOT-33). Kruskal–Wallis ($p<0.05$), pairwise Wilcoxon tests, and Spearman correlations (r) were used to compare measures between groups.

RESULTS SECTION: In general, higher T1 ρ and SUV values were observed in the symptomatic group compared to the asymptomatic and control groups. Example T1 ρ and SUV images can be seen in Figure 1. T1 ρ was significantly increased for the symptomatic group compared to asymptomatic and control groups in three sub-regions of cartilage (anterior medial: $p=0.0023$, posterior intermediate: $p=0.0017$, posterior medial: $p=0.0034$) and the entire hip cartilage ($p=0.0052$). The maximum SUV was significantly higher for symptomatic and control groups compared to the asymptomatic group in three sub-regions of the acetabulum (anterior intermediate: $p=0.029$, posterior lateral: $p=0.029$, posterior intermediate: $p=0.018$). T1 ρ values in the anterior lateral region of cartilage were significantly negatively correlated ($r<-0.7$, $p<0.05$) with SUVs in the femur. SUVs in the acetabulum were significantly positively correlated ($r>0.7$, $p<0.05$) with SUVs in the femur. Significant negative correlations ($r<-0.7$, $p<0.05$) were observed between anterior medial T1 ρ values and the baseline HOOS and iHOT-33 PROMs, as well as the T1rho values in the superior regions of the femoral head and the baseline HOOS and iHOT-33 PROMs.

DISCUSSION: Higher T1 ρ values in the symptomatic group indicate lower proteoglycan content and onset of osteoarthritis. Increased SUV in the adjacent acetabulum indicates active bone remodeling in the symptomatic group, while lower SUV in the asymptomatic group suggests less bone remodeling is occurring. Correlations of T1 ρ values and SUVs with HOOS and iHOT-33 PROMs in the symptomatic group may suggest these metrics are objective quality of life measures. As this study is ongoing, sample size is a limitation. PET-MRI allows simultaneous analysis of bone and cartilage, and may be a useful, non-invasive tool for FAI and OA research.

SIGNIFICANCE/CLINICAL RELEVANCE: This technique may provide a non-invasive method for determining diagnosis and prognosis of FAI and OA.

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IMAGES AND TABLES:

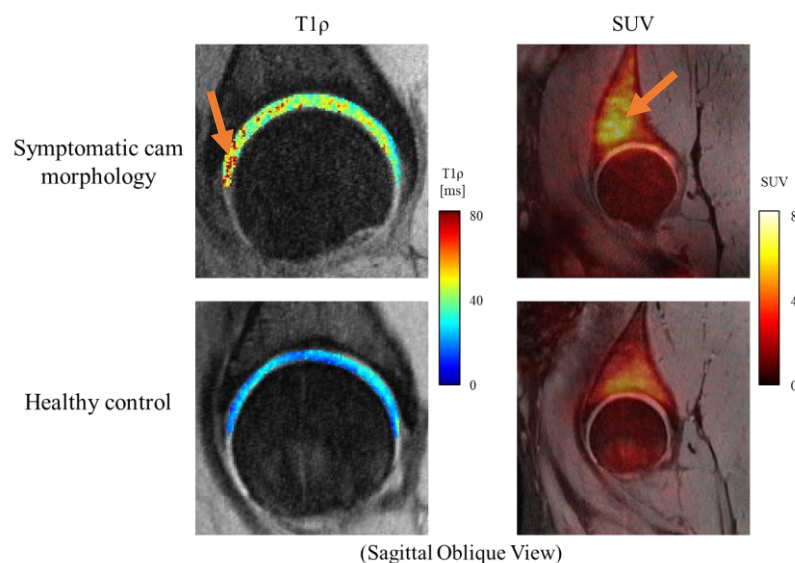


Figure 1. Example T1 ρ and SUV images for the symptomatic and control groups. Regions of higher T1 ρ and SUV can be seen in the symptomatic group compared to the healthy controls, as indicated by the arrows.