

# Pre-surgical hip cartilage evaluation using MRI T1rho mapping on periacetabular osteotomy (PAO) outcomes

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**INTRODUCTION:** Hip dysplasia is a condition in which the acetabulum does not cover the femoral head in the hip joint. This misalignment causes pain, degeneration, and is a precursor to osteoarthritis and hip replacement. The Bernese periacetabular osteotomy (PAO) is the gold standard for surgical correction, during which the acetabulum is repositioned to align with the femur. T1rho MRI is a non-invasive technique that allows insight into early stages of cartilage degeneration due to its sensitivity to the proteoglycan content. Patient reported outcome measures (PROMs) provide a measurement of pain, discomfort, and quality of life. This study investigates correlations between cartilage health through pre-surgical T1rho with patient quality of life through PROMs to predict PAO surgical outcomes of hip dysplasia patients.

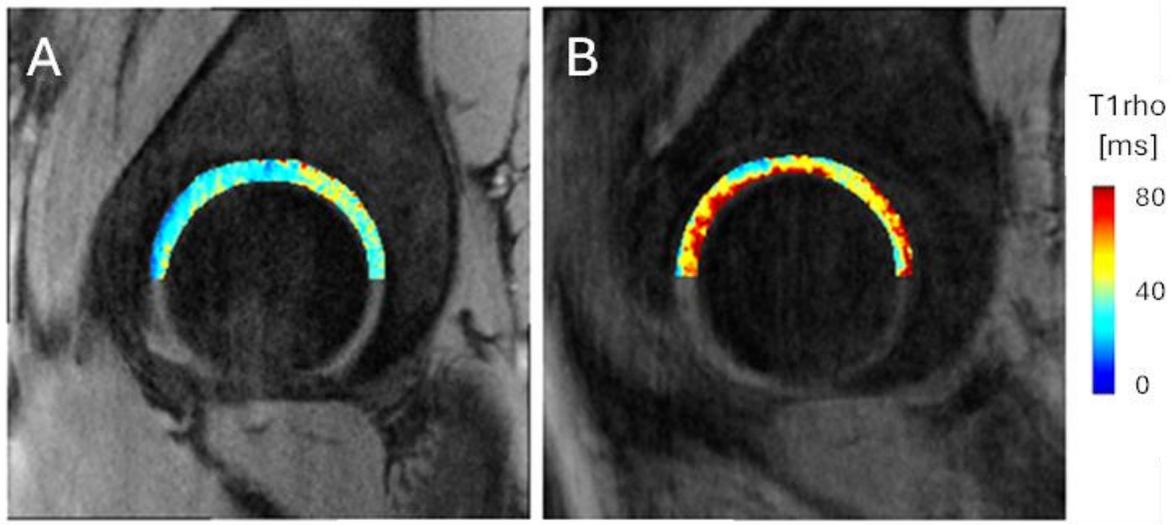
**METHODS:** This study has been approved by the Research Ethics Board. A total of 30 hip dysplasia patients were recruited before undergoing PAO, consisting of 18 females and 12 males with a mean age of 28.9 years. Of these, 18 participants were also reported to have a confirmed labral tear. Uni-lateral 3D hip cartilage T1rho mapping was performed at 3T (PrismaFit, Siemens Healthineers). The hip cartilage was segmented to extract T1rho values from following 6 subregions: anterior lateral, anterior intermediate, anterior medial, posterior lateral, posterior intermediate, posterior medial. PROMs were collected at baseline (pre-surgery) and 6 months post-surgery through Patient-Reported Outcomes Measurement Information System (PROMIS), International Hip Outcome Tool (iHOT-33), and Hip Disability and Osteoarthritis Outcome Score (HOOS). All PROMs use a scale with higher values indicating better quality of life. The difference between the baseline and post-surgery PROMs was also calculated. T1rho was compared for participants with and without labral tears. Spearman correlations ( $r$ ) with a significance level of  $p < 0.05$  were used to compare T1rho and the PROMs.

**RESULTS:** Moderate to strong, significant, negative correlations ( $-0.64 < r < -0.45$ ) were observed between T1rho in the anterior lateral cartilage region with almost all 6-month post-surgery PROMs, with the exception of the PROMIS mental health parameter. A weak, significant, negative correlation ( $r = -0.38$ ) was found between T1rho in the posterior lateral region of cartilage with the baseline HOOS pain parameter. There was also a moderate, significant, negative correlation ( $r = -0.45$ ) between T1rho in the anterior medial region of cartilage with the difference in HOOS symptoms parameter from baseline to 6-month post-surgery. No significant differences in T1rho were found between participants with and without labral tears in any of the cartilage regions.

**DISCUSSION:** Negative correlations indicate that increasing T1rho (worsening cartilage health through reduced proteoglycan content) is associated with decreasing PROMs (worsening pain, discomfort, and quality of life). Negative correlations of T1rho with both baseline and post-surgery PROMs suggest patients with increased cartilage degeneration before surgery experienced worse pain and quality of life before and 6 months after surgery. Negative correlations with changes in PROMs suggest patients with worse cartilage degeneration prior to surgery experienced lower quality of life improvements after surgery. While hip dysplasia causes cartilage degeneration to varying degrees, T1rho can provide insight into the level of degeneration prior to surgery which may be useful in predicting short-term surgical outcomes for PAO.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Pre-surgical T1rho may be a useful predictive tool for short-term surgical outcomes of PAO in hip dysplasia patients.

**IMAGES AND TABLES:** Example images showing T1rho maps of the hip cartilage for two patients, demonstrating the range in cartilage health prior to PAO surgery. Increased T1rho indicates worsening cartilage through reduced proteoglycan content. The patient in image B shows increased T1rho values compared to A, indicating reduced proteoglycan content.



Sagittal Oblique View