

Paper #14**REPRODUCIBILITY OF T2 MAPPING AND ITS COMPARISON WITH DELAYED GADOLINIUM ENHANCED MAGNETIC RESONANCE IMAGING (dGEMRIC) SCANNING IN THE HIP**

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Summary: This research explored the reproducibility and sensitivity to cartilage damage of T2 mapping of the hip compared to a proven, gold standard method of physiological MRI (dGEMRIC), to determine if it offered greater clinical utility as a surrogate marker of early cartilage damage.

Background: Current imaging strategies only allow osteoarthritis (OA) diagnosis once irreversible loss of cartilage has occurred. Physiological MRI offers the potential to diagnose osteoarthritis at a stage where patients may benefit from intervention, however it requires further validation. Delayed Gadolinium enhanced magnetic resonance imaging of cartilage (dGEMRIC) is the best-validated technique and is used for indirectly measuring cartilage glycosaminoglycan (GAG) content. However, it requires long scanning times and the use of a nephrotoxic contrast agent. T2 mapping is sensitive to the mobility of protons within water and hence the water content of cartilage, which increases in early cartilage damage. T2 scanning doesn't use a contrast agent and has shorter scan times than dGEMRIC scanning, thus presenting itself as an attractive alternative imaging modality. However, the reproducibility of T2 mapping, the effect of joint unloading, and its comparison to dGEMRIC scanning in the hip remains unknown.

Objectives: To explore the reproducibility and clinical applicability of T2 mapping of the hip compared to a proven, gold standard method of physiological MRI (dGEMRIC)

Design: This study comprised 2 separate cohorts. The first cohort consisted of healthy volunteers who underwent T2 mapping of both hips at 4 time points (25, 35, 45, and

55 minutes post offloading) in the same session. This allowed investigation into the reproducibility of T2 image acquisition and the reproducibility of observer analysis, along with the effect of joint loading. The second cohort consisted of asymptomatic individuals who have shown to be at high risk of developing osteoarthritis (termed 'SibKids') who underwent both T2 and dGEMRIC scanning of the same hip. This allowed us to determine if correlation existed between relaxation values of the two scanning modalities in both healthy cartilage and areas of early cartilage pathology.

Results: Study comprised 12 healthy volunteers (24 hips) and 10 Sibkids (10 hips). For T2 image analysis intra-observer reproducibility ICC = 0.975, RMSCoV = 3.536%, SDD = 2.168ms, and inter-observer reproducibility ICC = 0.956, RMSCoV = 5.168%, SDD = 3.503. The comparison of T2 mapping at different time points showed relaxation times at 25 minutes unloading were not significantly different to longer unloading times ($p = 0.132$). T2 and dGEMRIC relaxation times showed a statistically significant negative correlation ($R = -0.337$, $p = <0.001$) throughout the hip joint, comprising healthy and diseased cartilage. However, this correlation was stronger when only comparing diseased cartilage in the anterosuperior acetabulum ($r = -0.606$, $p = <0.001$)

Conclusions: T2 mapping of the hip is similarly reproducible to that seen in dGEMRIC scanning, and similarly sensitive in being able to distinguish the same areas of early cartilage disease. Moreover, a shorter post offloading scan time of 25 minutes is adequate in detecting these changes. Overall, our results strongly support the use of T2 mapping of the hip as a comparable method of cartilage pathology assessment to the gold standard of dGEMRIC scanning. With its shorter scanning and unloading times, and lack of nephrotoxic agent, T2 mapping may offer greater clinical utility than dGEMRIC scanning, however further validation and a standardized image protocol is required.