Is the Contralateral Hip at Risk in Patients with Unilateral Symptomatic Cam FAI? A Quantitative T1p MRI Study

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Introduction:
Cam-type femoroacetabular impingement (FAI) represents a leading cause of early labral and cartilaginous damage in the nondysplastic hip as well as a major risk factor for hip arthritis. Quantitative cartilage mapping such as delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) and T1ρ (rho) magnetic resonance imaging (MRI) are promising techniques which can permit early identification of patients at risk of arthritis. Both techniques identify hyaline cartilage degeneration by detecting changes in the proteoglycan (PG) content of the extracellular matrix with T1p not requiring any contrast agent. However there is a lack of understanding when and where the cartilage matrix changes occur in patients with pre-arthritic hip deformities. The goals of this study are to (1) assess the T1p MRI profile of weight-bearing cartilage of hips with a cam deformity (2) evaluate for a side-to-side difference in T1p profile in patients that have only unilateral hip pain in the context of bilateral cam morphology.

Methods:
19 patients (17 males; 2 females; mean age 37.1 years) with bilateral cam morphology undergoing osteochondroplasty for unilateral hip pain were prospectively recruited. The alpha angle was measured at both the anterior (3:00) and anterosuperior (1:30) positions using multi-planar computer tomography. All patients underwent bilateral 1.5T T1p MRI with the symptomatic hip being done pre-operatively. The weight-bearing hyaline cartilage bilayer of the acetabulum and femoral head was evaluated on 7 sagittal images and the mean T1p relaxation value was calculated for each sagittal slice. The weight-bearing area was divided into four quadrants and the mean T1p value calculated for each quadrant: anterolateral (AL), anteromedial (AM), posterolateral (PL) and posteromedial (PM).

Results:
There
was no statistically significant difference in mean alpha angles between the symptomatic and asymptomatic sides at the 3:00 position (54.2 vs 56.0 degrees; p=0.382) and at the 1:30 position (65.1 vs 65.2 degrees; p=0.971). There was loss of the normative gradient in PG content of the hip joint with the mean T1ρ relaxation times being not significantly different when each quadrant (AL, AM, PL, or PM) was compared to the rest of the weight-bearing surface of the symptomatic (p=0.07) and asymptomatic hips (p=0.102). There was also no statistically significant side-to-side difference in mean T1ρ values between the same quadrants of symptomatic and asymptomatic hips: AL 31.7ms vs 29.1ms (p=0.09); AM 34.0ms vs 32.0ms (p=0.24); PL 31.9ms vs 30.7ms (p=0.45); PM 32.9ms vs 31.5ms (p=0.40). No correlation was detected between severity of alpha angle and the mean T1ρ relaxation time value in each of the four quadrants.

Discussion:
In morphologically normal hips, the anterolateral quadrant displays a higher PG content than the remaining areas of the weight-bearing surface. This study confirms that this normal regional variation in PG content is lost in both symptomatic and asymptomatic patients with cam morphology manifest by a decrease in the PG content in the anterolateral quadrant of the weight-bearing surface. Therefore, regardless of the presence of hip pain, a cam deformity suggests ongoing hip joint cartilage degradation and increased risk of hip osteoarthritis.

Significance:
Femoroacetabular impingement (FAI) is a leading theory on the development of idiopathic hip arthritis. This study employs quantitative cartilage magnetic resonance imaging to confirm the association between cam morphology and ongoing cartilage degeneration in FAI, even in hips that are symptom-free.

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