Dysplastic Hips Have Decreased Hip Capsular Thickness on Magnetic Resonance Imaging: A Matched Cohort Analysis

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INTRODUCTION:

Previous work has established the association between hip instability and increased hip laxity in patients with hip dysplasia. While the classic thought has been that bony anatomy and edge loading is to blame for the hip instability seen in this population, there has been little investigation into potential differences in other stabilizing soft tissue capsular structures in this population. The purpose of this study was to characterize and compare hip capsule thickness on magnetic resonance imaging (MRI) in patients with hip dysplasia and patients without hip dysplasia. We hypothesized that patients with smaller lateral center edge angles (LCEA) would have thinner hip capsules on MRI.

METHODS:

Patients evaluated by the senior author for concerns of hip pathology from June 2020 to June 2021 were queried. Imaging was reviewed to evaluate for dysplasia based on lateral center edge angle (LCEA) on anteroposterior radiographs measured to the sourcil, with an LCEA ≤ 25 degrees considered dysplastic for this study cohort. A non-dysplastic cohort with LCEAs over 25 degrees was identified from a group of primary arthroscopic patients of the senior author in a previously collected database. These patients were matched to the dysplastic group by age, sex, and BMI. Hip capsular thickness was quantified using MRI in the coronal plane to approximate the thickness of the iliofemoral ligament, as measured on the cut with the widest diameter of the femoral head. Measurements were made proximal to the zona orbicularis, at the level of the acetabular labrum, and at a midpoint between these two points. An average of the three values for each patient was then taken to provide a millimetric measure of capsular thickness. A sub-analysis was conducted to compare true dysplastic patients (LCEA < 20) to borderline dysplastic patients (LCEAs between 20 - 25). Analysis was conducted using multivariable regression and independent samples t-tests with an alpha of < 0.05 indicating statistical significance.

RESULTS:

Eighty patients were included for analysis; forty patients with hip dysplasia were identified from 24 total available patients and matched with 40 non-dysplastic patients. Patients and controls were 100% matched to sex, with average age differences of 1.44 years and average BMI differences of 3.34 points. Dysplastic patients had an average LCEA of 19.8 ± 4.3 degrees. Twenty-one individuals were borderline dysplastic, with the remaining 19 individuals being truly dysplastic. Dysplastic individuals had decreased capsular thickness compared to their non-dysplastic controls (2.75 vs. 3.52 mm, $p = 0.003$). Multivariable regression showed decreased capsular thickness associated with decreased LCEAs ($\beta = 2.804$, $R = 0.432$, $p < 0.001$). Results of a sub-analysis of the dysplastic group examining differences between accepted definitions of borderline dysplasia and true dysplasia showed no significant differences in capsular thickness between the two groups ($p > 0.05$).

DISCUSSION AND CONCLUSION: The study demonstrates an association between hip dysplasia and decreased capsular thickness, finding that decreased LCEAs are associated with decreased iliofemoral capsular thickness on MRI. The iliofemoral ligament has been previously described as the most significant capsular contributor to hip stability, which may lend credence to the hypothesis that the increased hip laxity and hip instability reported in dysplastic patients may be due to both bony and soft tissue variability. This finding is clinically important because it suggests that capsular disruption should be minimized during surgical procedures, for instance in hip arthroscopy, and that capsular repair may be a viable technique to address hip instability in these patients. Additionally, results from the sub-analysis suggest a similar clinical picture in terms of hip capsular thickness among both the classically defined borderline and true dysplasia patients, which is important to consider when evaluating hip instability in this population and suggests these individuals have a similar hip capsule thickness.

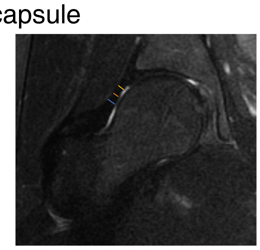

Figure 1: Right hip T2-weight MRI demonstrating the method of measuring hip capsule thickness. The blue line represents the measurement just proximal to the zona orbicularis, the yellow line represents the measurement at the acetabular labrum, and the orange line represents the measurement at the midpoint of the previous two measurements. These values were then averaged for each patient to generate a capsule thickness value in millimeters.

Table 1: Multivariable linear regression with LCEA to the sourcil as the dependent variable

Variable	β (95% CI)	R	R^2	P-value
Age	-0.004 (-0.153, 0.145)	0.432	0.187	0.959
BMI	-0.066 (-0.354, 0.222)			0.650
Sex	-0.965 (-4.807, 2.876)			0.618
Capsule thickness	2.804 (1.299, 4.309)			<0.001

†Patient sex coded as "male = 1"
††R = Pearson correlation coefficient; R^2 = coefficient of determination

Table 2: Multivariable logistic regression with patient classification of normal (0) and dysplasia (1) by LCEA.

Variable	β	OR (95% CI)	R^2	P-value
Age	-0.007	0.993 (0.951, 1.037)	0.168	0.751
BMI	0.017	1.017 (0.933, 1.109)		0.696
Sex	0.513	1.671 (0.521, 5.357)		0.388
Capsule thickness	-0.709	0.492 (0.303, 0.799)		0.004

†Patient sex coded as "male = 1"
††R^2 = Nagelkerke R square

Table 3: Multivariable logistic regression with patient classification of borderline dysplasia (0) and true dysplasia (1) by LCEA.

Variable	β	OR (95% CI)	R^2	P-value
Age	0.024	1.024 (0.965, 1.087)	0.056	0.434
BMI	0.010	1.010 (0.907, 1.126)		0.850
Sex	-0.056	0.945 (0.205, 4.362)		0.942
Capsule thickness	0.439	1.551 (0.728, 3.306)		0.256

†Patient sex coded as "male = 1"
††R^2 = Nagelkerke R square