Larger Zona Orbicularis Size on Magnetic Resonance Imaging Is Not Associated with Increased Resistance to Axial Distraction of the Hip Joint

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INTRODUCTION:

Hip stability is a topic of increasing importance concerning hip arthroscopy. Current research investigations have sought to identify pertinent contributors to hip stability and further define postoperative hip instability given its influence on outcomes in this patient population. Recent studies have demonstrated that hip stability is influenced by the overall osseous congruity of the joint, but that certain soft tissues surrounding this joint are also important to joint stability. The hip capsule has been implicated as helping to provide resistance to axial distraction of the hip, with the zona orbicularis (ZO) historically being described as a restraint to axial distraction as a contiguous structure with the hip capsule. Despite this characterization, there has been little investigation to features of the ZO that may contribute to its function against axial distraction, such as the overall size of the ZO.

The purpose of this study was to evaluate the relationship between zona orbicularis (ZO) thickness on magnetic resonance imaging and distractibility of the hip in patients undergoing hip arthroscopy. We hypothesized there would be a statistically significant association between larger ZO size and decreased hip axial distraction distance.

METHODS:

A retrospective review of primary hip arthroscopy patients treated for femoroacetabular impingement syndrome was performed from December 2021 to September 2022. Inclusion criteria were 1) completion of the traction protocol and 2) hip magnetic resonance imaging sufficient to characterize the zona orbicularis. Exclusion criteria were 1) patients less than 18 years of age at time of surgery and 2) previous surgery on the operative hip.

The study traction protocol consisted of fluoroscopic images taken at traction intervals of 0 and 100 pounds of axial traction on a post-free traction table. The operative extremity was placed in a neutral position with the patient on a foam pad and in 0-15 degrees of Trendelenburg. The lateral joint space was then measured on the AP fluoroscopic view and standardized with preoperative AP radiographs. Distraction distance was calculated as the difference between the joint space at 100 and 0 pounds of axial traction. Measurement of the ZO was performed on magnetic resonance imaging prior to hip arthroscopy and the width of the ZO was taken on the coronal sequence containing the largest diameter of the femoral head.

Descriptive statistics were calculated and recorded. Multivariable linear regression was performed with joint space at 100 pounds and overall distraction distance as the dependent variables, with the independent variables being age at surgery, sex, body mass index (BMI), lateral center edge angle (LCEA), and ZO size. A p-value of <0.05 was utilized to indicate statistical significance.

RESULTS:

A total of 100 patient charts were reviewed, with 23 being excluded for lack of appropriate imaging and 9 being excluded for being under 18 years of age at surgery. Sixty-eight patients were included in the final analysis. Mean age was 34.5 ± 12.4 years, 61.8% female, and had average BMI and Beighton scores of 26.4 ± 6.4 and 0.5 ± 1.5 points, respectively. Mean alpha angle on anteroposterior radiographs was 56.4 ± 14.2 degrees and mean lateral center edge angle was 29.9 ± 5.9 degrees.

Mean joint space at 100 pounds axial traction was 11.0 ± 3.8 millimeters and mean distraction distance was 6.6 ± 3.7 millimeters. Mean ZO size was 3.2 ± 1.0 millimeters. Linear regression demonstrated no relationship between the size of the zona orbicularis and joint space at 100 pounds ($\beta = -0.95$, $R = 0.321$, $p = 0.217$). Results of our linear regression analysis also demonstrated no significant association with ZO size and overall distraction distance ($\beta = -0.93$, $R = 0.305$, $p = 0.207$).

DISCUSSION AND CONCLUSION:

This study demonstrates that, in hip arthroscopy patients, there is no significant association between resistance to axial traction and the size of the zona orbicularis as measured on magnetic resonance imaging. While previous studies have identified the ZO to be a major component in maintaining overall hip stability, this study suggests that perhaps the predominate factor is the presence and integrity of the anatomic structure rather than its size. The results of our study suggest that other aspects of the hip, such as the acetabular labrum or ligaments of the hip capsule, may be more variable in their anatomic characteristics that help to contribute to hip stability and should be the focus when evaluating a patient with hip instability.

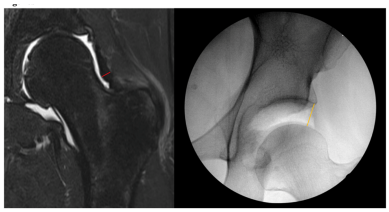

Figure 1: Left hip T2-weighted magnetic resonance arthrogram (Left) and intraoperative fluoroscopic image at 100 pounds axial traction (Right). The red line represents the measurement of the zona orbicularis (Left) while the yellow line represents the joint space measurement in response to axial traction (Right).

Table 1: Cohort characteristics and distraction profile

Variables	Mean ± SD or N (%)
Sample size	68 (100%)
Age	34.5 ± 12.4
BMI	26.4 ± 6.4
Sex	
Female	42 (61.8%)
Male	26 (38.2%)
*Beighton Score**	
Mean	0.5 ± 1.5
< 4	45 (91.8%)
≥ 4	4 (8.2%)
Alpha angle†	56.4 ± 14.2
LCEA, sourcil†	29.9 ± 5.9
Zona orbicularis size, mm	3.2 ± 1.0
Joint space, 100 lbs	11.0 ± 3.8
Distraction distance, mm	6.6 ± 3.7

*Scores available in 49 patients

†Measured on anteroposterior radiographs; measured on anteroposterior radiographs

Table 2: Multivariable linear regression analysis with joint space at 100 pounds and distraction distance as the dependent variables

Variables	β (95% CI)	R	R^2	P-value
Joint space, 100 lbs				
Age	-0.01 (-0.13, 0.11)			0.874
Sex	2.52 (-0.58, 5.62)			0.108
BMI	-0.02 (-0.21, 1.8)	0.321	0.103	0.870
Beighton score	0.23 (-0.77, 1.22)			0.648
LCEA, sourcil	-0.15 (-0.38, 0.08)			0.185
ZO size	-0.95 (-2.47, 0.58)			0.217
Distraction distance				
Age	-0.02 (-0.14, 0.10)			0.742
Sex	1.93 (-1.06, 4.92)			0.201
BMI	0.01 (-0.18, 0.20)	0.305	0.093	0.934
Beighton score	0.39 (-0.58, 1.35)			0.423
LCEA, sourcil	-0.17 (-0.39, 0.05)			0.128
ZO size	-0.93 (-2.40, 0.54)			0.207