Lateral Acetabular Coverage Predicts the Size of the Hip Labrum

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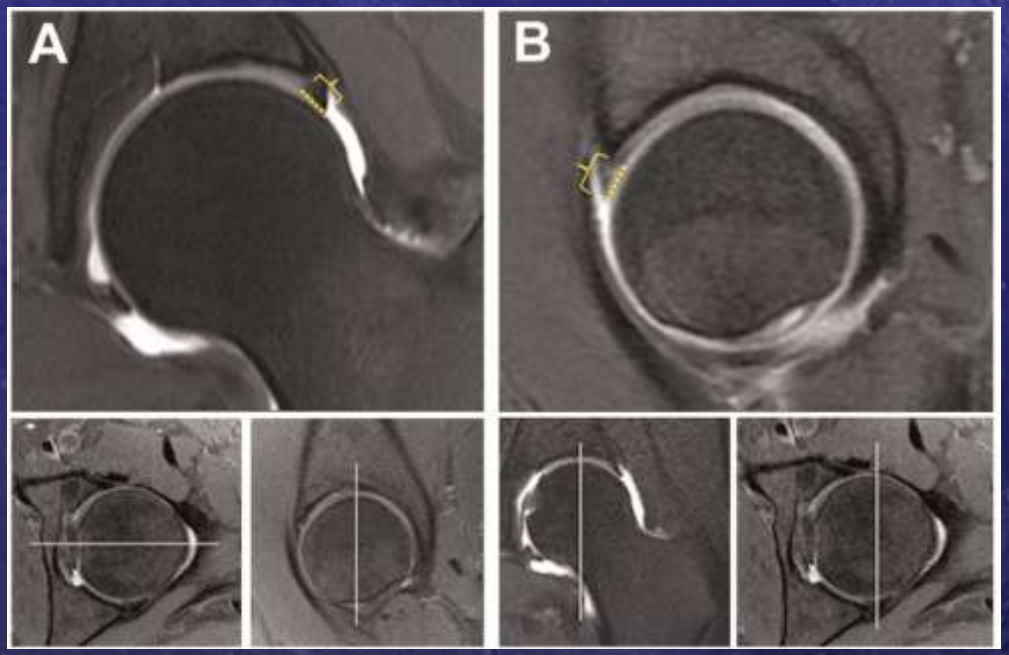

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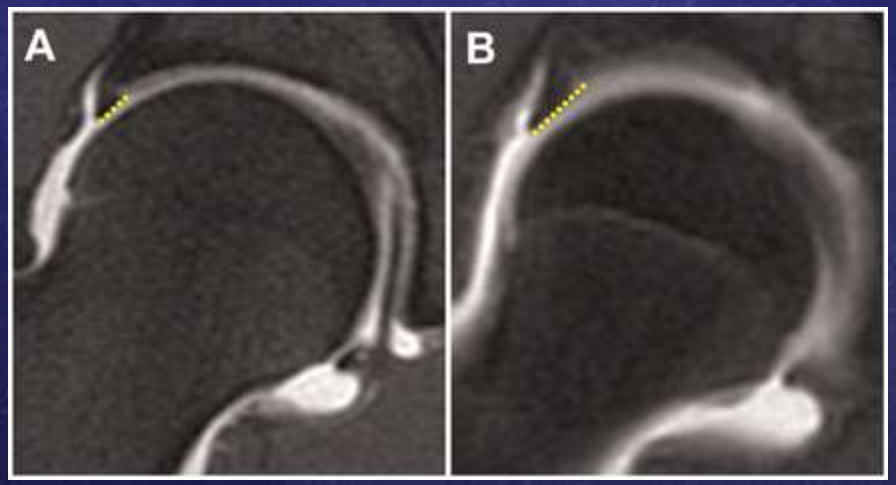
Introduction

- The acetabular labrum is a ring of fibrocartilage originating from the rim of the acetabulum and semi-circumferentially enveloping the femoral head to create a suction seal
- In patients with acetabular dysplasia, increased shear forces within the hip give rise to adaptive hypertrophy of the labrum
- In the setting of global acetabular overcoverage (protrusion acetabuli), the opposite effect is seen, and the labrum is hypoplastic with partial or complete osseous metaplasia
- Although secondary changes in labral size and composition have been qualitatively described, little is known about the extent of these changes in the setting of borderline acetabular dysplasia or pincer femoroacetabular impingement (FAI)

Purpose

- To determine whether a correlation exists between lateral acetabular coverage and labral length in patients with a wide range of hip morphological types
- To delineate characteristics unique to hips with borderline dysplasia, given the paucity of current knowledge on this clinical entity



Methods

- Retrospective analysis of 236 patients with hip pain
- After comprehensive evaluation by an orthopaedic surgeon, patients underwent a standardized series of plain radiography, preoperative MRI, and whole-pelvis CT
- Lateral center edge angle (LCEA) was determined on AP pelvic radiographs
- Patients were grouped according to the degree of acetabular coverage, as determined by LCEA measurements: normal (25-39.9º), acetabular overcoverage (≥40º), borderline dysplasia (20-24.9º), and frank dysplasia (<20º)

Methods

- Patients were evaluated using a standard MRI hip protocol on 1.5-T or 3-T magnets with a phased array torso coil
- The MRI hip protocol consisted of an axial proton density (PD) sequence, an axial oblique fat-saturated PD (FSPD) sequence, coronal T1-weighted and FSPD sequences, and a sagittal FSPD sequence
- A slice thickness of 3 mm and a gap of 0.5 mm were used
- The field of view was 18 cm with a matrix size of 320 x 192
- Magnetic resonance arthrography or delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) studies were aligned with the above protocol for measurements of labral length
- The length of the acetabular labrum was measured at 3 separate anatomic sites along the acetabular rim: lateral, anterior, and anteroinferior

Results

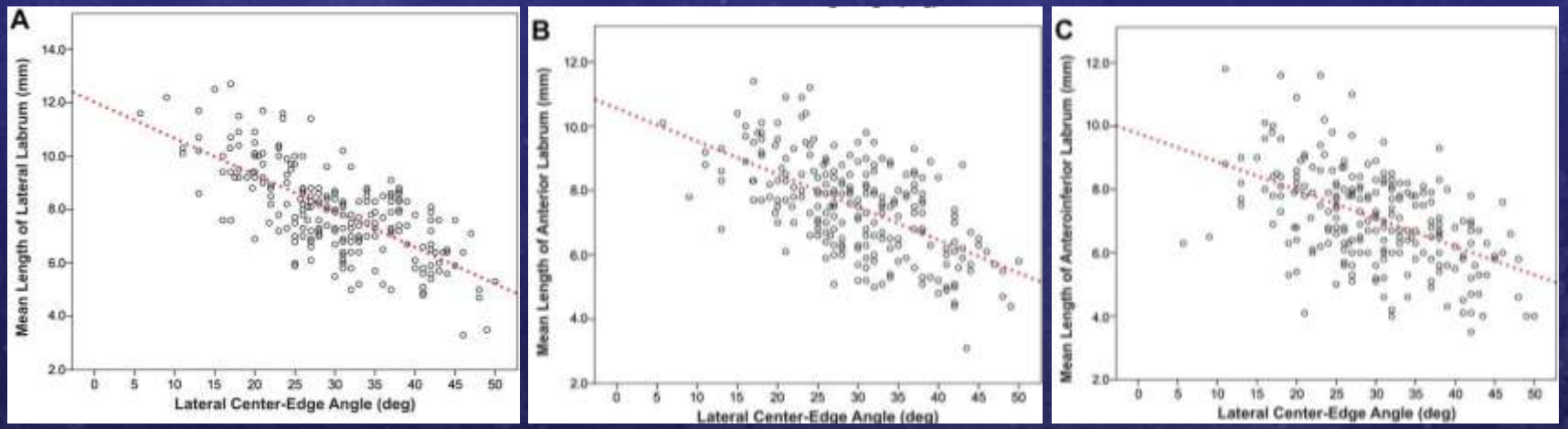
Patient Demographics (N = 236)[a]

	Values
Age, y	33.5 ± 11.2
Male sex, n (%)	58 (24.6)
Height, cm	168.7 ± 9.7
Weight, kg	69.1 ± 15.2
Body mass index, kg/m^2	24.1 ± 4.4
Lateral acetabular coverage of hips, n (%)	
Frank dysplasia (LCEA <20.0°)	28 (11.9)
Borderline dysplasia (LCEA 20.0°-24.9°)	34 (14.4)
Normal (LCEA 25.0°-39.9°)	139 (58.9)
Overcoverage (LCEA ≥40.0°)	35 (14.8)

[a]Data are reported as mean ± SD unless otherwise indicated.
LCEA, lateral center-edge angle.

Results

- Lateral acetabular coverage demonstrated a strong negative correlation to length of the lateral labrum (r = -0.706, p < .001), anterior labrum (r = -0.596, p < .001), and anteroinferior labrum (r = -0.504, p < .001)



Results

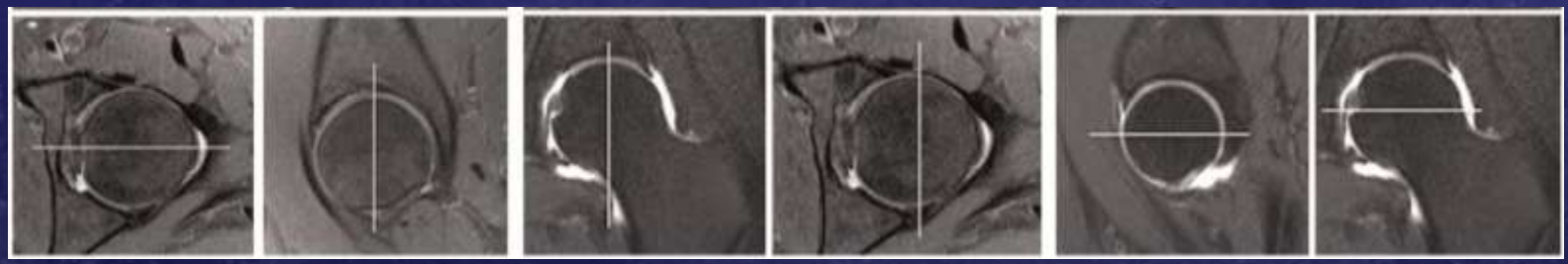
- Patients with frank hip dysplasia and borderline dysplasia demonstrated statistically equivalent measurements of lateral, anterior, and anteroinferior labral length
- Labral length (at all locations) was significantly increased in these 2 clinical subgroups relative to those with normal acetabular coverage ($p < .001$) or acetabular overcoverage ($p < .001$)
- Measurements of labral length at all locations were significantly increased in hips with normal acetabular coverage relative to those with acetabular overcoverage ($p < .001$)

Hip Labral Length According to Lateral Acetabular Coverage[a]

		Labral Length, Mean ± SD, mm		
LCEA	Sample Size, n	Lateral	Anterior	Anteroinferior
<20.0°	28	10.12 ± 1.32	8.97 ± 1.06	8.32 ± 1.53
20.0°-24.9°	34	9.44 ± 1.23	8.61 ± 1.31	7.96 ± 1.58
25.0°-39.9°	139	7.68 ± 1.08	7.38 ± 1.13	7.03 ± 1.25
≥40.0°	35	6.08 ± 1.15	5.83 ± 1.12	5.67 ± 1.12

Results

- When analyzing across measurement locations, labral length was maximized at its lateral aspect and minimized at its anteroinferior aspect in patients with frank dysplasia ($p < .001$), borderline dysplasia ($p < .001$), and normal acetabular coverage ($p < .001$)
- In contrast, labral length did not vary significantly according to the measurement location in patients with acetabular overcoverage ($p = .223$)



Discussion

- The results of this study suggest the notion that hips with deficient and excessive lateral acetabular coverage undergo unique patterns of pathomechanical loading, with compensatory hypertrophy in the former and osseous metaplasia in the latter
- Borderline dysplastic hips demonstrated a similarly increased labral size when compared with frankly dysplastic hips
- Currently, the majority of patients with borderline dysplasia are treated with arthroscopic hip surgery and/or capsular plication, attempting to restore stability through a “soft tissue only” approach
- Given the degree of similarly in adaptive changes between borderline and frank dysplasia, our study raises concerns for the adequacy of this approach in restoring hip stability

Conclusions

- We have shown a direct correlation between the severity of dysplasia and labral length, demonstrating that even patients with borderline dysplasia have significantly increased values when compared with hips with normal coverage or overcoverage
- Labral length may represent one of the many adaptive changes serving as a marker of instability to guide decision making in patients with borderline dysplasia

References

- Crawford MJ, Dy CJ, Alexander JW, et al. The 2007 Frank Stinchfield Award: The biomechanics of the hip labrum and the stability of the hip. *Clin Orthop Relat Res*. 2007;465:16-22.
- Domb BG, Stake CE, Lindner D, El-Bitar Y, Jackson TJ. Arthroscopic capsular plication and labral preservation in borderline hip dysplasia: two-year clinical outcomes of a surgical approach to a challenging problem. *Am J Sports Med*. 2013;41(11):2591-2598.
- Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res*. 2003;417:112-120.
- Hartig-Andreasen C, Soballe K, Troelsen A. The role of the acetabular labrum in hip dysplasia: a literature overview. *Acta Orthop*. 2013;84(1):60-64.
- James S, Miocevic M, Malara F, Pike J, Young D, Connell D. MR imaging findings of acetabular dysplasia in adults. *Skeletal Radiol*. 2006;35(6):378-384.