

# CAN SOFT TISSUES STRUCTURES DIFFERENTIATE BETWEEN DYSPLASIA AND CAM-FAI OF THE HIP?



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# DISCLOSURE

- No disclosures.



# BACKGROUND

- Clinically, it may be challenging to differentiate various etiologies of hip dysfunction.
  - Femoracetabular Impingement (FAI)
  - Hip dysplasia (DDH)
  - Labral tear (LT)
- Accurate diagnosis is essential in order to determine appropriate conservative or surgical treatment which differs significantly between the various etiologies.



# BACKGROUND

- X-ray
  - Excellent first line test to evaluate gross morphology of joint
  - Bone shape and orientation
- However, it may not be definitive
  - Primary abnormalities may be less conspicuous if subtle or with secondary degenerative changes.
- MRI is more comprehensive modality
  - can also assess intra- and extra-articular soft tissue structures of the hip joint



## BACKGROUND: VALUE OF MRI

- Based on literature, labrum size may distinguish between developmental dysplasia and femoroacetabular impingement <sup>1</sup>.
- Hips with developmental dysplasia tend to have an hypertrophied labrum<sup>2</sup>.
- The joint capsule tends to be thicker in femoroacetabular impingement<sup>3</sup>.
- There has been no study of differences in muscle mass between the different etiologies.

1. Leunig, M. Podeszwa, D. Magnetic Resonance Arthrography of Labral Disorders in Hips with Dysplasia and Impingement. COP 418 (2004) 74-80

2. Greenhill BJ, Hugosson C, Jacobson B, Ellis RD, Magnetic resonance imaging study of acetabular morphology in developmental dysplasia of the hip. J Pediatr Ortho 13 (1993) 314-317

3. Tannast, M. Siebenrock, K. Anderson, S. Femoroacetabular impingement: radiographic diagnosis – what the radiologist should know. AJR 188 (2007) 1540-52



## PURPOSE

- Determine whether MRI assessment of the soft tissue structure size can preoperatively predict the underlying etiology of hip dysfunction.



## METHODS – PATIENT SELECTION

- Retrospective study
- 48 patients with corrective hip surgery between 2006 and 2014
- All had MR arthrograms (1.5 T)
- Patients grouped by disease etiology:
  - 8 with hip dysplasia [DDH]
    - (5F, 4M; mean age 33.9 yrs, range 19.7-53.7).
  - 20 with cam-type femoroacetabular impingement [CAM-FAI]
    - (11F, 9M; mean age 38.9 yrs, range 18.9-51.0).
  - 20 with isolated labral tear [LT]
    - (17F, 3M; mean age 38.4 yrs, range 15.1-62.0).



# METHODS – MR ARTHROGRAM

- Protocol
  - 12-15cc gadolinium saline solution injected under fluoroscopy
  - 1.5 Tesla
  - Oblique axial T1
  - Oblique coronal & sagittal T1-FS
  - Axial PD-FS
  - Matrix 448x224, Slice thickness 3.5 mm





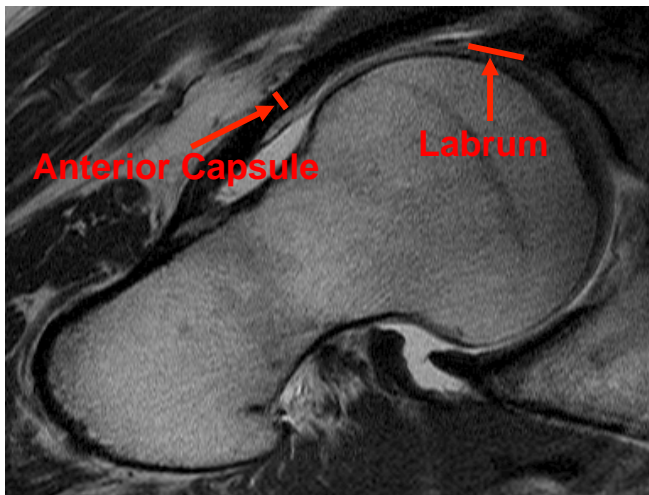
## METHODS – MEASUREMENTS

- Two readers (MSK rad , Med student)
- Capsule thickness
  - Superiorly and Anteriorly
- Labral length
  - Superiorly and Anteriorly
- Superior measures - obl coronal image @ mid acetabulum
- Anterior measures – obl axial image @ mid femoral neck

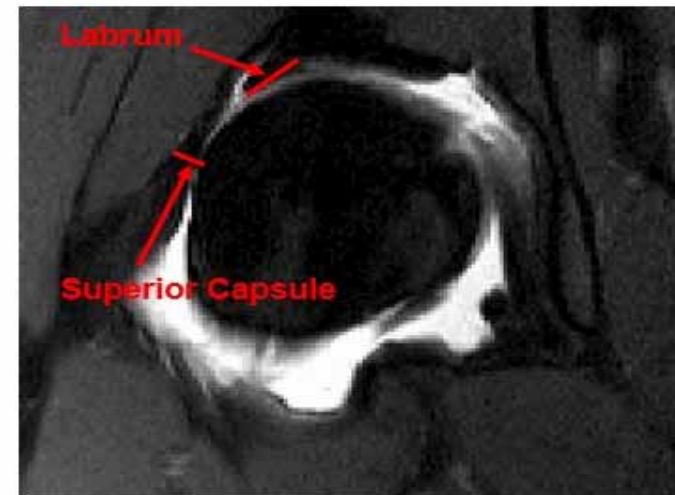


# METHODS – MEASUREMENTS

## Anterior – Labrum & Capsule

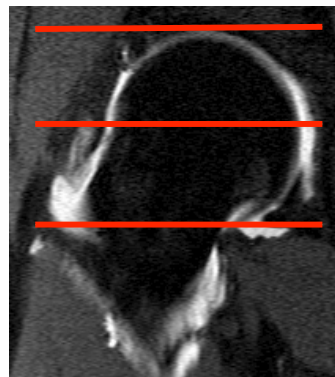


## Superior – Labrum & Capsule



# METHODS – MEASUREMENTS

- Muscle Dimensions
  - gluteus muscles short axis thickness (level of acetabular roof)
  - iliopsoas AP & trans (level of mid acetabulum)
  - rectus femoris AP & trans (level of inferior rim of acetabulum)



Gluteus Muscles

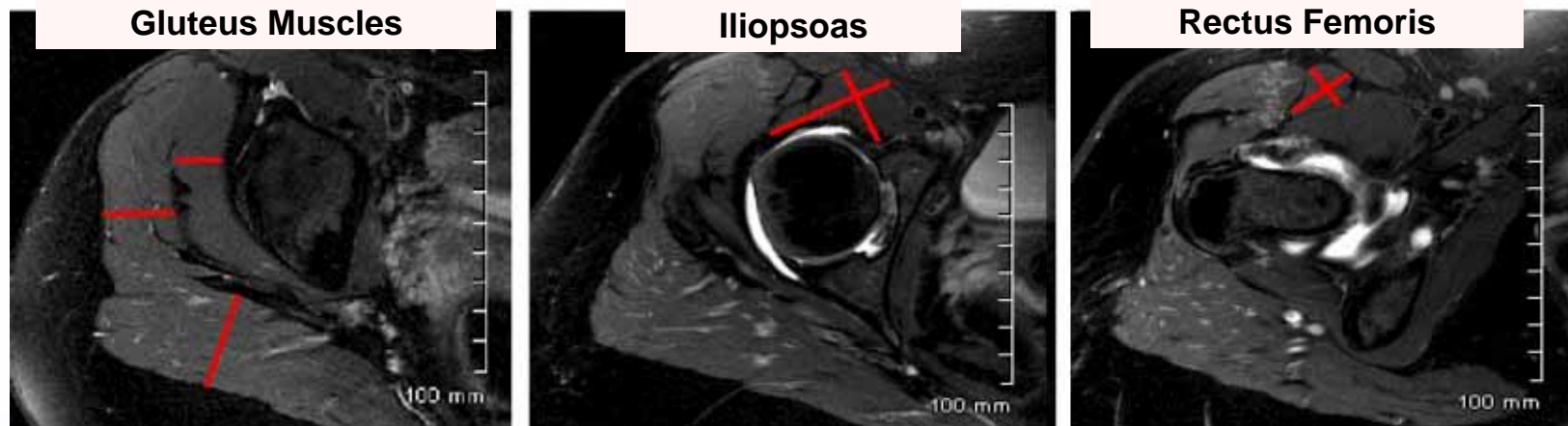
Iliopsoas

Rectus Femoris



# METHODS – MEASUREMENTS

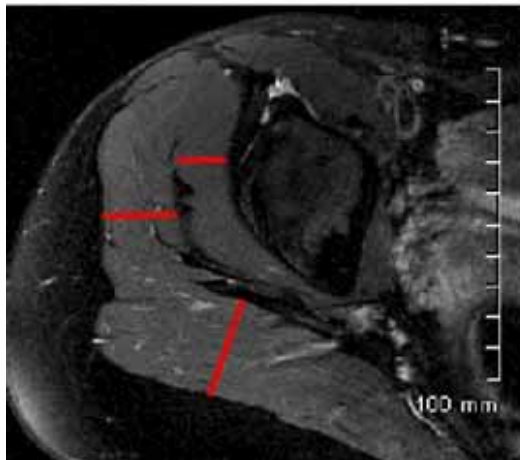
- Muscle Dimensions
  - gluteus muscles short axis thickness (level of acetabular roof)
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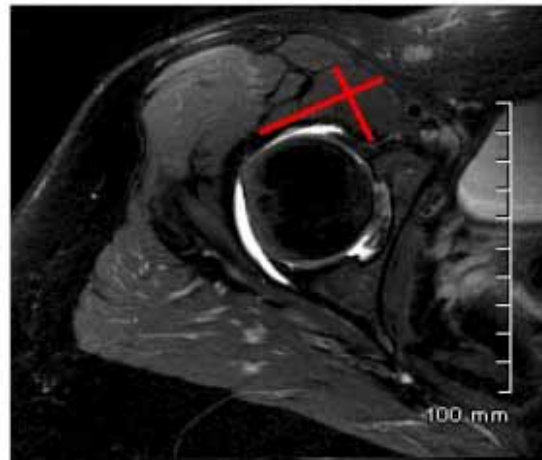
# METHODS - MEASUREMENTS

## Muscle Dimensions

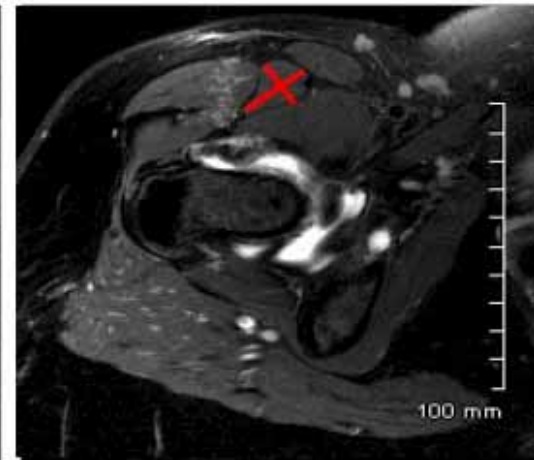
**Gluteus Muscles**



**Iliopsoas**



**Rectus Femoris**



## METHODS – STATISTICS

- Quantitative data (mean, standard deviation, range) calculated for all variables
- Between group analysis with analysis of variance (ANOVA)
- Inter-reader reliability evaluated - intra-class coefficient (ICC)
- Level of significance set at  $p < 0.05$



## RESULTS – Capsule & Labrum Measures

GROUP	CAPS-sup	LABR-sup	CAPS-ant	LABR-ant
DDH (mean ± SD)	*5.7 ± 1.4	7.4 ± 1.6	3.0 ± 0.8	7.1 ± 1.4
FAI (mean ± SD)	*4.1 ± 1.0	6.4 ± 1.8	3.9 ± 1.3	5.7 ± 1.0
LT (mean ± SD)	*3.7 ± 1.3	6.2 ± 1.3	3.1 ± 0.7	6.0 ± 1.4
ICC	0.348	0.833	0.362	0.354

\*p<0.05

CAPS-sup: Superior Capsular thickness (mm), CAPS-ant: Anterior Capsular thickness (mm), LABR-sup: Superior Labral long axis (mm), LABR-ant: Anterior Labral width (mm).



## RESULTS – Muscle Dimensions

GROUP	ILIOPSOAS		GLUTEAL MUSCLES			RECTUS FEMORIS	
	AP	TRANS	GLUT [min]	GLUT [med]	GLUT [max]	AP	TRANS
DDH (mean ± SD)	24.9 ± 5.5	40.6 ± 5.3	18.4 ± 3.0	28.6 ± 3.5	43.0 ± 5.6	16.4 ± 6.5	29.4 ± 5.3
FAI (mean ± SD)	27.1 ± 5.3	*45.1 ± 6.2	18.5 ± 3.8	27.0 ± 6.4	41.7 ± 5.4	21.1 ± 6.0	29.1 ± 8.6
LT (mean ± SD)	24.6 ± 5.4	*39.7 ± 7.3	18.6 ± 4.1	25.1 ± 5.3	38.4 ± 6.3	21.7 ± 7.8	28.2 ± 7.1
ICC	0.882	0.485	0.518	0.720	0.929	0.804	0.684

\*p<0.05

TRANS: Transverse, AP: Antero-posterior, GLUT-min: Gluteus minimus, GLUT-med: Gluteus medius, GLUT-max: Gluteus maximus.





## SIGNIFICANT RESULTS - SUMMARY

- **DDH group:**
  - superior hip capsule thickness (5.7 mm)
  - significantly > FAI (4.1mm,  $p=0.009$ ) & LT (3.7mm, $p=0.001$ )
- **FAI group:**
  - iliopsoas transverse dimensions (45.1 mm)
  - significantly > LT (39.7mm,  $p=0.035$ )

\*There was a general trend consistent with literature for the superior labral length being larger in DDH group (7.4 mm) compared to the FAI (6.4 mm) and LT (6.2 mm) groups, although not significant.



# RESULTS – Inter-Reader Reliability (ICC)

	ICC
Labrum - superior	0.833
Labrum - anterior	0.354
Capsule - superior	0.348
Capsule - anterior	0.362
Psoas AP	0.882
Psoas Trans	0.485
Rectus Fem AP	0.804
Rectus Fem Trans	0.684
Gluteus Min	0.518
Gluteus Med	0.720
Gluteus Max	0.929



## LIMITATIONS

- Small sample size
  - Limited for the DDH group (N=8)
  - No gender sub-analysis possible
- Data – not normalized to size of patient
- Variability in how measurements drawn, especially muscles which can have variable, irregular shape
- Variable Inter-reader reliability (ICC 0.354 – 0.929)
- Potential bias – readers may infer underlying etiology of hip dysfunction when reviewing MRI images, ?incomplete blinding



## DISCUSSION / CONCLUSION

- MRI can identify differences in the size of select soft tissue structures depending on etiology of hip dysfunction (DDH, Cam-FAI, LT)
- Superior hip capsular thickness & iliopsoas transverse dimension may serve as disease discriminators



## DISCUSSION / CONCLUSION

- Capsule: thicker in DDH
  - adaptive, developmental thickening due to hypoplastic acetabular fossa, or secondary to altered biomechanics or chronic synovitis
- Iliopsoas: greater dimension in FAI
  - varying morphology of hip joint leads to altered gait biomechanics, affecting activation/use of individual muscles with selective hypertrophy
- However, larger sample size, reader training are required to identify other possible soft tissue discriminators

