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

A Le Bouthillier, KS Rakhra¹ · PE Beaulé², RCB Foster¹

¹Department of Medical Imaging
²Division of Orthopaedic Surgery
University of Ottawa/The Ottawa Hospital;
Ottawa, Ontario, Canada
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 \(^1\).

Hips with developmental dysplasia tend to have an hypertrophied labrum\(^2\).

The joint capsule tends to be thicker in femoroacetabular impingement\(^3\).

There has been no study of differences in muscle mass between the different etiologies.

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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)
METHODS – MEASUREMENTS

• Muscle Dimensions
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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

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

*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

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Iliopsoas</th>
<th>Gluteal Muscles</th>
<th>Rectus Femoris</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AP</td>
<td>TRANS</td>
<td>GLUT [min]</td>
</tr>
<tr>
<td>DDH (mean ± SD)</td>
<td>24.9 ± 5.5</td>
<td>40.6 ± 5.3</td>
<td>18.4 ± 3.0</td>
</tr>
<tr>
<td>FAI (mean ± SD)</td>
<td>27.1 ± 5.3</td>
<td>*45.1 ± 6.2</td>
<td>18.5 ± 3.8</td>
</tr>
<tr>
<td>LT (mean ± SD)</td>
<td>24.6 ± 5.4</td>
<td>*39.7 ± 7.3</td>
<td>18.6 ± 4.1</td>
</tr>
<tr>
<td>ICC</td>
<td>0.882</td>
<td>0.485</td>
<td>0.518</td>
</tr>
</tbody>
</table>

*<p<0.05

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)

<table>
<thead>
<tr>
<th>Component</th>
<th>ICC</th>
</tr>
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<tbody>
<tr>
<td>Labrum - superior</td>
<td>0.833</td>
</tr>
<tr>
<td>Labrum - anterior</td>
<td>0.354</td>
</tr>
<tr>
<td>Capsule - superior</td>
<td>0.348</td>
</tr>
<tr>
<td>Capsule - anterior</td>
<td>0.362</td>
</tr>
<tr>
<td>Psoas AP</td>
<td>0.882</td>
</tr>
<tr>
<td>Psoas Trans</td>
<td>0.485</td>
</tr>
<tr>
<td>Rectus Fem AP</td>
<td>0.804</td>
</tr>
<tr>
<td>Rectus Fem Trans</td>
<td>0.684</td>
</tr>
<tr>
<td>Gluteus Min</td>
<td>0.518</td>
</tr>
<tr>
<td>Gluteus Med</td>
<td>0.720</td>
</tr>
<tr>
<td>Gluteus Max</td>
<td>0.929</td>
</tr>
</tbody>
</table>
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