A Radiographic Assessment of CAM-Type Femoroacetabular Impingement Morphology in the Developing Hip
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In CAM-type femoroacetabular impingement (FAI), abnormal excess bone at the anterosuperior surface of the femoral head neck junction results in reduced clearance during flexion, adduction and internal rotation [1-4]. Repeated abutment of the femoral neck and acetabular rim causes labral tears and eventually chondral damage and osteoarthritis (OA). The importance of early and accurate diagnosis of FAI stems from the fact that there are effective treatments available to alleviate the symptoms of FAI and correct the underlying anatomic abnormality with relatively minor surgery. Having said the exact etiology of the deformity as well as understanding what parameters should be used to define what represents a normal head neck contour are still evolving. To the best of our knowledge, there is no published data on the prevalence of FAI in the young adolescent population. Therefore, our objective was to investigate the prevalence of FAI in patients without hip pain by means of MRI of the hips.

METHODS

Prior to commencing the study, ethics approval was obtained from our Institutional Research Ethics Board. Forty-four volunteers with asymptomatic lower extremities were recruited (27 boys, 17 girls; 23 open-physes, 21 closed-physes). Males were 10-12 years (pre-physial closure) or 15-18 years (post-closure), while females were 8-10 years or 14-18 years. Each volunteer underwent an MRI of bilateral hips and a clinical exam which included commonly used hip impingement tests. MR imaging assessment was independent, blinded and recorded using established parameters including alpha angles measured at both the 3:00 (anterior head-neck junction) and 1:30 (antero-superior head-neck junction) radial image positions. The presence of abnormal excess bone at the anterosuperior surface of the femoral head neck junction (bony bump) was assessed using an alpha angle score of greater than 50.5° at the 3:00 position [11]. Alpha angle results and the presence of a bony bump were analyzed according to gender and skeletal maturity (open vs. closed physes). Chi-square analyses and Student t-tests were used, as appropriate.

RESULTS

In total, 88 hips (46 open physes, 42 closed physes) were imaged and included in analyses. Mean ages of female volunteers were 9.7 years and 15.2 years for open and closed physes groups, respectively. Ages of male volunteers were 11.7 and 16.2 years respectively. When compared with hips from volunteers with open physes, the mean alpha angle was significantly greater among patients with closed physes (42.0±6.0 vs. 38.1±3.2, p<.001). With respect to gender, males had a significantly higher mean alpha angle (41.5±5.4 vs. 37.7±3.6, p=0.02). This analysis showed no CAM-type morphology in pre-closure hips, while CAM-type morphology was observed in 10.4% (n=5) of post-closure hips, using our established criteria (alpha angle > 50.5°) (X²=5.81, p=0.02). This corresponded with 3 of 21, or 14.3%, of post-closure volunteers having at least one CAM-bump. With respect to gender, all hips with CAM-type morphology were male (X²=3.34, p=0.15). In addition, a significant difference between alpha angle measurements at the 3:00 and 1:30 positions was observed (40.0±5.1 vs. 47.5±6.2, p<.001) in our developing hips. This result is consistent with recent results observed among adult hips. Alpha angle results are shown in Table 1.

Table 1: Alpha Angles according to gender, skeletal maturity, and radial image position

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Alpha Angle (SD)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>41.5 (5.4)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>37.7 (3.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Skeletal Maturity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed Physes</td>
<td>42.0 (6.0)</td>
<td></td>
</tr>
<tr>
<td>Open Physes</td>
<td>38.1 (3.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Radial Position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:00</td>
<td>40.0 (5.1)</td>
<td></td>
</tr>
<tr>
<td>1:30</td>
<td>47.5 (6.2)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

DISCUSSION

Our results suggest that in the pre-adult population, CAM-type FAI is related to gender and skeletal maturity, as all patients with a bony bump were skeletally mature males. Interestingly, the prevalence of asymptomatic FAI in skeletally mature adolescents was similar to the previously published rate among adults [12]. Similarly, the difference in alpha-angle values at the 3:00 vs. 1:30 radial positions (approximately 7 degrees) is similar to published values among adults [12]. This reinforces the importance of standardized alpha angle measurement, regardless of age. Our results are, to our knowledge, the first attempt to assess CAM-type FAI morphology in the developing hip. As our preliminary data suggest that the period immediately prior to physeal closure may have significant etiological implications, long-term follow-up will prove useful in further determining which individuals may develop CAM-type morphology in later years.

SIGNIFICANCE

Our data showed that 14.3% of patients with closed physes and no patients with open physes had asymptomatic CAM-type FAI morphology. This, in combination with the fact that all patients with the bony bump were male, suggests that gender and physeal closure may play an important role in the development of CAM-type FAI.

REFERENCES