Validity of the Alpha Angle Measurement on Plain Radiographs for the Diagnosis of CAM FAI

1Barton, C R; 1Salineros, M J; 1Rakhra, K; +Beaulé P E
+University of Ottawa, Ottawa, Ontario, Canada
pbeaule@ottawahospital.on.ca

INTRODUCTION:
Femoroacetabular impingement (FAI) is a painful condition of the young adult hip. It is postulated that it is a precursor for osteoarthritis (OA) of the hip and as a result there is currently great interest both in the diagnosis and treatment of FAI. Impingement is between the femoral head/neck junction and the rim of the acetabulum with its’ attached labrum. There are two main types of impingement. One is caused by a lack of concavity of the head/neck junction, the so called CAM impingement and the other is caused by an over coverage of a normal femoral head, the so called pincer impingement. These two can also exist in combination. The main interest currently is in the CAM morphology as it is quantifiable both pre and post treatment and is thought to be the driving deformity causing early OA. The alpha angle of Nötzli is widely used as a means of quantifying and diagnosing CAM impingement. Although its measurement has been described and validated using multiplanar imaging such as CT scan or MRI scan, plain radiographs are commonly used to quantify the alpha angle.

The purpose of our study is to evaluate the accuracy and reproducibility of plain radiography and validate the best plain view in the diagnosis of CAM type impingement.

METHODS:
A consecutive series of 83 patients presenting with unilateral hip pain, a positive impingement sign and positive labral pathology on Magnetic Resonance Arthrography (MRA) were seen by the senior author between September 2007 and February 2009. From this group, only patients <60 years of age with a complete set of radiographs (AP pelvis, Cross Table Lateral and Dunn view) of the hip and a Tönnis grade of less than 2 and no prior hip surgery were selected leaving us with 68 patients for our study group. The mean age of the study group was 38 (range 17-60) with 37 females and 31 males. There were 29 left hips and 39 right hips.

As per the routine MRA protocol for the investigation of FAI, each hip was injected with 10 to 15 mL of a dilute (2 mmol) gadolinium-saline solution (Omniscan; GE Healthcare, Princeton, NJ). Our technique of MRA as well as alpha angle measurement has been described in detail (Rakhra et al).

All plain films were taken by orthopaedic radiology technicians. The Cross Table Lateral was taken with the patient supine on the x-ray table with the contralateral hip and knee flexed beyond 80° and the symptomatic limb internally rotated 15° to expose the anterolateral surface of the femoral head-neck junction. The Dunn view was taken with the patient supine with the symptomatic hip flexed at 90° and abducted 20° in neutral rotation.

RESULTS:
All patients had positive labral pathology. We considered alpha angles of greater than 50.5° as diagnostic for CAM morphology. 41 patients were positive for CAM impingement morphology on MRI leaving 27 true negatives i.e., alpha angle less than 50.5°. As compared to MR, the Dunn view was by far the best single plain view (Table 1).

<table>
<thead>
<tr>
<th>View</th>
<th>AP</th>
<th>X Table</th>
<th>Dunn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>0.60 (0.44-0.75)</td>
<td>0.74 (0.59-0.86)</td>
<td>0.91 (0.78-0.97)</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.81 (0.58-0.95)</td>
<td>0.63 (0.38-0.84)</td>
<td>0.88 (0.68-0.97)</td>
</tr>
<tr>
<td>PPV</td>
<td>0.60 (0.69-0.96)</td>
<td>0.82 (0.66-0.92)</td>
<td>0.93 (0.80-0.98)</td>
</tr>
<tr>
<td>NPV</td>
<td>0.50 (0.32-0.68)</td>
<td>0.52 (0.31-0.73)</td>
<td>0.84 (0.64-0.95)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.67 (0.54-0.78)</td>
<td>0.71 (0.58-0.82)</td>
<td>0.90 (0.80-0.96)</td>
</tr>
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We compared the Dunn view values and the MRI values using a Bland Altman plot (Figure1) that plots the average between the individual values obtained on the x axis against the difference between the two values. The dotted lines represent 2 SD from the norm & the majority of the results should (and do) lie between these lines.

**Figure 1:** Bland Altman plot showing the majority of results within the acceptable range.

DISCUSSION:
Our study shows that the alpha angle can be evaluated with high accuracy using the Dunn view. The Dunn view values are reliably and consistently close to the MRI values. Our paper also illustrates the importance of obtaining lateral views of the hip in assessing for CAM type FAI as in a high percentage of cases, the AP view is insufficient. Although MR arthrogram remains a powerful tool in the assessment of hip pathology i.e., labral pathology, cystic changes, or cartilage delamination, based on our study it is not mandatory in the quantification of the CAM deformity. This provides useful clinical guidelines for the physician evaluating patients with pre-arthritic hip pain. In borderline cases of FAI MRI using radial reformats is most beneficial as recently published. This study validates the use of the Dunn view for diagnosing CAM FAI.

REFERENCES: