Use of Pre-operative Magnetic Resonance Arthrography in Femoroacetabular Impingement

Abstract

**Background**: Magnetic resonance arthrography is the current method of choice for investigating patients with a clinical diagnosis of femoroacetabular impingement prior to performing hip arthroscopy. The aim of our study was to assess the efficacy of this investigation by comparing the findings of MR arthrogram with those found at arthroscopy, with reference to labral tears and chondral damage.

**Methods**: A prospective trial to investigate the sensitivity, specificity, accuracy and predictive value of MRA for diagnosis of labral tears and chondral defects. Over a 25-month period 69 hips undergoing hip arthroscopy were investigated with MRA prior to the definitive operative procedure. MRA findings were compared to the intraoperative findings.

**Results**: In the assessment of labral tears, MRA demonstrated a sensitivity of 81% with a specificity of 51% and an accuracy of 58%. Positive predictive value of MRA was 33% and negative predictive value 90%. For chondral defects MRA demonstrated a sensitivity of 17%, a specificity of 100% and accuracy of 55%. Positive predictive value of MRA was 100% and negative predictive value was 51%.
Conclusions: In what the authors believe to be the first study to explore both chondral injury and labral tears in a prospective manner and looking specifically at accuracy, it can be seen that the MRA has poor accuracy for both pathologies. We recommend a moved away from MRA, which is an invasive procedure with associated risks. We recommend the use of computed tomography with three dimensional reconstruction to clearly identify the osseous pathology.

Introduction

Hip arthroscopy as a treatment for femoroacetabular impingement (FAI) is gaining increasing popularity. With the increasing awareness amongst clinicians of soft tissue hip pathology comes the difficulty of gaining an accurate diagnosis. A high level of clinical suspicion is needed with a detailed history and examination to gain a provisional diagnosis, which should be supplemented with radiological evidence. Unfortunately, non-invasive radiological techniques have been shown to give poor specificity for intra-articular hip pathology with standard magnetic resonance imaging (MRI) demonstrating sensitivity as low as 8%. With the use of higher Tesla machines and intra-articular contrast medium, these techniques become much more sensitive with levels of sensitivity as high as 92% for detecting labral tears. The diagnosis of chondral lesions has proved even more difficult with lower sensitivity seen. We have compared pre-operative magnetic resonance angiography (MRA) with the intra-operative findings at hip arthroscopy in a prospective study of patients with clinical signs and symptoms of FAI.
Patients and Methods

Over a 25-month period 69 hips in 66 patients underwent hip arthroscopy for FAI. All patients were worked-up in a standard manner with history and examination by the senior author (MJF), radiographs and an MRA performed and reported by a single radiologist with a specialist interest in musculoskeletal radiology (RM). Patients with inflammatory arthropathy and previous or suspected septic arthritis were excluded from the study.

MRA was performed on a Siemens Symphony 1.5 Tesla machine (Erlangen, Germany). Scans were performed with a small field of view (14 to 20cm). The arthroscopies were performed within 12 weeks of the MRA by one surgeon (MJF) under general anaesthesia using a hip distractor and saline distension of the joint in a standardised 2 portal technique.

A prospective database was kept, recording the results of the MRA with specific reference to chondral damage and labral tears, these were compared to the intra-operative findings at hip arthroscopy.

Statistical analysis was undertaken on Microsoft excel (Microsoft, USA) and using StatsDirect statistical software V2.7.7 (http://www.statsdirect.com. England: StatsDirect Ltd.)

Results

For all patients the MRA and view at arthroscopy was felt to be satisfactory.

At MRA 39 hips showed evidence of a labral tear, 13 of these were found to be true tears during hip arthroscopy and 26 hips showed no tear. In 3 cases the
MRA did not detect a tear although one was evident during surgery. In 27 cases the MRA correctly showed that there was no tear present (table 1). Using the intra-operative results as true positive (in the presence of tear) or negative (in the absence of tear) these are compared to the results at MRA. When calculated using these figures sensitivity was 81%, specificity 51% and accuracy 58%. Positive predictive value of MRA was 33% and negative predictive value 90%.

With reference to chondral damage, the MRA showed wear in 6 patients, which was confirmed at the time of arthroscopy. There were no hips in which the MRA showed wear that could not be seen at surgery. The absence of wear was correctly identified in 30 cases but in 29 patients the MRA failed to correctly diagnose the chondral damage seen during arthroscopy (table 2). Again using the arthroscopic findings as the standard, we calculated sensitivity to be 17%, with a specificity of 100% and accuracy of 55%. Positive predictive value of MRA was 100% and negative predictive value was 51%.

**Discussion**

The aetiology of labral tears can be divided into four categories\(^6\). Traumatic; with a clear history of trauma leading to symptoms, congenital; in the presence of acetabular dysplasia, degenerative and idiopathic; later defined as FAI and split into cam or pincer type\(^3\). Although the diagnosis of labral tears and chondral damage is not possible on standard radiographs, the underlying aetiology may be evident. Plain radiographs should be gained in two views (we prefer anteroposterior and cross table lateral in 15° internal rotation views\(^4\)) to look for
dysplasia, loss of joint space or FAI. The radiographic signs of FAI are subtle and easily missed if inappropriate radiographs are taken or the reviewer is not experienced in this diagnosis\(^1\). It is our practice to undertake computerised tomography scans in 1.0mm slices with 1mm overlap and reconstruct the images in 3 dimensions (3D-CT) using a Siemens 16 or 40 slice GE scanner with Leonardo software package (Siemens, Erlangen, Germany). This modality allows the surgeon to orientate the images in multiple planes, further delineating the underlying bony pathology and allows for pre-operative planning of the bony excision needed during hip arthroscopy.

In agreement with previous studies, we have found the sensitivity of MRA to be reasonable at 81% in the detection of labral tears\(^1^1\), the specificity is low however at only 51% with poor accuracy and positive predictive value. A negative predictive value of 90% would be useful in deciding when not to operate if the test was an accurate one, but in view of only a 58% accuracy, a negative result from this invasive investigation would not be enough in our view to prevent the surgeon from operating on a symptomatic patient. For chondral damage MRA has a low sensitivity and accuracy, but does demonstrate a positive predictive value of 100%. This would infer that when chondral damage is sufficient to be visualised on MRA, it would always be seen at arthroscopy. The treatment of chondral injury is controversial, but it is believed that early treatment of chondral lesions may prevent or delay the degenerative process\(^8\). With smaller lesions (less than 1cm) MRA is of little use\(^2\) and where a chondral injury is suspected
and the joint shows no evidence of advanced degeneration on radiographs, hip arthroscopy would be the treatment of choice\textsuperscript{8}.

The majority of labral tears are associated with bony abnormalities and it is important to identify these abnormalities to prevent poor outcome and function. Addressing the osseous abnormalities at the time of the soft tissue pathology reduces recurrence of symptoms\textsuperscript{7,9}. These osseous abnormalities are clearly defined on 3D-CT (figures 1 and 2) but cannot be easily identified at the time of hip arthroscopy. The majority of the operative time is spent dealing with the osseous pathology and any labral or chondral defects can be diagnosed and dealt with at the time of the hip arthroscopy. It is therefore our practice not to undertake MRA as a standard imaging modality for suspected labral tear or FAI. We find a 3D-CT more beneficial to plan the bony procedure and with such poor accuracy of MRA, the results, whether negative for labral tear or positive for chondral damage (in the absence of gross arthritis) would not prevent us from undertaking hip arthroscopy.

The authors accept that 3D-CT would not identify osteonecrosis of bone as early or clearly as magnetic resonance imaging, and where this pathology is suspected, or when 3D-CT results do not fit the clinical picture, we do undertake a MRA.
Tables

**Table 1: MRA vs hip arthroscopy for labral tears.** True positive (TP), true negative (TN), false positive (FP) and false negative (FN) identified.

<table>
<thead>
<tr>
<th></th>
<th>Scope tear</th>
<th>Scope no tear</th>
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<tbody>
<tr>
<td>MRA tear</td>
<td>13 (TP)</td>
<td>26 (FP)</td>
</tr>
<tr>
<td>MRA no tear</td>
<td>3 (FN)</td>
<td>27 (TN)</td>
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</tbody>
</table>

**Table 2: MRA vs hip arthroscopy for chondral wear.**

<table>
<thead>
<tr>
<th></th>
<th>Scope wear</th>
<th>Scope no wear</th>
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<tr>
<td>MRA wear</td>
<td>6 (TP)</td>
<td>0 (FP)</td>
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<tr>
<td>MRA No wear</td>
<td>29 (FN)</td>
<td>30 (TN)</td>
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Figures

Figure 1: 3D-CT of cam impingement left femur. Typical lesion identified on the anterosuperior aspect of the femoral neck
Figure 2: 3D-CT of pincer impingement right acetabulum. Typical lesion identified on the anterior aspect of the acetabulum.
References


