Glenoid Articular Surface on Magnetic Resonance Arthrography of the Shoulder

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Purpose

Magnetic resonance imaging is the diagnostic imaging modality of choice for evaluation of internal derangement of the gleno-humeral joint, with MR arthrography providing the necessary contrast resolution to outline chondral defects in the articular surfaces.

Anecdotal discussion in our department led us to consider that there has been a historical lack of emphasis on MR demonstrated articular cartilage lesions of the glenohumeral joint, when compared with other large joints such as the knee. For this reason, a retrospective review of all magnetic resonance arthrograms performed in a calendar year at our institution was undertaken. This enabled a review of our recording of the glenoid articular appearances for these examinations.

This poster will summarise the normal appearances, anatomic variants and osteochondral lesions of the glenoid surface. Illustrative examples are shown including normal appearances, the bare area, osteochondritis dissecans, post traumatic glenoid cartilage defects, post operative chondral irregularity and glenoid modelling abnormality, with these illustrative images obtained from the review.

An appreciation of both normal and pathological appearances of glenoid cartilage lesions is important, as the presence of glenoid chondral abnormality has influence in the ongoing management of patients with shoulder pain.
Methods and Materials

In our institution, MR arthrography is routinely used in the assessment of patients with shoulder instability in whom surgery is being considered, with CT arthrography used only occasionally, where a significant bony component to instability is already suspected or for claustrophobic patients. Non-contrast MR shoulder is used as a follow-up to ultrasound of the rotator cuff, for assessment of cuff quality prior to surgical repair, or for other targeted indications.

Review of all MR shoulder arthrography performed at the author's NHS hospital over a calendar year was carried out for examinations dated January to December 2012 inclusive.

Patients were identified retrospectively from the hospital RIS system. The images were reviewed, without access to imaging or arthroscopy reports, by the author (SJ), a fellowship-trained musculoskeletal radiologist with 12 year's experience. Particular emphasis was placed on the presence or absence of glenoid articular cartilage abnormality. The imaging report for each case was then also reviewed to assess whether a specific record of the glenoid articular surface had been included.

Illustrative examples were chosen to review the breadth of glenoid articular appearances and pathologies.
Results

I. Imaging Review Findings:

79 cross sectional arthrographic examinations were performed between January and December 2012. Of these, only 2 examinations were computed tomography arthrograms, with 77 magnetic resonance arthrograms (MRA). These 77 MRA examinations were performed in 73 patients. (3 patients had bilateral MRA, and one had a repeat.)

A summary of the glenoid appearances on MRA are given below in Table 1:

Table 1: Summary of Glenoid Appearances on MRA Review.

<table>
<thead>
<tr>
<th>Glenoid appearances</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal glenoid cartilage</td>
<td>48</td>
</tr>
<tr>
<td>Central glenoid bare area</td>
<td>9</td>
</tr>
<tr>
<td>Anterior chondral defect</td>
<td>10</td>
</tr>
<tr>
<td>Posterior chondral defect</td>
<td>2</td>
</tr>
<tr>
<td>Bony Bankart lesion</td>
<td>4</td>
</tr>
<tr>
<td>Abnormal glenoid morphology</td>
<td>1</td>
</tr>
<tr>
<td>Post op chondral abnormality</td>
<td>4</td>
</tr>
<tr>
<td>Glenoid osteochondritis</td>
<td>2</td>
</tr>
</tbody>
</table>

(a few patients had more than one of the above findings)

Comparison between the reports and imaging review was then made. No cases of glenoid lesions were noted on original reports but not on the subsequent review.

Glenoid appearances on review compared with original reports are summarised in Table 2:

Table 2: Reporting of Glenoid Appearances on MRA.
Glenoid appearances on review | Number reported originally
--- | ---
Normal glenoid cartilage | 3
(n=48)
Central glenoid bare area | 1
(n= 9)
Anterior chondral defect | 9
(n=10)
Posterior chondral defect | 0
(n=2)
Bony Bankart lesion | 4
(n=4)
Abnormal glenoid morphology (n=1) | 1
Post op chondral abnormality (n=4) | 2
Glenoid Osteochondritis | 2
(n=2)

On comparison of image review with the previous contemporaneous reports, a tendency to under report the presence of a normal glenoid articular surface was noted, with specific mention of glenoid chondral appearances in the reports usually reserved for cases of definite abnormality.

Under reporting of smoothly marginated central glenoid bare areas was also noted. This may reflect the fact that the thin glenoid cartilage can be only a few pixels thick even when normal, making distinction between normal and bare area susceptible to subjective differences in interpretation.

Anterior chondral defects predominated in our post trauma /instability cases, reflecting the preponderance of previous anterior dislocation in this group of patients. Most significant glenoid chondral lesions identified on image review had been recorded in the imaging reports, although there were two definite posterior and one anterior chondral lesion not reported. One case had both anterior and posterior chondral defects present, with the anterior one specified but not the posterior defect.
In 2 cases of post operative glenoid abnormality, the presence of tracks from bone anchors related to previous labral tear repair was reported, without specific mention of associated overlying cartilage abnormality at the glenoid articular surface, perhaps expected by inference, with the underlying bony abnormality recognised.

II. Pictorial Review of Glenoid Appearances:

Normal appearances

The glenoid articular cartilage is thicker than that of the humeral head. It is thicker peripherally and thinnest at the central glenoid. Although subject to recognised error in the absolute measurement of cartilage thickness, MR arthrography provides a means of assessment of the articular surfaces (1).

 Joint distension with dilute chelated gadolinium, such as Magnevist 2mmol/l, helps to separate the humeral and glenoid cartilage surfaces and provides improved soft tissue contrast resolution. When assessing the joint surfaces, care needs to be given to careful windowing to avoid cartilage detail being obscured.

Figures 1 and 2 show normal appearances of the glenoid articular surface, with a thin uninterrupted covering of intermediate signal hyaline cartilage over the glenoid articular surface.

Bare Area

A focal central smoothly marginated glenoid articular cartilage defect is a well recognised radiological and arthroscopic defect (2,3), often found incidentally.

While some have considered it as a normal variant, this defect is less common in children than adults, leading to the hypothesis that it is in fact an acquired abnormality, caused by mechanical stress at the articulation. It is not associated with a history of trauma.

In our retrospective review, there was a tendency for the bare area to be under-reported at MR arthrography. Arthroscopically, it is seen in up to 22.7% cases (Mr. L Funk, ShoulderDoc.co.uk) and is used as an arthroscopic landmark.
Figure 3 shows the appearances of a central glenoid bare area, which was presumed incidental in this patient with a posterior labral tear.

**Post Traumatic Glenoid Chondral Defects**

MR arthrogramphy, as previously discussed, is commonly carried out in patients with a history of shoulder instability, usually post traumatic. In these patients, glenoid chondral defects are not infrequently found, often in association with other abnormalities such as Hill Sachs lesions and labral injury.

In our review, the majority of post traumatic glenoid chondral defects were anteriorly located, as expected in a patient population in whom the majority had a history of previous anterior glenohumeral dislocation.

Figure 4 shows an example of an anterior post traumatic glenoid chondral defect.

Posterior post traumatic chondral defects were less common in our series. Of note is the fact that a higher proportion of these were found to have been missed on review, which may reflect reporting bias in predominantly anterior instability patients.

Figures 5 and 6 show an example of both anterior and posterior chondral defects in a patient with a history of repeated dislocations over a 16 year period. This patient was also shown to have circumferential labral abnormality and a bony Bankart lesion.

**Osteochondritis Dissecans**

Osteochondritis dissecans is usually seen in young patients, usually involving convex weight bearing surfaces, most commonly in the knee. It is characterised by an area of subchondral bony necrosis, which may separate to give an unstable or displaced osteochondral fragment.

Osteochondritis dissecans has only rarely been described involving the glenoid, with variable nomenclature (4,5). It has been recognised in young throwing athletes with recurrent shoulder symptoms (6). Pathophysiology may relate to overuse with repetitive microtrauma, but ischaemia, genetic predisposition and abnormal ossification have all been proposed as causative factors.
Our imaging review included a 17 year old water polo player with a diagnosis of osteochondritis dissecans of the glenoid made at MRA (see Figure 7).

The patient was subsequently treated by arthroscopic debridement of an unstable 1 x 1.5cm chondral fragment and microfracture. The patient had improvement in symptoms, with recurrent problems on re-initiation of sports activities, with repeat MRA post operatively (see Figure 8).

**Post Operative Chondral Changes**

Only a few patients undergoing MRA in our series had a history of previous surgical intervention. Two patients with previous labral repair were reviewed, with bony changes reflecting bone anchors in the glenoid. These showed overlying glenoid irregularity and fissuring.

Figure 9 shows one such case, with subtle fissuring overlying the anchor sites.

**Abnormal Glenoid Morphology**

The glenoid has a pear shaped, slightly concave articular surface, deepened slightly by thicker marginal articular cartilage and more markedly by the labrum around the glenoid rim. The normal glenoid concavity is shallow, with reliance on soft tissue periarticular structures for maintenance of joint stability.

One patient in the MRA review was noted to have absence of normal glenoid concavity in the transverse plane (see Figure 10). This patient had circumferential labral tears and a long standing history of multidirectional shoulder instability.

It is unknown whether this abnormal glenoid contour was an underlying causative factor in his instability or whether it reflects modelling deformity in response to instability in this case.
**Fig. 1:** Normal appearances. T1 fat sat axial MR arthrogram through the mid glenohumeral joint shows distension of the joint with high signal contrast (*). Glenoid cartilage is seen as a continuous thin intermediate signal layer lining the articular surface (arrows), in apposition with the humeral cartilage posteriorly.

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Fig. 2: Normal appearances. T1 fat sat coronal oblique image through the mid glenohumeral joint showing intermediate signal glenoid cartilage (arrows). The use of multiple imaging planes at MR arthrography enables better assessment of the chondral surfaces.

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**Fig. 3:** Central bare area. T1 fat sat axial MRA image shows anterior and posterior glenoid cartilage (white arrows), with a smoothly marginated central glenoid chondral defect or 'bare area'. This patient also has high signal contrast undercutting the posterior labral attachment (yellow arrow), reflecting a labral tear.

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Fig. 4: Glenoid chondral defect. T1 axial MRA image shows anterior glenoid defect (*) in a patient with a history of previous glenohumeral dislocation. High signal contrast undercuts the residual anterior glenoid cartilage (arrow) as a chondral flap.

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**Fig. 5:** Anterior and posterior glenoid chondral defects. T1 fat sat axial MRA image. This patient with a long history of repeat glenohumeral dislocation has larger anterior and smaller posterior chondral defects (*). Anterior and posterior labral tears are also noted, with contrast undercutting the labral attachments (yellow arrows).

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**Fig. 6:** Anterior and posterior glenoid chondral defects. T1 axial MRA image in same patient as Figure 5. Improved bony anatomical visualisation with more clearly demonstrated displaced, healed bony Bankart lesion (*).
Fig. 7: Osteochondritis dissecans. T1 axial (a.) and T1 fat sat coronal oblique (b.) MRA images showing abnormal subchondral bone of the upper glenoid, with mixed sclerosis and fatty signal change with cortical depression (arrows). No overlying chondral defect or contrast undercut fragment is identified.

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Fig. 8: Osteochondritis dissecans. T1 axial MRA image, in the same patient as Figure 7, with recurrent symptoms following arthroscopy. There is sclerosis of the glenoid (*) and thinning of the glenoid cartilage following debridement and microfracture.

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Fig. 9: Post operative changes. T1 fat sat axial and cor oblique MRA images in a patient with previous anterior labral repair. Subarticular signal change in the glenoid reflect bone anchor sites (white arrows) with subtle contrast filled fissuring of the overlying glenoid cartilage (yellow arrows).

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Fig. 10: Glenoid modelling deformity. Axial T1 fat sat MRA image shows loss of glenoid concavity (compared with reference line between bony margins) in patient with a history of multidirectional instability. Anterior and posterior labral tears (yellow arrows) in this patient with circumferential labral abnormality.

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Conclusion

Magnetic resonance arthrography (MRA) is an important imaging examination for the diagnostic assessment of patients suspected to have internal derangement of the glenohumeral joint. A review of MRA over the period of a calendar year was undertaken, presented here as a pictorial review, to illustrate the normal glenoid cartilage appearances and a range of abnormalities. Glenohumeral cartilage lesions are common (7) and recognised as a feature not infrequently missed on shoulder MR (8).

This review has shown a tendency amongst our reporters to under-record the appearances of normal or bare area appearances. Although limited by a lack of arthroscopic correlation or analysis of intra- or inter-observer variation, it shows a preponderance of anterior glenoid chondral abnormality, unsurprising for our MRA patient population.

It is to be hoped that an improved appreciation of both normal and pathological appearances of glenoid cartilage lesions by careful MRA evaluation will have a positive influence in the ongoing management of patients with shoulder pain.
References


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