Role of MRI in Sports Related Glenohumeral Instability

Poster No.: C-1302
Congress: ECR 2012
Type: Educational Exhibit
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Keywords: Athletic injuries, eLearning, MR, Musculoskeletal joint
DOI: 10.1594/ecr2012/C-1302

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Learning objectives

The purpose of this poster is to review the role of MRI in imaging of sports related glenohumeral instability and commonly encountered abnormalities in glenohumeral instability.

Background

The glenohumeral joint is a synovial-lined ball-in-socket joint that has the greatest range of motion of any joint in the human body. The glenohumeral joint is the most commonly dislocated joint, attributed to the much larger articular surface area of the humeral head and the smaller, shallow glenoid fossa. The glenoid labrum is a fibrocartilaginous cuff surrounding the glenoid fossa. The labrum deepens the fossa and increases the articular surface area of the glenoid. The osseous rim of the glenoid and the fibrocartilaginous labrum are sites of attachment for the glenohumeral ligaments and long head biceps tendon, which can be injured individually or in tandem.

Glenohumeral stability is provided by dynamic and static "restraints". Dynamic restraints include the rotator cuff and the long head biceps brachii tendon. Static restraints include the glenohumeral ligaments, glenohumeral joint capsule (including the rotator cuff interval capsule), the coracohumeral ligament, the glenoid labrum, and the bones. The attachments of the glenohumeral ligaments and the long head biceps anchor to the labrum are stronger than the attachment of the labrum to the glenoid rim. Therefore, the glenoid labrum is commonly torn or avulsed when excessive force is applied to a glenohumeral ligament or the long head biceps. These injuries have classic appearances, and are associated with multiple acronyms (such as ALPSA and SLAP) and eponyms (like the Hill Sachs deformity).

Imaging findings OR Procedure details

MRI TECHNIQUE IN SHOULDER INSTABILITY

Routine imaging of the shoulder is done in three planes. The acquisition of images in the oblique coronal plane, which is the single most important imaging plane in the shoulder joint, is done parallel to the supraspinatus tendon. Oblique sagittal images are acquired at a plane perpendicular to the plane of the glenoid face, and best planned on an axial image. Articular cartilage and labrum are best evaluated on a proton density (PD)
or gradient echo image on axial and oblique coronal planes. The rotator cuff tendons should be evaluated on oblique coronal and oblique sagittal planes. For evaluation of the signal intensity of the rotator cuff tendons, T2W fat-saturated images are ideal. On oblique sagittal images, the entire rotator cuff tendons, muscles and Rotator cuff can be assessed.

MR ARTHROGRAPHY

MR arthrography has proven its utility in the evaluation of glenohumeral instability and cartilage abnormalities. MR arthrography can either be direct or indirect. Usually fat-saturated T1W images are obtained in all three planes. The labrum and glenohumeral ligaments are well visualized after distension of the joint cavity by the intra-articular injection. Injection can be performed either through anterior, anteroposterior or posterior approach. Anterior approach is the most commonly adopted one. In 1975, Schneider et al described a simplified injection technique, which uses a straight anteroposterior approach with a 3.5 inch (8.8 cm), 22 gauge needle directed vertically at the junction of the middle and lower thirds of the glenohumeral joint under fluoroscopic guidance. After confirmation of needle placement using 1-2 mL iodinated contrast agent, 10-12 mL of a dilute gadolinium solution (1:200 dilution) is injected into the joint cavity. MR imaging is usually performed within 90 min to avoid absorption of the intra-articular contrast. A posterior approach can also be adopted, especially when there is anterior instability as needle placement through an anterior route may distort the images of healthy anatomic structures. The patient lies prone with ipsilateral shoulder raised off the table with a pad. A 21 gauge spinal needle is advanced vertically through the inferomedial aspect of the humeral head under fluoroscopic guidance. For a long time, a modified Schneider technique (anteroposterior approach through rotator interval) has been in use, where the patient is kept supine with arm externally rotated and a 1.5 inch (3.8 cm), 20-22 gauge needle is inserted through an area medial to the superior third of the humeral head. The needle tip is advanced in an anteroposterior direction to the humeral head to avoid contact with the glenoid labrum. The utility of this procedure was established by Dépelteau et al. In indirect MR arthrography, gadolinium is injected intravenously and imaging is done after it diffuses into the joint cavity through a highly vascular synovial lining (which takes a few minutes). However, it lacks the effect of joint distension (compared to direct MR arthrogram).

MRI FINDINGS IN SHOULDER INSTABILITY

Hill-Sachs lesion

Hill-Sachs lesion is the most common injury associated with anterior glenohumeral instability. It consists of bony injury of the posterosuperior humeral head manifesting as cortical bony loss, impaction fracture or associated bone marrow edema in acute cases.
Classic bankart lesion

Bankart lesion is the commonest labral injury, manifesting as tear of the anterior inferior labrum with associated peristomal tear. It can be purely cartilaginous or may involve the bony glenoid rim (bony Bankart lesion). Bankart lesion is usually accompanied by Hill-Sachs lesion. Several other variants of Bankart lesion have been described, including the Perthes lesion, anterior labroligamentous peristomal sleeve avulsion (ALPSA) lesion, glenolabral articular disruption (GLAD) lesion. On conventional MR imaging in Bankart lesion, the anteroinferior labrum is seen to be attenuated or absent. The signal intensity on T2* gradient-echo or PD FS FSE MR images may be increased secondary to degeneration of the labrum. On T1 TSE FS post-arthrographic MR images, contrast is seen between the labrum and the glenoid margin.

Perthes lesion

Perthes lesion described by Perthes in 1905, is defined as a tear of the glenoid labrum with intact scapular periostuem. The torn anterior labrum is often undisplaced and visualized in its normal location on conventional MR imaging. MR arthrography, especially when imaging is performed with the arm in ABER position, improves the detection rate of Perthes lesion, as it puts the anterior band of the IGHL and anteroinferior capsule under stress. This is a difficult lesion to detect, both on conventional MRI and even on arthroscopy.

ALPSA lesion

ALPSA lesion is defined as an avulsion and medial rolling of the inferior labroligamentous complex along the scapular neck secondary to a chronic injury. The main differentiating point of ALPSA from a Perthes lesion is the displacement of the torn labroligamentous tissue, which is undisplaced or shows minimal displacement in Perthes lesion. An ALPSA lesion differs from a Bankart lesion in that an ALPSA lesion has an intact anterior scapular periostuem (it is ruptured in Bankart lesion) that allows the labroligamentous structures to displace medially and rotate inferiorly on the scapular neck.

GLAD lesion

This lesion consists of a superficial anterior inferior labral tear associated with an anterior inferior articular cartilage injury. The use of intra-articular contrast in MR arthrogram helps to visualize the small tears at the level of the anterior inferior glenoid rim. When a GLAD lesion is seen on MRI, one should look for loose bodies, which can occur from a detached articular cartilage fragment.

Superior labrum anterior and posterior type 5 lesion
Superior labrum anterior and posterior (SLAP) lesion, described by Snyder et al, is an injury involving the superior aspect of the glenoid labrum that includes the biceps tendon anchor. SLAP tears were initially classified by Snyder et al into 4 distinct but related lesions; Maffet et al added three more types, and currently 10 types or patterns have been recognized. Though SLAP lesions often present with nonspecific symptoms such as pain, locking and snapping, type 5 SLAP lesion (type 2 or 3 SLAP lesion with superior extension of a Bankart lesion) is often associated with anterior shoulder dislocation. Sagittal MRI or MR arthrogram can demonstrate the complete extent of labral tear.

**Humeral avulsion of anterior glenohumeral ligament (HAGL) lesion** is a less commonly encountered abnormality in anteroinferior instability. It may coexist with an anterior labral tear in patients with anterior instability. In patients with documented anterior instability without a demonstrable "primary" Bankart lesion, a HAGL lesion should be ruled out. For detection of HAGL, the glenohumeral joint cavity should be well distended, either by contrast agent (direct MR arthrogram) or joint effusion. On coronal MR image, normal distended axillary pouch is seen as a U-shaped structure, which changes into a J-shape in a HAGL lesion as the IGHL drops inferiorly (J sign).

Bony humeral avulsion of glenohumeral ligaments lesionBony humeral avulsion of glenohumeral ligaments (BHAGL) lesion is less common than HAGL. In BHAGL, there is a small avulsed osseous fragment attached to the torn end of the humeral attachment of the IGHL.

**GAGL lesion**

This uncommon lesion implies an avulsion of the IGHL from the inferior pole of glenoid without associated disruption of the inferior labrum.

**Rotator cuff tears**

These tears associated with anterior and inferior glenohumeral dislocation, are commoner in the elderly rather than the younger age group (30% incidence in patients less than 40 years of age and 80% incidence above 60 years of age. RCI tearA tear of the RCI typically does not appear as complete disruption of the fibres of its components. Instead it is seen on imaging as thinning, irregularity or focal discontinuity of the rotator interval capsule. Arthroscopy is considered the gold standard in diagnosing RCI lesions. MR arthrography, particularly the T2W sagittal or axial images, may be useful in diagnosing RCI pathologies.

**IMAGING FINDINGS IN POSTERIOR DISLOCATION**

**Reverse hill-sachs lesion**
This lesion consists of an anteromedial superior humeral head impaction fracture which is often associated with a reverse Bankart lesion (posterior glenoid labrum disruption).

**Reverse HAGL lesion**

In posterior instability, there is sometimes a complete avulsion of the posterior attachment of the shoulder capsule from the posterior humeral neck, associated with tear of the posterior band of the IGHL.

**Posterior glad lesion**

This lesion is a newly described entity in posterior glenohumeral instability, which can be seen as focal posterior articular cartilage defect (between 7 and 9 o'clock location).

**Bennett lesion**

This is an extra-articular crescentic posterior ossification associated with posterior labral injury and capsular avulsion, sometimes secondary to the posterior subluxation. The ossification is best visualized on CT, and often missed by arthroscopy as it is extra-articular. Posterior superior labral tear. This occurs as a part of posterior SLAP 2 or posterosuperior to a posterior labral tear in association with a paralabral cyst and may be seen in patients with posterior instability. Posterior superior labral tear may be associated with repetitive microtrauma, as in throwers, and can even be seen in anterior instability. The cysts are almost always associated with labral tears, but the communication with the joint space is often not visualized on MRI.

**Images for this section:**
Fig. 1: Normal T1-weighted TSE fat-saturated axial magnetic resonance arthrogram image. The anterior and posterior labrum appears as triangular hypointense structures (straight arrows). Normal middle glenohumeral ligament has been shown with an arrowhead. Note the long head of biceps tendon in the bicipital groove and extension of joint fluid around the tendon (dashed arrow)
**Fig. 2:** Axial T1-weighted TSE fat-suppressed magnetic resonance arthrogram image shows bony defect involving posterosuperior humeral head (Hill-Sachs lesion) (arrow)
**Fig. 3:** Axial T1-weighted TSE fat-suppressed magnetic resonance arthrogram image shows detached anteroinferior labrum from the glenoid margin; classic soft tissue Bankart lesion. Contrast within the joint is seen to traverse the gap between the detached labrum and the glenoid margin (arrow).
Fig. 4: Axial T1-weighted TSE fat-suppressed magnetic resonance arthrogram image shows anteroinferior labral tear with bony glenoid injury shown with an arrow (Bony Bankart lesion)
**Fig. 5:** Perthes lesion. Oblique axial T2-weighted TSE image of the shoulder joint with the arm in abduction and external rotation location shows tear of the anteroinferior labrum (arrow) with intact periosteum, suggesting Perthes lesion.
**Fig. 7:** Glenolabral articular disruption lesion and posterior labral tear in a patient with multidirectional instability. Axial proton density fat-suppressed image reveals absence of the anteroinferior labrum with tear of the adjacent articular cartilage (straight arrow). Also associated is a tear involving the posterior labrum, seen as interposition of fluid between the posterior labrum and the posterior glenoid margin (dashed arrow).
Fig. 6: Anterior labroligamentous periosteal sleeve avulsion lesion in a patient with recurrent anterior shoulder dislocation. A: Axial T2-weighted gradient-echo image of the right shoulder reveals irregular contour of the anteroinferior labrum and hypointense soft tissue lying along the scapular neck (arrow); B: On magnetic resonance arthrographic axial T1-weighted fat-saturated image the avulsed labroligamentous tissue is seen displaced medially along the scapular neck (arrow)
**Fig. 8:** Humeral avulsion of anterior glenohumeral ligament in chronic anterior instability. Coronal T1-weighted TSE fat-suppressed magnetic resonance arthrogram image reveals the 'J' shape (arrow) of the axillary pouch (A), compared to the 'U' shape (arrow) in a normal individual (B).

**Fig. 9:** Reverse Hill-Sachs and reverse Bankart lesion in a case of posterior instability. T1-weighted TSE axial magnetic resonance image reveals hemarthrosis, posterior glenohumeral dislocation and reverse Hill-Sachs lesion (straight arrow). There is associated posterior labral tear (reverse Bankart lesion), shown with a dashed arrow.
**Fig. 10:** Posterior labral tear. Axial T1-weighted TSE fat-suppressed magnetic resonance arthrogram image reveals the undisplaced posterior labral tear (arrow). The anterior joint capsule attachment is placed medially along scapular neck (normal variation)
Conclusion

Shoulder pain and instability are common orthopedic problems in athletes. Although there are many causes of shoulder pain and instability (including fractures and rotator cuff tears), injuries to the glenohumeral ligaments, labrum, and biceps labral complex are often the cause. Its high spatial resolution, excellent image contrast, and multiplanar capabilities make MRI an excellent tool in the evaluation of the labrum. MR allows accurate depiction of the size and location of labral tears and their associated capsular and glenohumeral ligament injuries.

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References


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