Glenohumeral Instability: Evaluation with MR Arthrography[1]

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Magnetic resonance arthrography is superior to other imaging techniques in evaluation of the glenohumeral joint. Normal variants that can be diagnostic pitfalls include the anterosuperior sublabral foramen, the Buford complex, and hyaline cartilage under the labrum. Anteroinferior dislocation is the most frequent cause of anterior glenohumeral instability and produces a constellation of lesions (anteroinferior labral tear, classic and osseous Bankart lesions, Hill-Sachs lesion). Variants of anteroinferior labral tears include anterior labroligamentous periosteal sleeve avulsion and glenoid labral articular disruption. Anterior glenohumeral instability can also involve tears of the anterior or anterosuperior labrum or the glenohumeral ligaments. Posterior glenohumeral instability can involve a posterior labral tear; posterior capsular stripping or laxity; fracture, erosion, or sclerosis and ectopic ossification of the posterior glenoid fossa; reverse Hill-Sachs lesion; McLaughlin fracture; or posterosuperior glenoid impingement. Superior labral anterior and posterior lesions involve the superior labrum with varying degrees of biceps tendon involvement.

■ INTRODUCTION

The shoulder is the most commonly dislocated major joint of the body. The discrepancy in size between the small glenoid fossa and the large humeral head gives the glenohumeral joint the greatest mobility among the human articulations but also makes this joint particularly vulnerable to dislocation. The stability of the glenohumeral joint

Abbreviations: ABER = abduction and external rotation, ALPSA = anterior labroligamentous periosteal sleeve avulsion, GHL = glenohumeral ligament, GLAD = glenoid labral articular disruption, LHBT = long head of the biceps tendon, SLAP = superior labral anterior and posterior

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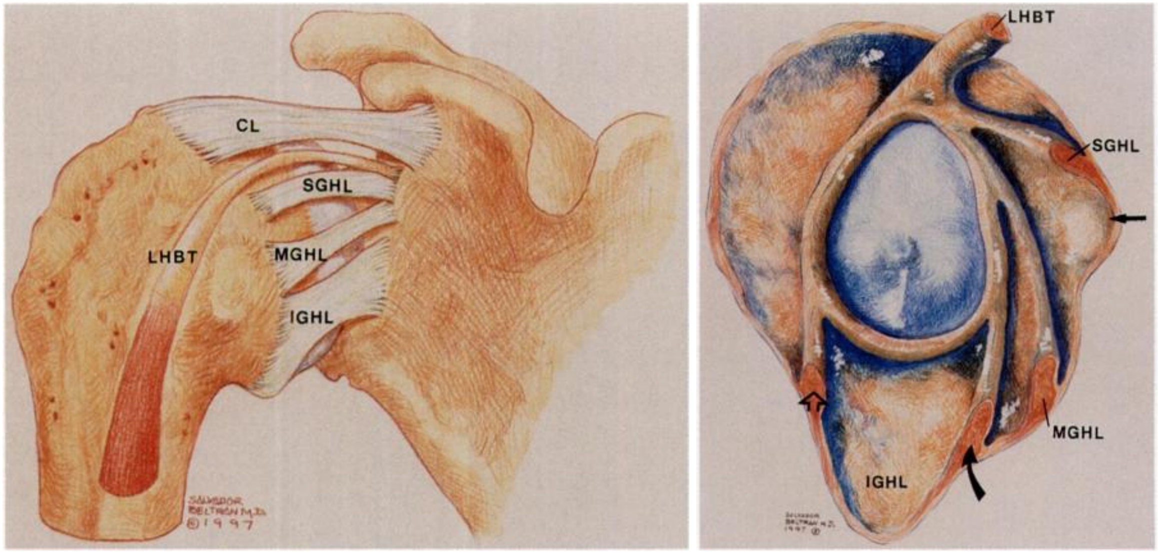


a. b.

Figure 1. Normal anatomy. **(a)** Drawing (anterior view) shows ligaments of the glenohumeral joint. The coracohumeral ligament (*CL*) extends from the base of the coracoid process to the greater tuberosity. The superior GHL (*SGHL*) extends from the anterosuperior margin of the glenoid fossa to the humeral neck, above the lesser tuberosity. The middle GHL (*MGHL*) extends from the anterosuperior glenoid fossa to the lesser tuberosity. The inferior GHL (*IGHL*) extends from the inferior margin of the glenoid fossa to the inferior aspect of the humeral neck. The long head of the biceps tendon (*LHBT*) inserts in the superior margin of the glenoid fossa and labrum. **(b)** Drawing (lateral view) shows the glenoid fossa outlined by the labrum. Note the insertions of the LHBT and GHLs in the labrum. The subscapular recess (straight solid arrow) opens into the anterior aspect of the capsule, between the superior GHL (*SGHL*) and the tendon of the subscapular muscle, but many variations have been described. If the middle GHL (*MGHL*) is absent, a large opening to the subscapular recess may be seen. Rarely, more than one recess can be found. Note the anterior (curved arrow) and posterior (open arrow) bands of the inferior GHL (*IGHL*).

is maintained by passive and active mechanisms (muscle energy is required for the latter but not for the former) (Table 1).

The glenohumeral ligaments (GHLs), particularly the inferior one, are thought to be the major passive stabilizers of the joint; the glenoid labrum is believed to be important as a site for ligamentous attachment, not because it provides increased depth to the glenoid fossa and hence stability, as previously believed. The strong intertwining between the collagen fibers of the GHLs and the labrum is more resistant to injury than the union between the glenoid fossa and labrum. Because the superior and middle GHLs are often underdeveloped or absent, they are thought to play a minor role in the stability of the joint (1,2) (Fig 1). In general, cases of shoulder instability can be classified as atraumatic or traumatic (Table 2).

Familiarity with the different types of labral and capsuloligamentous lesions will improve diagnostic accuracy. Magnetic resonance (MR) arthrography is superior to other imaging techniques for evaluation of glenohumeral instability. In this article, we discuss MR imaging of the glenohumeral joint and present the MR arthrographic appearances of the normal glenohumeral joint, anterior and posterior glenohumeral instability, and superior labral anterior and posterior (SLAP) lesions.

■ MR IMAGING

In the shoulder, MR imaging is used for the same indications as computed tomographic (CT) arthrography to take advantage of the noninvasiveness of MR imaging. The reported accuracies of MR imaging for the detection of labral tears have been mixed. For instance, Garneau et al (3) reported a sensitivity of 44% in 26 patients. Conversely, Legan et al (4) reported a sensitivity of 95% in 88 patients. More recently, Gusner et al (5) evaluated the accuracy of high-resolution MR imaging in 103 patients. In their series, the sensitivity for anterior, superior, and posterior labral tears was 100%, 86%, and 74% and the specificity was 95%, 100%, and 95%, respectively. The accuracy of nonenhanced MR imaging for the evaluation of GHL lesions has not been reported, to our knowledge.

Table 1
Stabilizing Mechanisms of the Glenohumeral Joint

Passive stabilizing mechanisms
Size, shape, and tilt of the glenoid fossa
Negative intracapsular pressure
Adhesion and cohesion of the two articular surfaces
Ligamentous and capsular structures
Glenoid labrum
Osseous restraints (acromion, coracoid process)
Active stabilizing mechanisms
Long head of the biceps tendon
Rotator cuff muscles

Table 2
Clinical Characteristics of Shoulder Instability

Atraumatic instability
Constitutionally lax shoulder
Multidirectional
Bilateral
Treated with physical therapy and rehabilitation
Traumatic instability
Unidirectional
Anterior dislocation may be the initial event
Often requires surgical management
Anterior dislocation: abduction, extension, and external rotation forces
Posterior dislocation: axial loading in adduction or violent muscle contracture
Inferior dislocation: hyperabduction (luxatio erecta)

Table 3
Technique for MR Arthrography of the Shoulder

Parameter	Recommendation
Pulse sequences*	
T1-weighted axial and oblique sagittal spin-echo	600-800/15-20†
Proton-density- or T2-weighted oblique coronal spin-echo	1,800-2,000/20-100†
Field of view (cm)	16-18
Matrix	256×256 or 256×192
Section thickness	3 mm interleaved or 4 mm with 1-mm gap

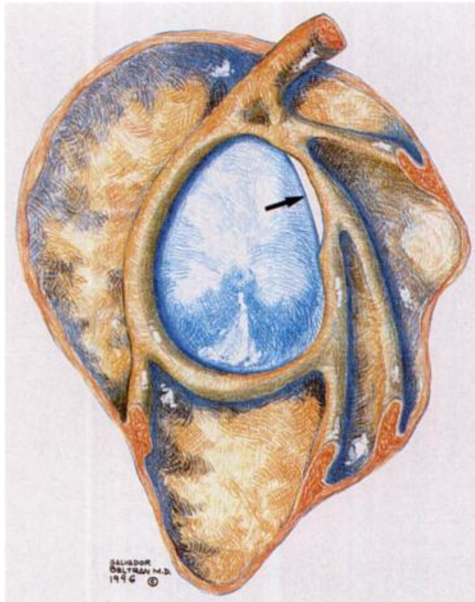
Note.—Intraarticular use of gadopentetate dimeglumine is not approved by the U.S. Food and Drug Administration. Approval by an institutional review board is required, and patients must sign a consent form.
*Optional sequences: fat-saturated T1-weighted oblique coronal or axial imaging and T1-weighted oblique sagittal imaging with the arm in the abduction and external rotation (ABER) position and with a flexible coil placed over the axilla.
†Repetition time msec/echo time msec.

MR arthrography has been proposed to be more accurate for evaluation of the capsuloligamentous complex, glenoid labrum, intracapsular portion of the LHBT, and rotator cuff (3,4,6-10). Chandnani et al (6) reported a sensitivity of 96% for MR arthrography compared with 93% and 73% for MR imaging and CT arthrography, respectively, in 28 patients. Palmer et al (7) reported a sensitivity of 91% and specificity of 93% for MR arthrography in 48 patients. Chandnani et al (8) used MR arthrography with arthroscopic correlation to evaluate the GHLs in 46 patients. In that series, the sensitivity for lesions of the superior, middle, and inferior GHL was 100%, 89%, and 88% and the specificity was 94%, 88%, and 100%, respectively.

MR arthrography is performed as follows: Under fluoroscopic control, a 20-22-gauge needle is positioned in the glenohumeral joint with a standard arthrographic technique. Alternatively, the needle can be positioned under ultrasound guidance or even blindly by using anatomic landmarks. Needle position can be verified with injection of 1-5 mL of 60% diatrizoate meglumine. Next, a dilution of 0.1 mL of gadopentetate dimeglumine in 20 mL of normal saline is injected, along with 0.3 mL of epinephrine diluted 1:1,000 to delay reabsorption of the contrast material. After intraarticular injection of the contrast material, the patient is escorted to the MR imaging suite. MR imaging is performed with a dedicated shoulder surface coil and the parameters listed in Table 3 (11).

■ NORMAL ANATOMY

The glenoid labrum varies in shape and thickness on cross-sectional images (12-15). It is often rounded anteriorly and is triangular posteriorly. It may have clefts or be crescentic, thin, or even absent. The anterosuperior labrum may be normally separated from the glenoid margin (anterosuperior sublabral foramen) (Fig 2) (9). The anterosuperior labrum can also be absent. In this situation, a thick, cordlike middle GHL (Buford complex) can be found, simulating a labral tear on axial images (Fig 3) (16,17).



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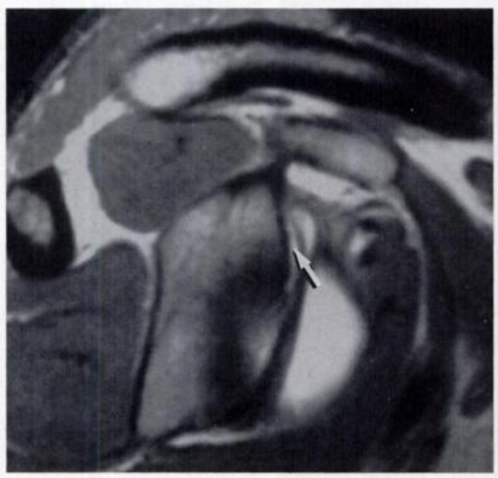

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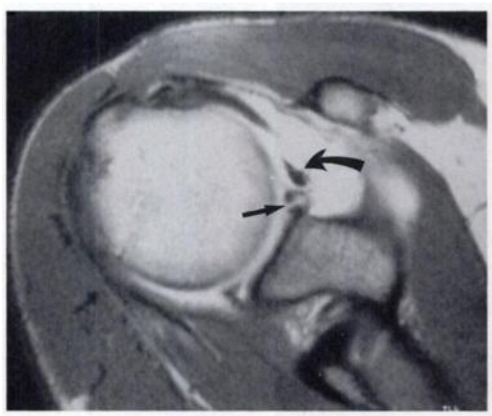

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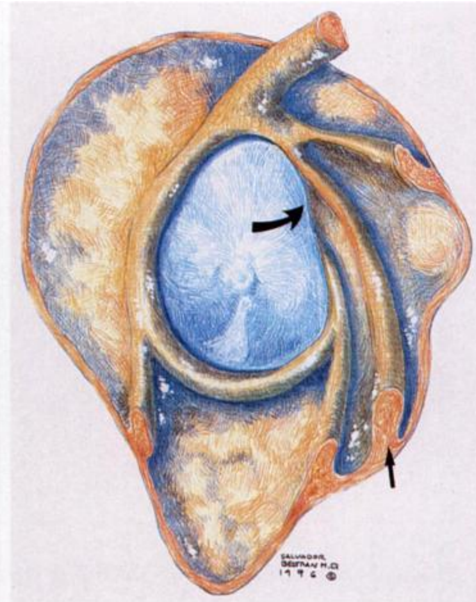

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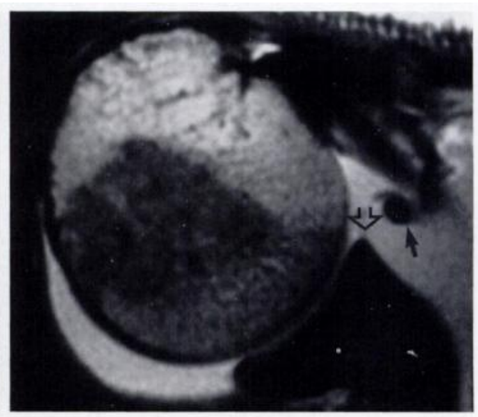

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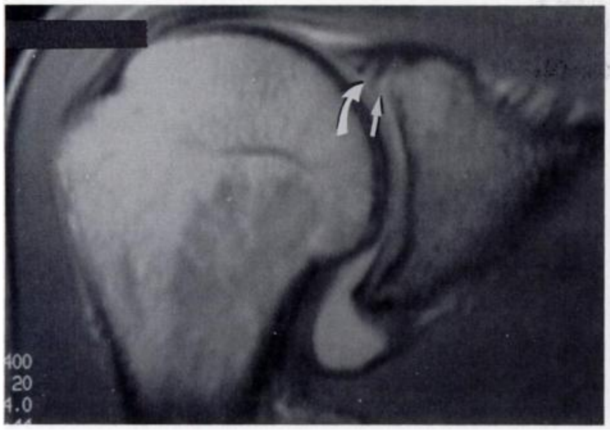

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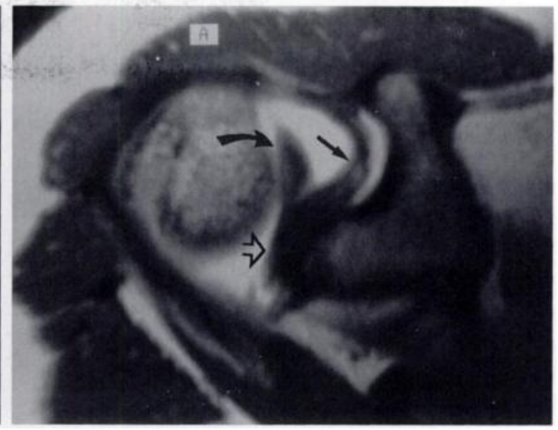

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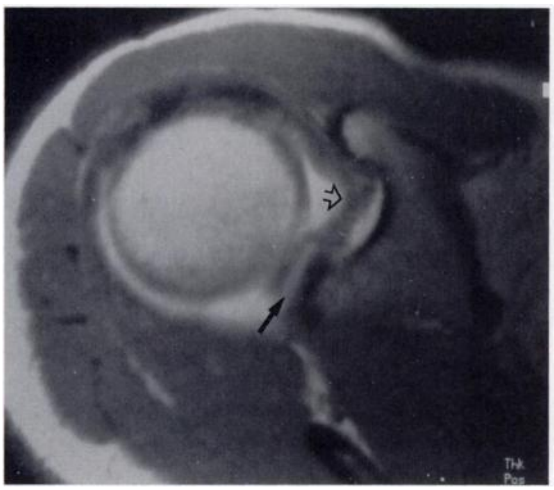


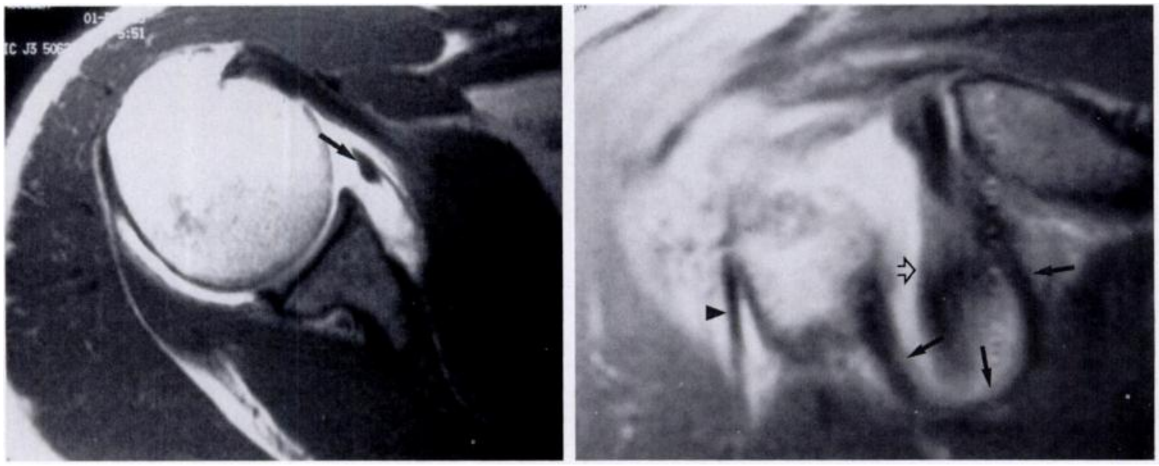
6.

Figures 4–6. **(4)** LHBT and superior labrum. Oblique coronal MR arthrogram shows normal insertion of the LHBT in the superior labrum. Note the hyperintense hyaline cartilage between the glenoid fossa and superior labrum (straight arrow) and the recess between the superior labrum and LHBT (curved arrow). **(5)** Superior labrum and LHBT. Axial MR arthrogram through the coracoid process shows the superior GHL (straight solid arrow) and the insertion of the LHBT (curved arrow). Note the superior labrum (open arrow) attached to the cortical margin of the glenoid fossa. **(6)** Superior labrum. Axial MR arthrogram slightly below the level of Figure 5 shows the superior labrum separated from the glenoid margin by hyperintense hyaline cartilage (solid arrow), which should not be confused with a superior labral tear. Note the superior GHL (open arrow).

Superiorly, the labrum and the LHBT become intertwined. A normal recess or cleft of varying depth can be seen on oblique coronal sections between these two structures (Fig 4). Hyaline cartilage covering the glenoid fossa can extend under the labrum superiorly and anteriorly (Figs 4–6).

The superior GHL is a fairly constant structure that arises in the shoulder capsule just anterior to the insertion of the LHBT and inserts

◀ **Figures 2, 3.** **(2)** Anterior sublabral foramen. **(a)** Drawing shows a normal anterior sublabral foramen (arrow). The anterosuperior labrum is separated from the glenoid margin. **(b)** Oblique sagittal MR arthrogram shows the anterosuperior labrum separated from the glenoid margin. A small amount of contrast material is interposed between the two structures (arrow). (All MR arthrograms were obtained with a repetition time of 500–600 msec and an echo time of 15 msec.) **(c)** Axial MR arthrogram shows the sublabral foramen (straight arrow). Note the middle GHL (curved arrow). **(3)** Buford complex. **(a)** Drawing shows the thickened middle GHL (straight arrow) and the absent portion of the superior labrum (curved arrow). **(b)** Oblique sagittal MR arthrogram shows a thick middle GHL (arrow). **(c)** Axial MR arthrogram shows the middle GHL (solid arrow) simulating a torn anterior labrum. Note the absence of the anterior labrum (open arrow).



a. b.

Figure 8. Middle GHL. **(a)** Axial MR arthrogram shows a normal middle GHL (arrow). **(b)** Oblique coronal MR arthrogram obtained anterior to the glenohumeral joint shows a redundant middle GHL (solid arrows). Note the anterior labrum (open arrow) and the LHBT (arrowhead) within the bicipital groove.

into the fovea capitis line just superior to the lesser tuberosity (Fig 5). It varies in thickness and is present in 90%–97% of cadaveric dissections. The coracohumeral ligament is an extracapsular structure located superior to the LHBT (Fig 7). The superior GHL has been identified in 85% of cases with MR arthrography (10).

The middle GHL shows the most variation in size of all the GHLs and is absent in about 27% of cadaveric dissections. It arises most frequently from the labrum immediately below the superior GHL or from the neck of the glenoid fossa. It inserts into the humerus just medial to the lesser tuberosity. At the level of the origin of this ligament, a labral tear may be simulated (Fig 6). Occasionally, a redundant middle GHL is seen, which also simulates a labral tear on axial images (Fig 8). The middle GHL has been identified in 85% of cases with MR arthrography (10).

The inferior GHL consists of an anterior band, a posterior band, and the axillary recess of the capsule between these bands (Fig 9).

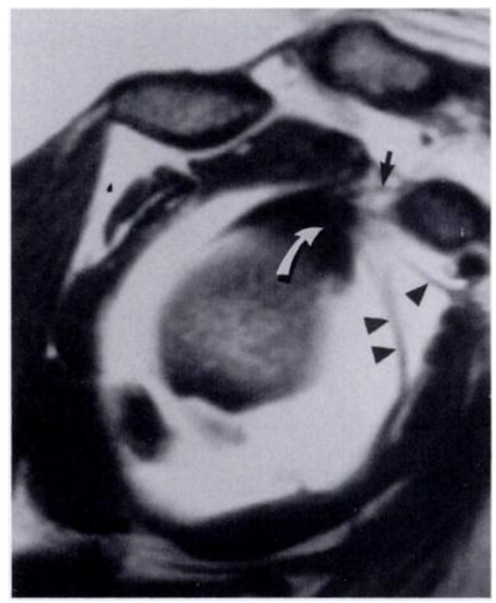
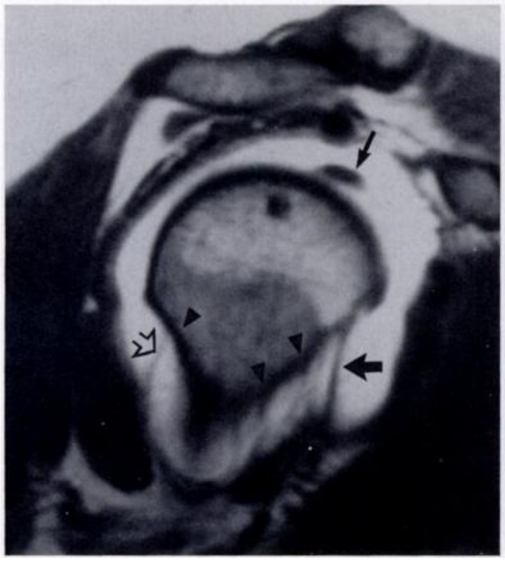


Figure 7. LHBT, superior and middle GHLs, and coracohumeral ligament. Oblique sagittal MR arthrogram through the glenoid fossa shows the normal insertions of the LHBT (curved arrow), superior GHL (single arrowhead), and middle GHL (double arrowhead). Note the thin coracohumeral ligament (straight arrow) located just above the LHBT. In this image, the more superficial portion of the humeral head occupies the glenoid fossa.



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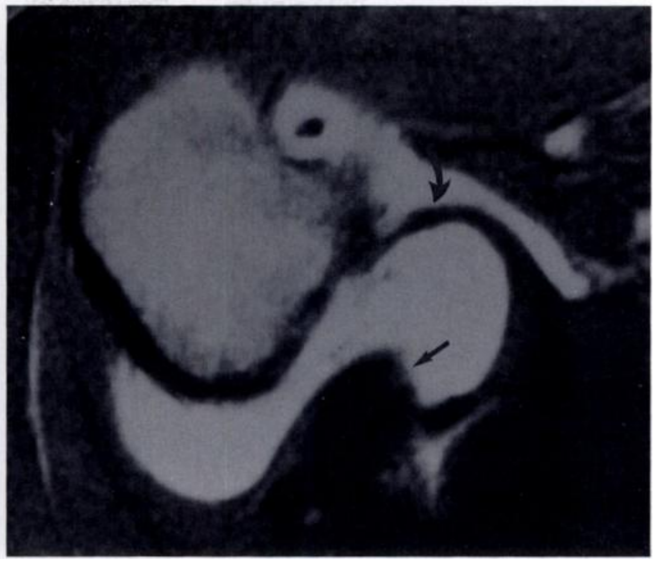


b.

Figure 9. Inferior GHL. **(a)** Oblique sagittal MR arthrogram shows the inferior GHL complex. Note the anterior band (large solid arrow), the posterior band (open arrow), and the striated appearance of the axillary recess (arrowheads). The LHBT (small solid arrow) is seen as an elliptical structure above the humeral head. **(b)** Axial MR arthrogram shows the anterior band of the inferior GHL as a curved structure (curved arrow) inserting in the anterior labrum (straight arrow). Almost the entire anterior band of the inferior GHL is seen on this image due to capsular distention.

This ligament inserts in a collarlike fashion in the inferior aspect of the neck of the humerus. With the arm in the ABER position, the anterior band of the inferior GHL becomes taut and can be visualized in almost its entire extension on MR arthrograms obtained with the arm in this position (18). The inferior GHL has been identified in 91% of cases with MR arthrography (10).

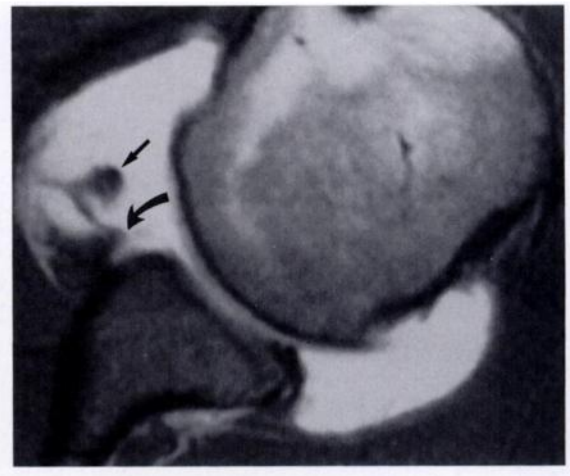
The LHBT is identified on axial MR images obtained just above the coracoid process as a broad band of low signal intensity overlapping the anterior third of the humeral head and inserting in the superior margin of the labrum (Fig 5). The insertion of the LHBT can also be evaluated on oblique coronal (Fig 4) and oblique sagittal (Fig 7) images.

The joint capsule attaches on the neck of the humerus and around the glenoid fossa, in close relationship with the labrum. Capsular laxity and recessed capsular attachment are associated with glenohumeral instability. At MR arthrography, a fully distended capsule can demonstrate relatively prominent anterior and posterior recesses, simulating capsular laxity. This appearance is a potential pitfall of MR arthrography.

■ ANTERIOR GLENOHUMERAL INSTABILITY

Restraints to anterior translation of the humeral head are provided by the capsule and GHLs. The labrum is torn due to the avulsion forces produced by the GHLs at the time of the injury.

Figure 10. Anteroinferior labral tear. **(a)** Drawing shows the classic Bankart lesion: detachment of the anteroinferior capsulolabral complex and scapular periosteum. **(b)** Drawing of the anterior labrum (*AL*) (axial view) shows the periosteum (*P*), capsuloligamentous complex (*CLC*), and articular cartilage of the glenoid fossa (*C*). **(c)** Drawing shows a Bankart lesion. Note the anterior labrum (*AL*), capsuloligamentous complex, and torn periosteum (*P*). **(d)** Axial MR arthrogram shows the classic Bankart lesion. Note the torn fragment of the anterior labrum (straight arrow). Note also the cleft between the glenoid margin and an irregular structure (curved arrow) that represents the detached capsule and periosteum. The anterior labrum is partially separated from the glenoid fossa, and there is periosteal stripping and rupture (curved arrow).



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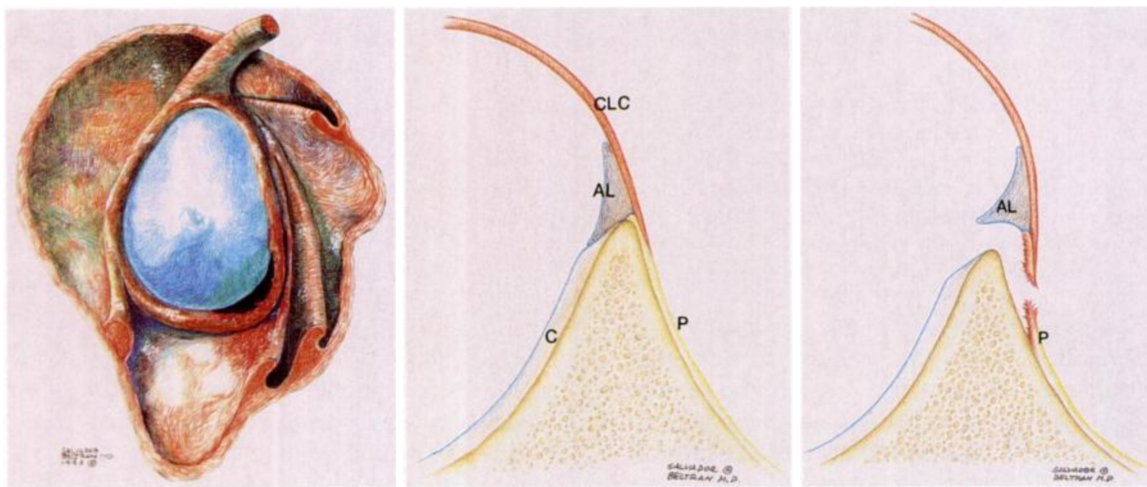
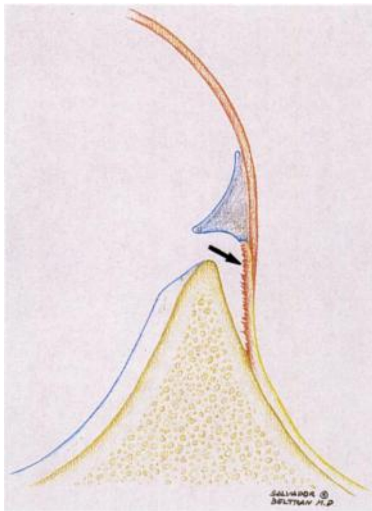


a. b. c.

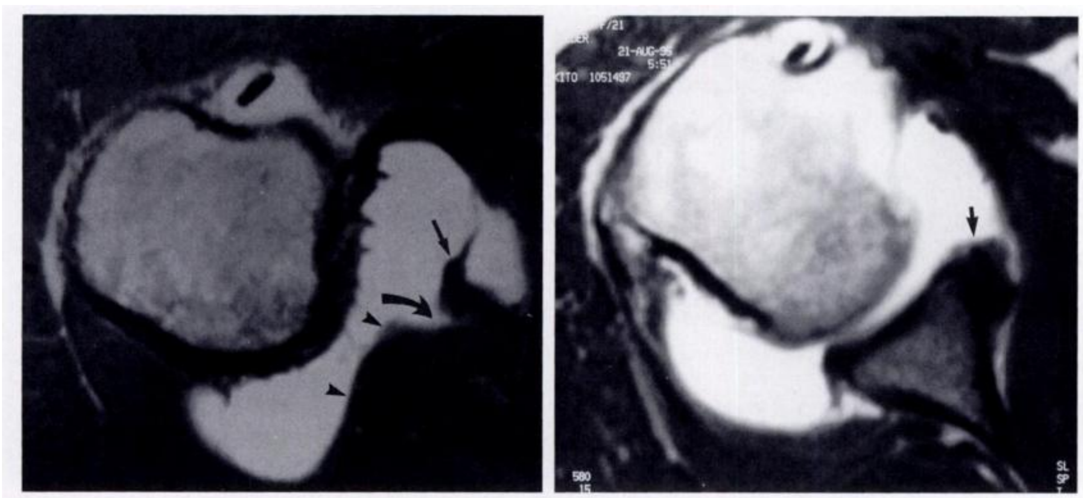
• Anteroinferior Labral Tear

Anteroinferior dislocation is the most frequent cause of anterior glenohumeral instability. A single event originates a constellation of lesions leading to other episodes of dislocation or subluxation. The lesions that may occur during an anteroinferior dislocation are anteroinferior labral tear (Figs 10–12), tear of the inferior GHL or capsuloperiosteal stripping (Figs 10, 11), fracture of the anteroinferior glenoid margin



a.

Figure 11. Anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion. **(a)** Drawing shows the ALPSA lesion. The anteroinferior labrum is torn and internally rotated, and capsuloperiosteal stripping is present (arrow). **(b)** Axial MR arthrogram through the inferior labrum shows an acute ALPSA lesion: a labral tear with periosteal separation. Note the cleft (curved arrow) between the edge of the glenoid fossa (arrowheads) and the torn labrum (straight arrow). **(c)** Axial MR arthrogram through the inferior labrum shows a chronic ALPSA lesion. Abnormal thickening and flattening of the labrum (arrow) resulted from healing with synovial fibrous tissue between the labrum and glenoid margin.



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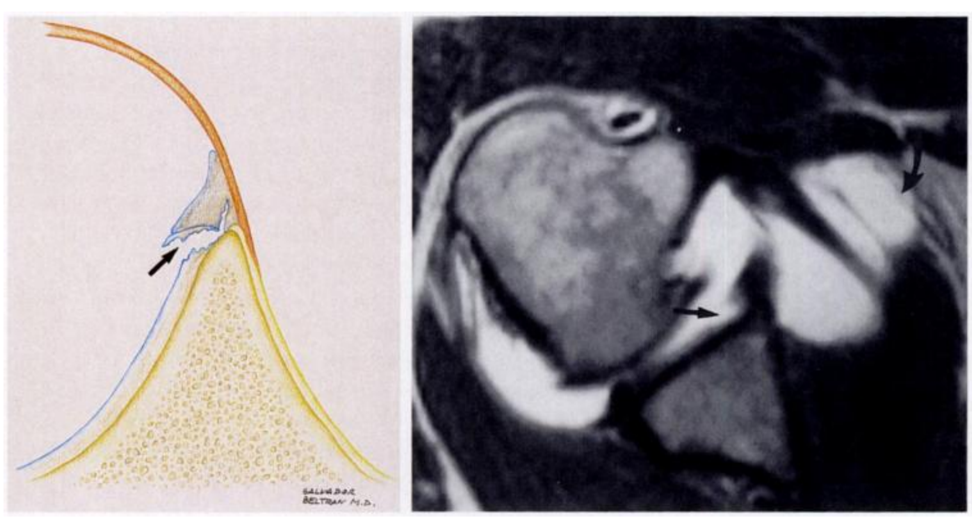
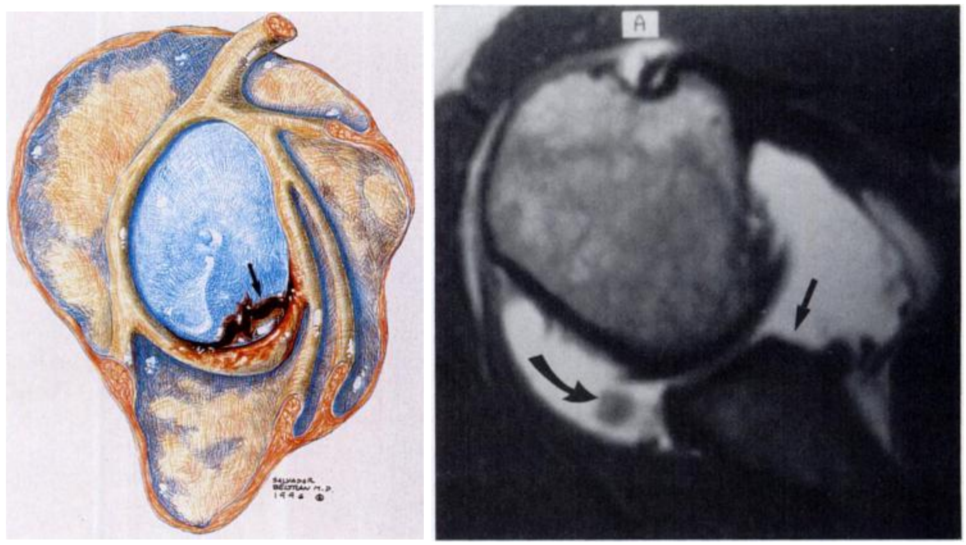


a. b.

Figure 12. Glenoid labral articular disruption (GLAD) lesion. **(a)** Drawing shows a GLAD lesion. Note the separation of the anterior labrum along with a fragment of articular cartilage (arrow). **(b)** Axial T1-weighted MR arthrogram shows a GLAD lesion (straight arrow). Note the subscapular recess (curved arrow) distended with contrast material.



a. b.

Figure 13. Fracture of the anteroinferior glenoid margin. **(a)** Drawing shows an anteroinferior glenoid margin fracture (osseous Bankart lesion) (arrow). **(b)** Axial MR arthrogram shows an osseous Bankart lesion (straight arrow) and a posteriorly located intraarticular loose body (curved arrow).

(Fig 13), and compression fracture of the superolateral aspect of the humeral head (Hill-Sachs lesion) (19). Anteroinferior labral tear is one of the most frequent lesions in glenohumeral instability.

The classic Bankart lesion is a combination of the first two lesions listed. At arthroscopy and MR arthrography, the Bankart lesion is seen as a fragment of labrum attached to the anterior band of the inferior GHL and to the ruptured scapular periosteum, "floating" in the anteroinferior aspect of the glenohumeral joint (Fig 10). Extensive bone and soft-tissue damage and persistent instability may lead to multidirectional instability, resulting in episodes of posterior dislocation (18).

A number of variants of anteroinferior labral tears have been described. The ALPSA lesion is a tear of the anteroinferior labrum with associated capsuloperiosteal stripping. The torn labrum is rotated medially, and a small cleft or separation can be seen between the glenoid margin and labrum (Fig 11). Unlike the Bankart lesion, the ALPSA lesion can heal, leaving a deformed and patulous labrum (Fig 11). The GLAD lesion is a tear of the anteroinferior labrum with an attached fragment of articular cartilage but without associated capsuloperiosteal stripping (Fig 12) (20,21).

• Extensive Anterior Labral Tear

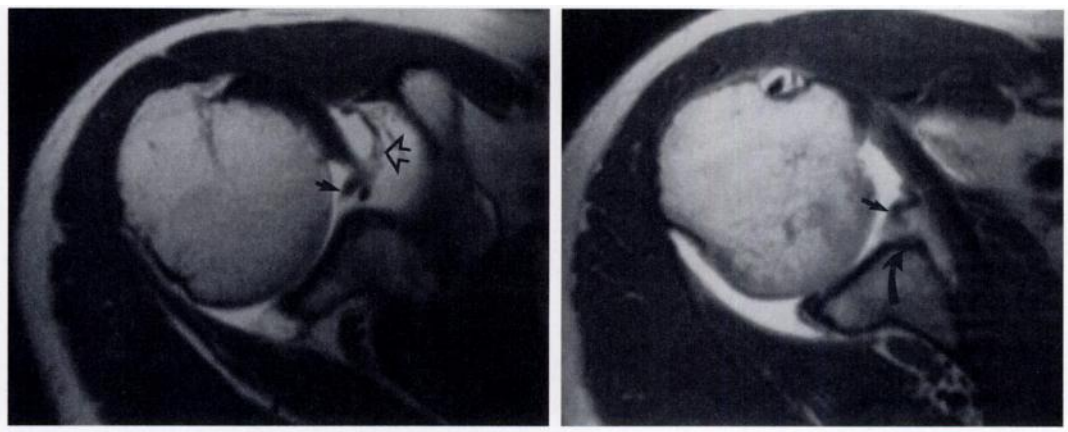
The second most frequent location of labral lesions is the anterior aspect of the labrum from the base of the biceps tendon insertion to the insertion of the inferior GHL, involving also the insertions of the superior and middle GHLs (Fig 14). In a study of 45 patients, Palmer et al (7) found that nine of 27 labral tears had this distribution.

• Anterosuperior Labral Tear

A tear limited to the anterosuperior aspect of the labrum, with or without (Fig 15) associated lesions of the superior and middle GHLs, is often associated with lesions of the insertion of the LHBT. Isolated anterosuperior labral tears without clinical evidence of instability and without a previous episode of dislocation can produce shoulder pain. This condition is found in the throwing athlete. The patient complains of pain and a sensation of instability when throwing (functional instability). Care should be taken not to confuse an anterosuperior labral tear with a normal anterosuperior sublabral foramen (Fig 2). Periosteal detachment and irregularity of the torn labrum along with the clinical history and symptoms may help differentiate the two conditions.

a.

Figure 14. Extensive anterior labral tear. **(a)** Drawing shows an extensive tear of the anterior labrum from the insertion of the middle GHL to the inferior glenoid margin. **(b, c)** Axial MR arthrograms at the levels of the superior **(b)** and inferior **(c)** labrum show detachment of the anterior labrum from the glenoid fossa (solid arrow in **b**, straight arrow in **c**). The superior GHL (open arrow) and middle GHL are still attached to the labrum. There is an osseous Bankart lesion inferiorly (curved arrow).



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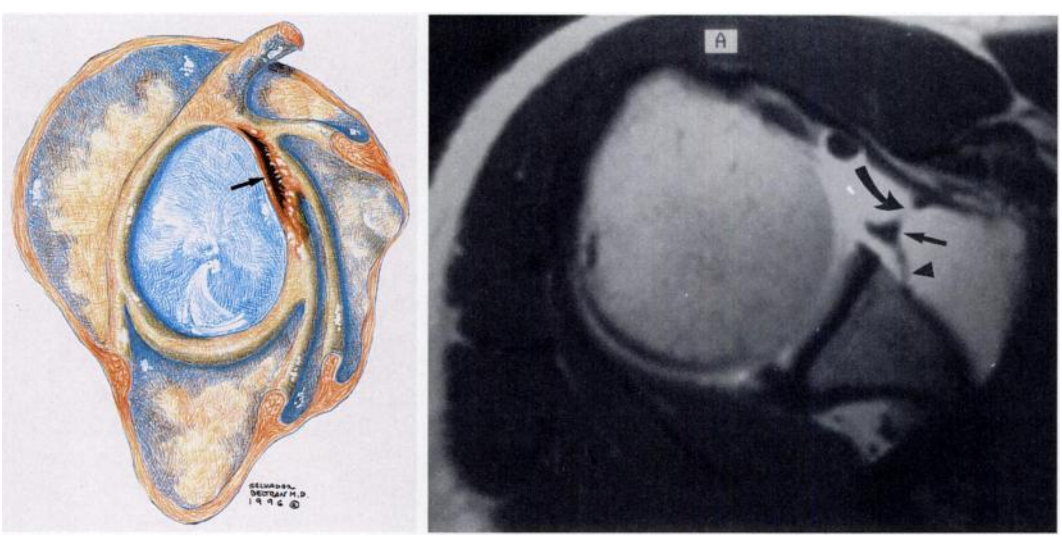
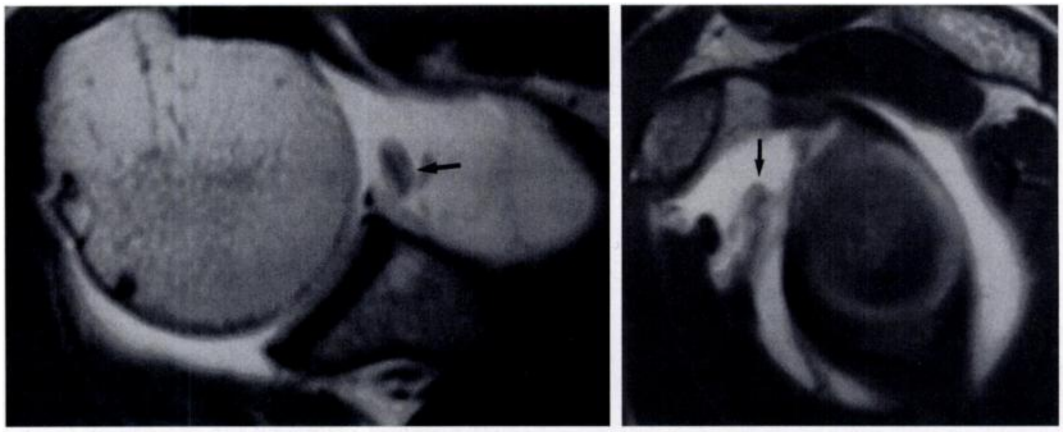


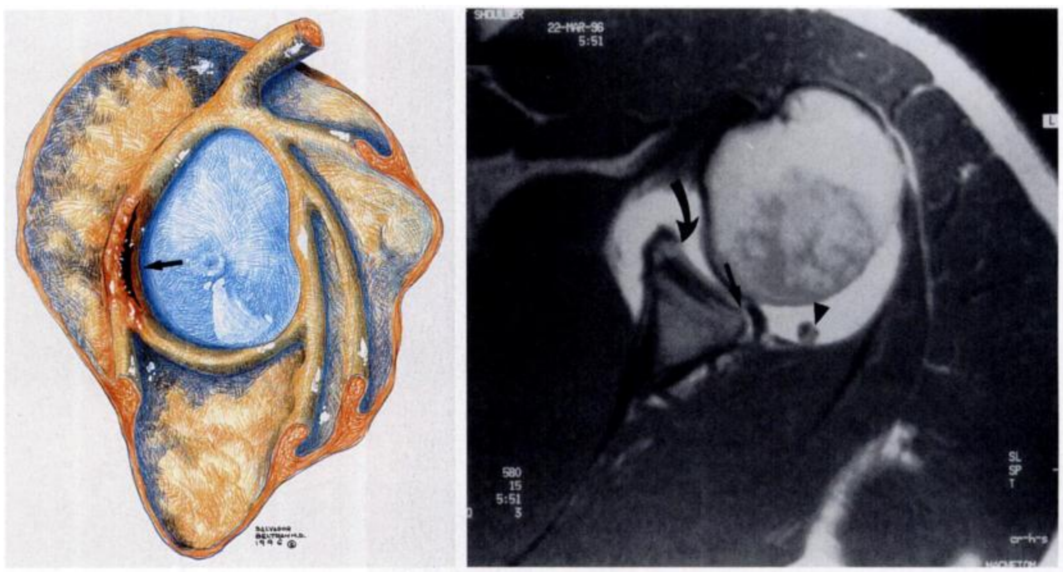
a. b.

Figure 15. Anterosuperior labral tear. **(a)** Drawing shows a tear of the anterosuperior labrum at the insertion of the middle GHL (arrow). **(b)** Axial MR arthrogram at the level of the superior labrum shows the anterior labrum detached from the glenoid margin (straight arrow) with stripping of the periosteum (arrowhead). Note the intact middle GHL (curved arrow).



a. b.

Figure 16. Tear of the middle GHL. **(a)** Axial MR arthrogram shows a detached, thick, and irregular middle GHL (arrow) with a small fragment of the anterior labrum. **(b)** Oblique sagittal MR arthrogram shows the middle GHL floating within the contrast material–distended anterior capsular space (arrow). Compare this appearance with that of the normal middle GHL in Figure 8a.



a. b.

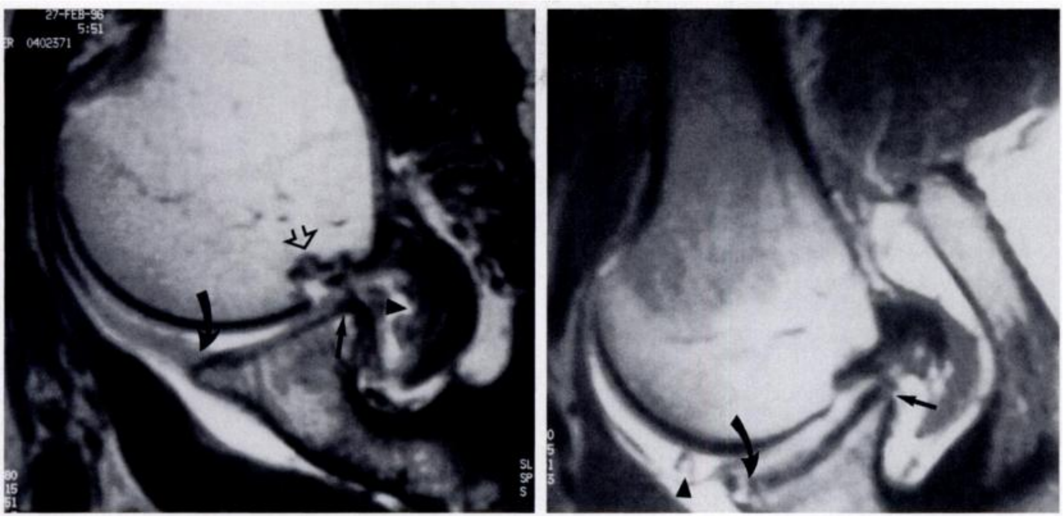
Figure 17. Posterior labral tear. **(a)** Drawing shows a tear of the posterior labrum (arrow). **(b)** Axial MR arthrogram shows a tear of the posterior labrum (straight arrow). There is also an anterior labral tear (curved arrow) and an intraarticular loose body (arrowhead).

• GHL Tear

Tears of the GHLs can occur without associated labral tears (Fig 16). Signs of a GHL tear at MR imaging include thickening, a wavy and irregular contour, and increased signal intensity.

■ POSTERIOR GLENOHUMERAL INSTABILITY

Posterior shoulder dislocation most often occurs as a result of violent muscle contraction due to electric shock or seizures. After the acute episode of dislocation, the arm frequently remains locked in adduction and internal rotation. Posterior instability caused by repeated microtrauma without frank dislocation may



b.

c.

a.

Figure 18. ABER position. **(a)** Oblique sagittal MR arthrogram along the longitudinal axis of the humerus shows a normal glenohumeral joint in the ABER position. Note the stretched anterior band of the inferior GHL (straight solid arrow) attached to the anteroinferior labrum (curved arrow) and humeral neck (arrowhead). Note also the supraspinous tendon inserting into the greater tuberosity (open arrow). **(b)** MR arthrogram shows the shoulder in the ABER position in a patient with posterosuperior glenoid impingement syndrome. There is impaction at the level of the humeral head (open arrow), a tear of the posterosuperior labrum (straight solid arrow), poor definition and abnormally high signal intensity of the anteroinferior labrum (curved arrow), and marked irregularity of the inferior margin of the supraspinous tendon (arrowhead). **(c)** MR arthrogram shows the shoulder in the ABER position in a patient with multidirectional instability. There is a tear of the anterior labrum (curved arrow), an attenuated labrum (straight arrow), and an intraarticular loose body (arrowhead).

cause persistent shoulder pain in young athletes. Abduction, flexion, and internal rotation are the mechanisms involved in these cases (swimming, throwing, punching). Such shoulder pain may also be associated with posterior capsular laxity. The following lesions may occur during posterior dislocation or in cases of repeated microtrauma: posterior labral tear (Fig 17); posterior capsular stripping or laxity; fracture, erosion, or sclerosis and ectopic ossification of the posterior glenoid fossa; and vertical impacted fracture of the anterior aspect of the humeral head (reverse Hill-Sachs lesion, McLaughlin fracture).

Posterosuperior glenoid impingement syndrome refers to shoulder pain induced by placing the arm in the ABER position. This condition has been reported in the throwing athlete; some degree of anterior instability may be present. The ABER position causes anterior subluxation of the humerus with impingement of the humeral head against the posterosuperior labrum and associated damage to the rotator cuff and humeral head (Fig 18) (18).

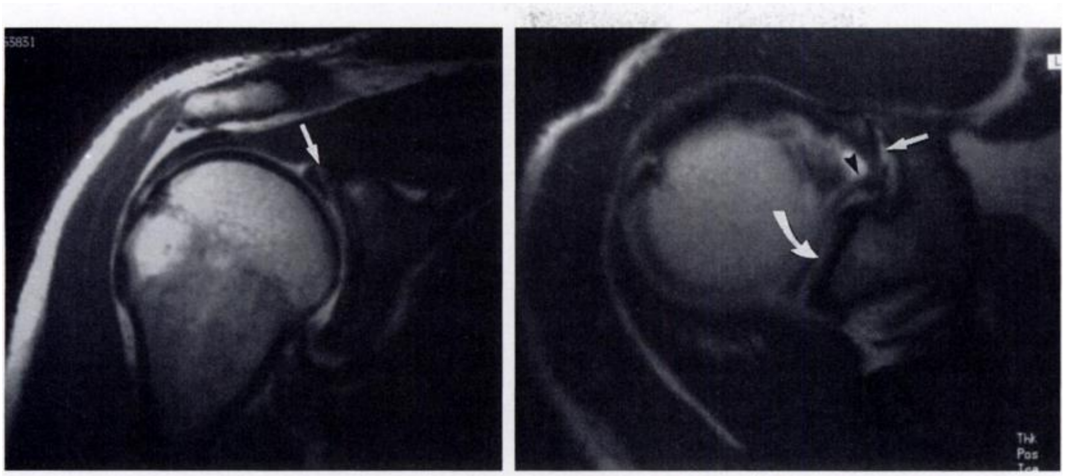
a. b.

c. d.

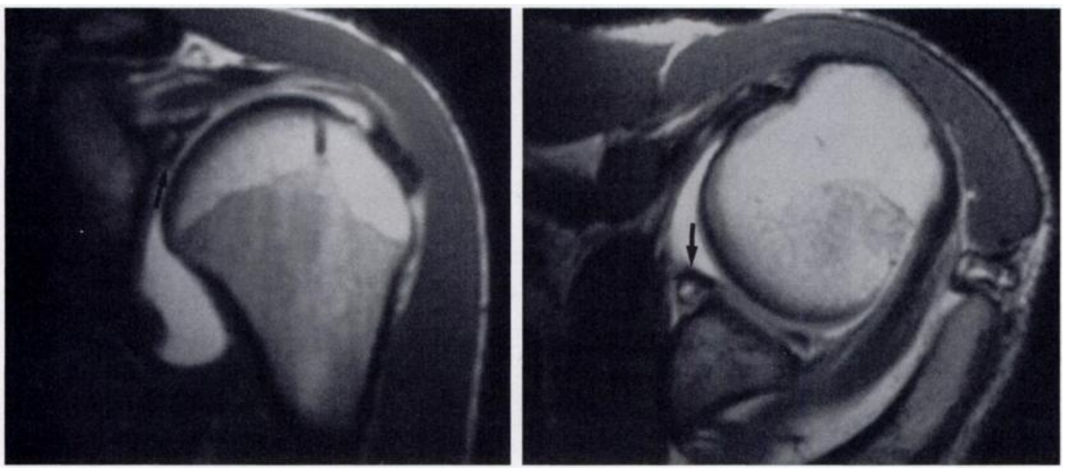
Figure 19. Types of SLAP lesions. **(a)** Drawing shows a type I lesion. There is a partial tear of the LHBT at the labral insertion. The labrum is normal. **(b)** Drawing shows a type II lesion. The LHBT and the anterosuperior labrum are detached from the glenoid margin. **(c)** Drawing shows a type III lesion. There is a bucket-handle tear of the labrum with a fragment displaced inferiorly. **(d)** Drawing shows a type IV lesion. There is a bucket-handle tear of the labrum with a longitudinal tear of the LHBT.

■ SLAP LESIONS

SLAP lesions are rare, occurring in 3.9% of patients undergoing arthroscopy. These lesions involve the superior part of the labrum with varying degrees of biceps tendon involvement. Pain, clicking, and occasional instability in a young patient are the typical clinical manifestations. SLAP lesions have been classified into four



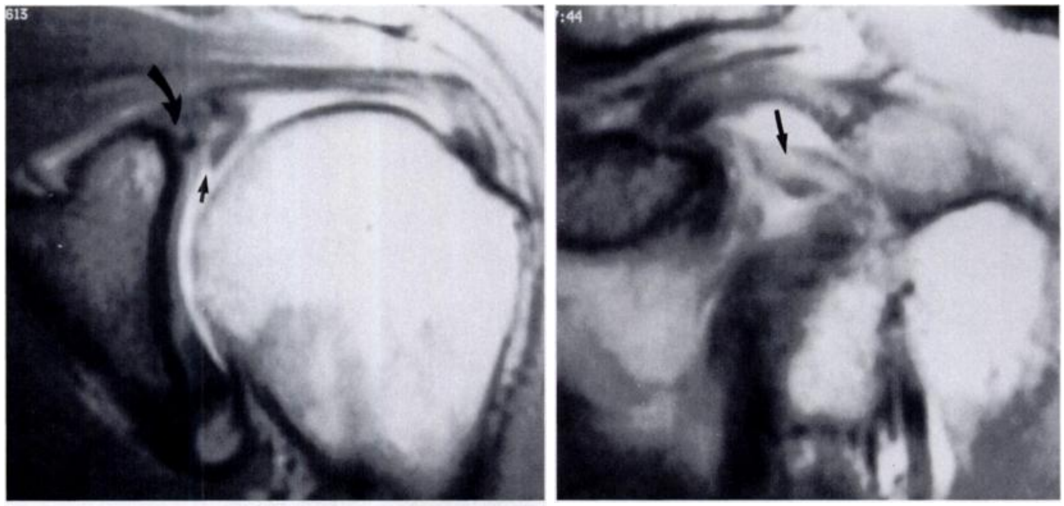
20a. **20b.**



21a. **21b.**

Figures 20, 21. **(20)** Type II SLAP lesion. **(a)** Oblique coronal MR arthrogram shows a tear involving the insertion of the LHBT and the superior labrum (arrow). **(b)** Axial MR arthrogram shows the superior (curved arrow) and anterior (arrowhead) extensions of the labral tear. The superior labrum and the superior GHL are detached together from the glenoid margin (straight arrow). Compare this appearance with that of the normal insertion of the superior GHL in Figure 5. **(21)** Type III SLAP lesion. **(a)** Oblique coronal MR arthrogram shows a tear of the superior labrum, which is slightly displaced inferiorly (arrow). **(b)** Axial MR arthrogram shows the anterior extension of the labral tear (the "Cheerio" sign) (arrow).

types on the basis of arthroscopic findings (Fig 19) (22–24): Type I is a tear of the superior part of the labrum with an intact LHBT. Type II is avulsion of the LHBT with a tear of the anterior and posterior labrum (Fig 20). Type III is a bucket-handle tear of the labrum (Fig 21). Type IV is a bucket-handle tear of the labrum with a longitudinal tear of the LHBT (Fig 22).



a. b.

Figure 22. Type IV SLAP lesion. **(a)** Oblique coronal MR arthrogram shows a fragment of the superior labrum displaced inferiorly and interposed between the humerus and the glenoid fossa (straight arrow). Note the irregularity at the insertion of the LHBT (curved arrow). **(b)** Oblique coronal MR arthrogram obtained anterior to **a** shows thickening of the LHBT and a longitudinal area of increased signal intensity within the LHBT (arrow), indicating a longitudinal tear. Such a longitudinal tear should not be present in the other types of SLAP lesions.

MR arthrography may demonstrate the following signs of a SLAP lesion: (*a*) contrast material extending into the glenoid attachment of the LHBT on oblique coronal images, (*b*) irregularity of the insertion of the LHBT on oblique coronal and oblique sagittal images, (*c*) accumulation of contrast material between the labrum and glenoid fossa on axial images, (*d*) displacement of the superior labrum on oblique sagittal and oblique coronal images, and (*e*) a fragment of the labrum displaced inferiorly between the glenoid fossa and humeral head. To our knowledge, the accuracy of MR arthrography for the detection and classification of SLAP lesions has not been determined.

■ CONCLUSIONS

MR arthrography is superior to other imaging techniques in the evaluation of glenohumeral instability. This technique is better than conventional MR imaging for visualization of capsulolabral and ligamentous structures. The information provided by MR arthrography may have surgical implications: Arthroscopic débridement is often performed in cases of labral separation, but capsular reconstruction is preferred in cases of involvement of the inferior GHL and capsule. The need for institutional review board approval, the invasiveness and added cost of the technique, and the cumbersome scheduling are significant disadvantages of MR arthrography.

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