Review

MR Arthrography of Rotator Interval, Long Head of the Biceps Brachii, and Biceps Pulley of the Shoulder[1]

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The rotator interval and the long head of the biceps brachii tendon are anatomically closely associated structures believed to confer stability to the shoulder joint. Abnormalities of the rotator interval may be acquired or congenital and are associated with instability of the long head of the biceps brachii tendon. Clinical and arthroscopic diagnoses of rotator interval abnormalities and subtle instability patterns of the long head of the biceps brachii tendon are difficult. Magnetic resonance arthrography, owing to its superior depiction of ligaments with distention of the joint capsule, may be the procedure of choice, barring open surgery, for help in diagnosis of these conditions.

Growing emphasis has been put on previously neglected structures in the anterosuperior aspect of the shoulder: the rotator interval. Orthopedic surgeons and radiologists alike are focusing on this area because of a prevalent view in the orthopedic and anatomic literature that links passive shoulder stability with the structural integrity of the rotator interval and the long head of the biceps brachii tendon, which are both intimately associated anatomically and functionally (1–3).

There is a spectrum of abnormalities that involve the rotator interval complex, which encompass various rotator interval tears and associated instability patterns of the long head of the biceps brachii tendon. In this article, we will review the anatomy and biomechanics of the structures that compose the rotator interval, and we will present examples of pathologic conditions.

ANATOMY

The shoulder comprises four layers that overlie and support the glenohumeral joint. The most superficial layer consists of the deltoid and pectoralis muscles and the overlying fascia. The second layer is formed by the clavipectoral fascia, the conjoined tendon of the short head of the biceps and coracobrachialis originating from the coracoid apex, the coracoacromial ligament, and the scapular fascia. The third layer includes the rotator cuff. The deepest layer is the glenohumeral joint capsule (4).

The glenohumeral joint capsule is a continuous cylinder between the humerus and the glenoid and is composed of three layers: a synovial lining on the articular surface, a subsynovial layer with loosely packed collagen, and a relatively thicker bursal surface layer consisting of dense collagen (5,6). The thin capsular tissue is reinforced by bandlike collagenous thickening, termed *ligaments*—specifically, the superior glenohumeral, the middle glenohumeral, the inferior glenohumeral, and the coracohumeral ligaments, which form a distinct *z*-shaped pattern (7,8). The inferior glenohumeral ligament complex is a hammocklike structure with anchor points on the anterior and posterior glenoid and attachment to the humeral head. The middle glenohumeral ligament originates at the supraglenoid tubercle and anterosuperior region of the labrum and blends distally with the subscapularis tendon. Both the superior glenohumeral and the coracohumeral ligaments traverse the rotator interval (9).

ESSENTIALS

- *MR arthrography appears to be a promising imaging modality for evaluation of the rotator interval through the distention of the capsule and depiction of the associated ligaments.*
- *Diagnosis of injury to the rotator interval capsule, the coracohumeral ligament, and the long head of the biceps brachii tendon is important given their presumed role in glenohumeral joint stabilization.*
- *The intraarticular portion of the long head of the biceps brachii tendon is intimately associated with the coracohumeral and the superior glenohumeral ligaments, which, together with superior fibers from the subscapularis tendon, act as a pulley that keeps the long head of the biceps brachii tendon from subluxating or dislocating.*
- *Instability patterns of the long head of the biceps brachii tendon vary according to the injured supporting structure.*
- *Structures within the rotator interval are an anatomic and functional unit, and injury to one of the components may have associated findings in other portions of the rotator interval, including the long head of the biceps brachii tendon.*

The rotator interval is a triangular anatomic area defined superiorly by the anterior edge of the supraspinatus tendon and inferiorly by the superior edge of the subscapularis tendon (Figs 1, 2). The base of this triangle is at the base of the coracoid process, and its apex is at the transverse ligament over the bicipital groove. The rotator interval is bridged by the glenohumeral joint capsule, the superior glenohumeral ligament, the coracohumeral ligament, and crisscrossing fibers from the supraspinatus and subscapularis tendons (1,10,11).

The coracohumeral and superior glenohumeral ligaments, two distinct structures with separate origins and insertions, are considered part of the rotator interval (Fig 3). In the majority of shoulders, the coracohumeral ligament is a well-developed structure (1,12). Neer et al (12) identified the coracohumeral ligament as a clear, well-developed structure in 59 of 63 shoulder dissections. The remaining four shoulders had either a vestigial or a missing coracohumeral ligament.

The coracohumeral ligament originates at the lateral aspect of the base of the coracoid. Distally, the ligament forms two major bands. The larger lateral band inserts on the greater tuberosity and on the anterior border of the supraspinatus tendon, while the smaller medial band crosses over the intraarticular biceps tendon to insert on the lesser tuberosity, the superior fibers of the subscapularis, and the transverse ligament (Fig 4) (1,13). The smaller of the two ligaments—the superior glenohumeral ligament—originates at the supraglenoid tubercle; it blends distally with the coracohumeral ligament and inserts on the lesser tuberosity (Fig 5) (1,9). The subscapularis tendon and supraspinatus tendon insertion fibers blend with the coracohumeral ligament at its insertion and are thus intimately associated (1,2).

The long head of the biceps brachii tendon arises from the supraglenoid tuberosity and the superior labrum. The main labral attachment varies, arising from the posterior, the anterior, or both aspects of the superior labrum (14). The long head of the biceps brachii tendon traverses the rotator interval on its course from the bicipital-labral anchor to the bicipital groove. The intraarticular portion of the biceps tendon has an intimate association both anatomically and functionally with the rotator interval (Fig 6). The coracohumeral ligament and superior glenohumeral ligament form a sling-like band surrounding the biceps brachii tendon proximal to the bicipital groove (1,15) (Fig 7). The medial portion of the coracohumeral ligament, the superior glenohumeral ligament inserting on the lesser tuberosity, and the superior fibers from the subscapularis tendon are believed to act as a pulley, which is critical in keeping the biceps tendon from subluxating or dislocating (Figs 5, 8). Injuries to this structure have been termed *pulley lesions* (1,16).

GLENOHUMERAL JOINT STABILITY AND THE ROTATOR INTERVAL

The precise role that structures in the rotator interval play in static and dynamic stabilization of the glenohumeral joint is debated. In a cadaveric study, Harryman et al (13) demonstrated instability or dislocation of the glenohumeral joint inferiorly and posteriorly after section of the rotator interval capsule. Alternatively, imbrication of this part of the capsule increased resistance to inferior and posterior translation. Some cases of capsular redundancy that led to instability were associated with redundancy in the bicipital sheath or coracohumeral ligament. It was shown that although the coracohumeral ligament adds to joint stability through its structural presence, the rotator interval capsule maintains negative pressure in the joint, thereby contributing its part to the stability (1,2,17).

The presumed role in stabilization of the joint has led some orthopedic surgeons to surgically treat isolated rotator interval defects in the unstable shoulder. During open surgery, the rotator interval defects are freshened by removing granulation and scar tissue. The edges are then approximated or closed in an overlapping manner. In some cases, redundant rotator interval tissue is fashioned into a functional coracohumeral ligament. Overlapping of lax superior glenohumeral ligaments may also be performed (18).

In a similar fashion, some authors have professed a role for the long head of the biceps tendon in anterior stability of the shoulder, thereby explaining observations of a tendency for anterior shoulder subluxation in patients with a ruptured biceps tendon (19). Itoi et al (20) replaced the long head and the short head of the biceps brachii tendon with spring devices in 13 cadaveric shoulders. The shoulders were put into different angles of abduction with different loads on the long head and the short head of the biceps brachii tendons while a 1.5-kg anterior force was applied with the capsule either intact, vented, or damaged by a Bankart lesion. The conclusions were that both the long head and the short head of the biceps brachii tendon have a role as anterior stabilizers to the glenohumeral joint with the arm in abduction and external rotation.

This role increases as shoulder stability decreases. Data from a study by Rodosky et al (21), who used a dynamic cadaveric shoulder model, suggest that the long head of the biceps brachii tendon contributes to anterior stability of the glenohumeral joint by increasing the shoulder's resistance to torsional forces in the abducted and externally rotated position. In addition, the long head of the biceps brachii tendon helps diminish stress on the inferior glenohumeral ligament. A role in superior stabilization of the humeral head has also been attributed to the tendon of the long head of the biceps

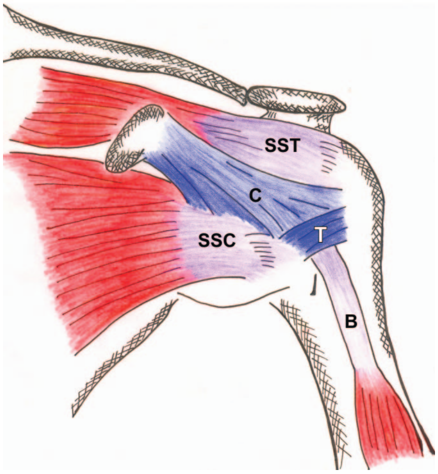
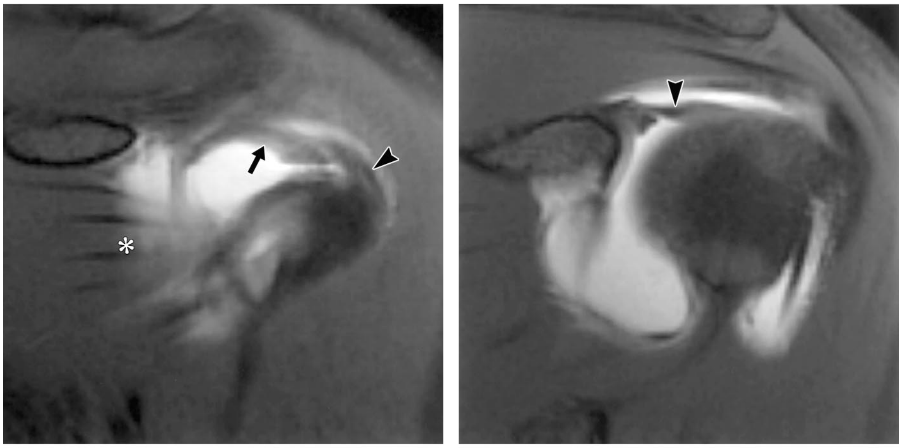


Figure 1. Illustration of rotator interval anatomy. Frontal view depicts anatomic boundaries of rotator interval. *B* = long head of biceps brachii tendon, *C* = coracohumeral ligament, *SSC* = subscapularis tendon, *SST* = supraspinatus tendon, *T* = transverse humeral ligament.



a. **b.**

Figure 2. Normal anatomy as depicted on coronal oblique T1-weighted magnetic resonance (MR) arthrographic images (repetition time msec/echo time msec = 700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. **(a)** Rotator interval is anatomically defined by superior border of subscapularis tendon (*) and anterior border of supraspinatus tendon. Also shown is distal portion of normal coracohumeral–superior glenohumeral ligamentous anchor (arrow) at site of insertion on the lesser tuberosity medial to and intimately associated with the long head of the biceps brachii tendon (arrowhead in **a** and **b**). Long head of the biceps brachii tendon slips over the coracohumeral–superior glenohumeral ligamentous anchor to insert on the superior labrum, as shown on **(b)** subsequent image. The "pulley" effect of this ligamentous anchor can be inferred from **a**.

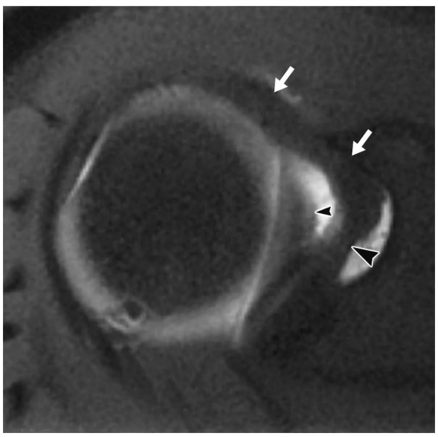


Figure 3. Normal anatomy as depicted on transverse T1-weighted MR arthrographic image (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. Proximal portions of coracohumeral ligament (arrows), superior glenohumeral ligament (large arrowhead), and nearby long head of biceps brachii tendon (small arrowhead) are shown. Coracohumeral ligament is well defined because of adjacent contrast agent. Note normal relationship between the smaller superior glenohumeral ligament as it joins the relatively more robust coracohumeral ligament.

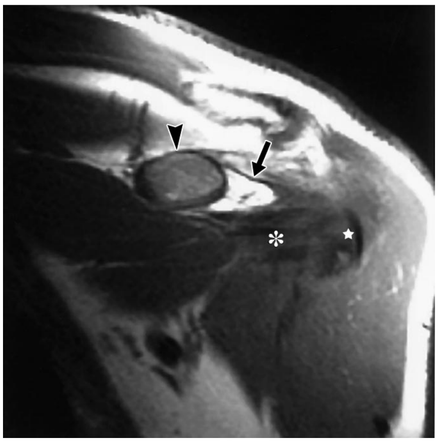


Figure 4. Coracohumeral ligament on nonarthrographic coronal T1-weighted MR image (700/10). A portion of coracohumeral ligament (arrow) can be seen arising from the coracoid process (arrowhead) to insert, in a broad fashion, on lesser tuberosity (star) and on distal portion of subscapularis tendon (*).

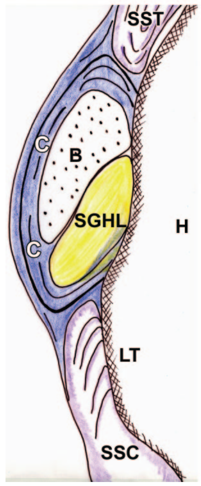


Figure 5. Illustration shows distal portion of coracohumeral ligament *(C)* and superior glenohumeral ligament *(SGHL)* near their insertions. Sagittal oblique view depicts distal portion of the coracohumeral and superior glenohumeral ligaments superior to lesser tuberosity *(LT)* and just medial to long head of biceps brachii tendon *(B)* entering the bicipital groove. *H* = humeral head, *SSC* = subscapularis tendon, *SST* = supraspinatus tendon.

brachii tendon (22,23), although electromyographic studies have yielded conflicting evidence (24,25).

EVALUATION OF THE ROTATOR INTERVAL

The clinical manifestation of injury to the rotator interval or biceps brachii tendon may be nonspecific chronic shoulder pain and instability (1–3,26). The instability may be in an anterior direction, manifesting with recurrent anterior subluxations associated with rotator interval defects, rotator interval widening, and injury (27–29). A clinical manifestation of posterior and multidirectional glenohumeral joint instability has been associated with rotator interval injury (30,31). Superior glenohumeral joint instability may occur with rupture of the long head of the biceps brachii tendon (23), while inferior instability in certain shoulder positions may occur as part of specific ligamentous injury involving the superior glenohumeral ligament or coracohumeral ligament (9,17,32).

The nonspecific clinical manifestation underlines the importance of diagnostic imaging. Rotator interval abnormalities have been called "hidden" lesions—a phrase first used by Walch et al (16). This term indicates the difficulty with arthroscopic identification. The usual lax ap-

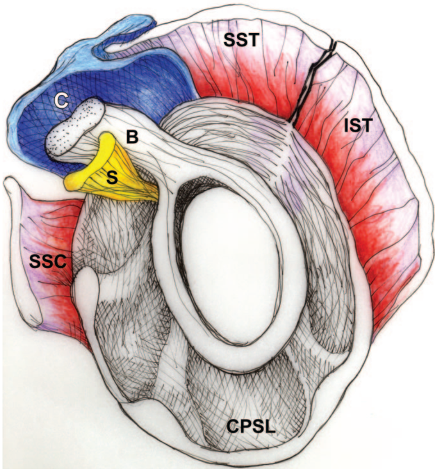


Figure 6. Illustration in coronal plane depicts association between long head of biceps brachii tendon *(B)*, coracohumeral ligament *(C)*, and superior glenohumeral ligament *(S)* medially. *CPSL* = glenohumeral capsule, *IST* = infraspinatus, *SSC* = subscapularis, *SST* = supraspinatus.

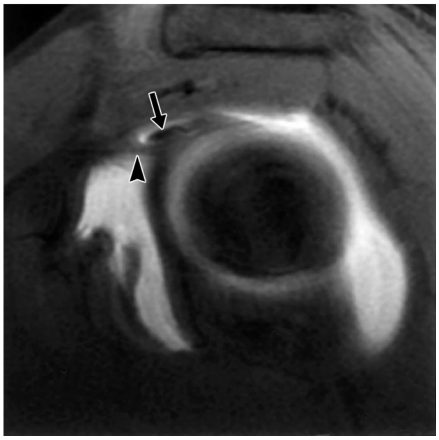


Figure 7. Normal anatomy depicted on sagittal T1-weighted MR arthrographic image (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. Long head of biceps brachii tendon (arrow) enveloped by contrast agent–distended "sling" (arrowhead) formed by coracohumeral and superior glenohumeral ligaments.

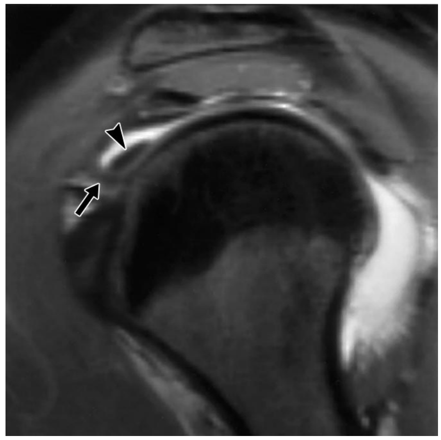


Figure 8. Normal anatomy as depicted on sagittal T1-weighted MR arthrographic image (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. Blended coracohumeral and superior glenohumeral ligaments (arrow) trace inferiorly and medially to long head of the biceps brachii tendon (arrowhead) before inserting on lesser tuberosity.

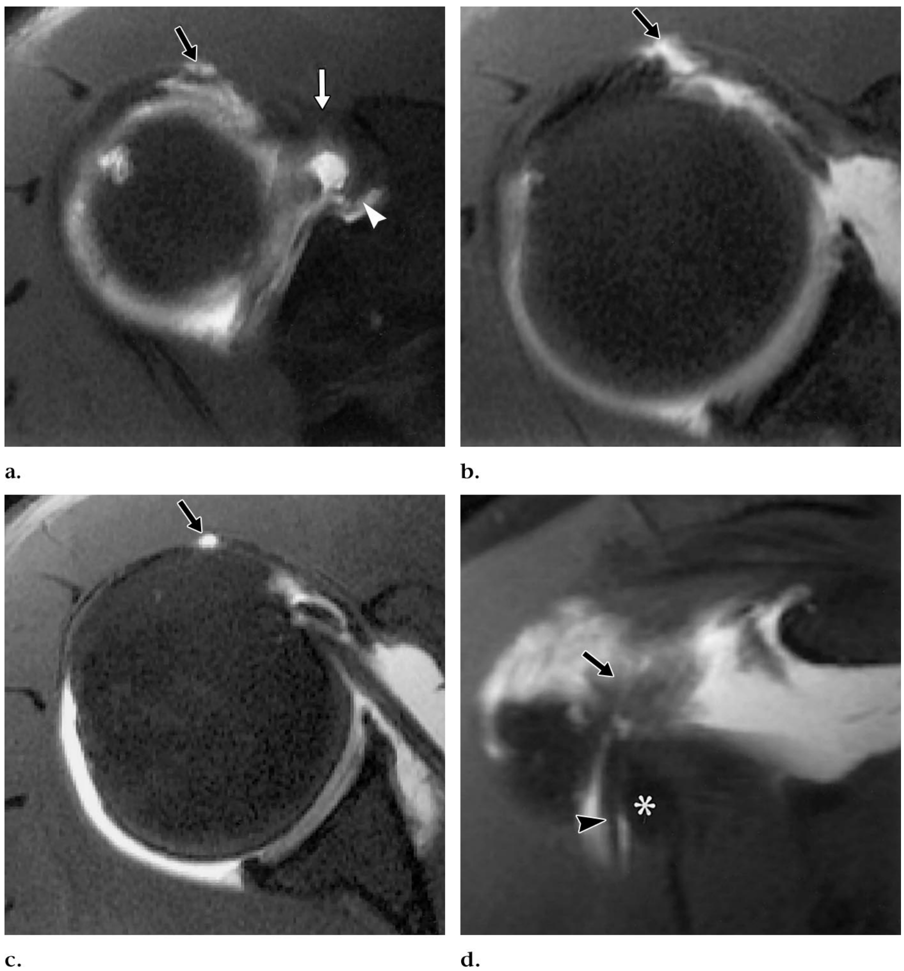
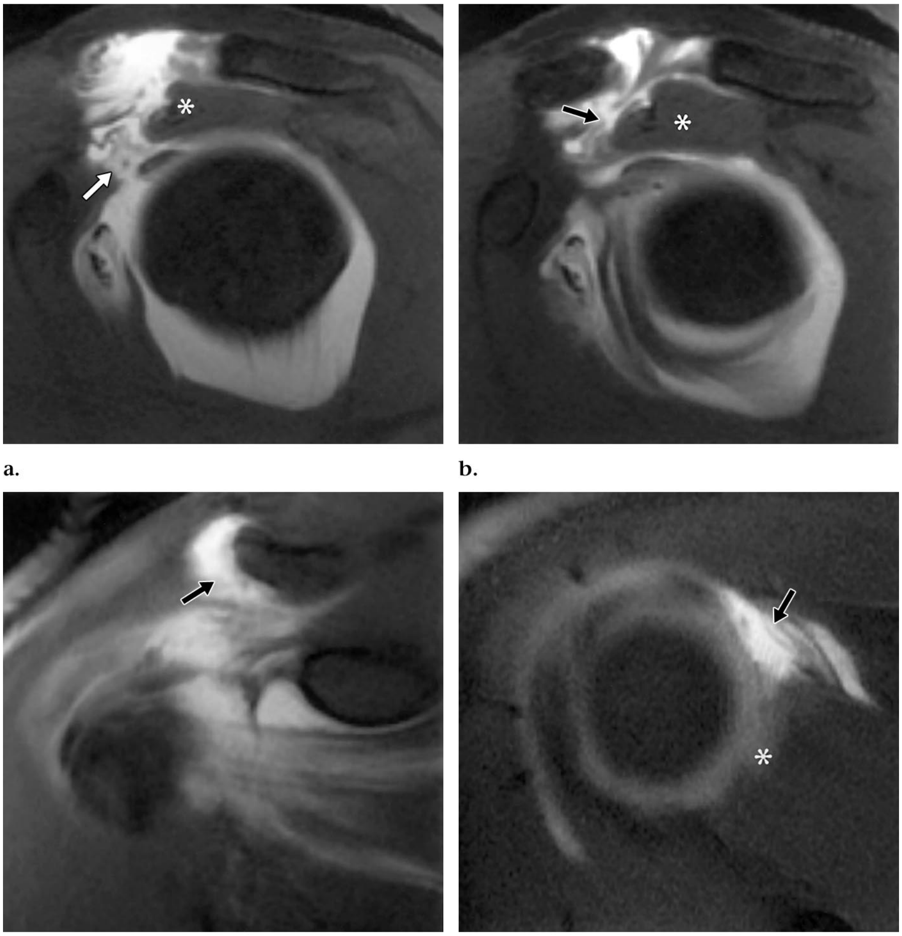


Figure 9. Arthroscopically confirmed partial tear of bicipital sling. **(a–c)** Transverse and **(d)** oblique coronal T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. **(a–c)** Contrast agent is seen leaking (black arrow) in an irregular fashion through long focal cleft extending superiorly from lateral portion of rotator interval inferiorly and laterally through lateral portion of bicipital sling. Arrowhead = superior glenohumeral ligament, white arrow = coracohumeral ligament. **(d)** Thickened irregular tissue (arrow) is seen at area of bicipital sling above superior aspect of the lesser tuberosity (*), just medial to long head of biceps brachii tendon (arrowhead).

pearance of the anterior capsule and glenohumeral ligaments (18) and possible obscuration of anatomy during anterior portal arthroscopy (15) are possible explanations for this difficulty. In a study by Field et al (18), 15 patients with surgically proved rotator interval defects were retrospectively evaluated. Twelve rotator interval defects measured 1–5 cm in medial-to-lateral width and 1–4 cm in superior-to-inferior height, while the remaining three cases were described as "large/very large." Preoperative MR imaging was performed in four cases, but the reports failed to comment on capsular irregularity. Three arthroscopic procedures performed in two patients before definitive

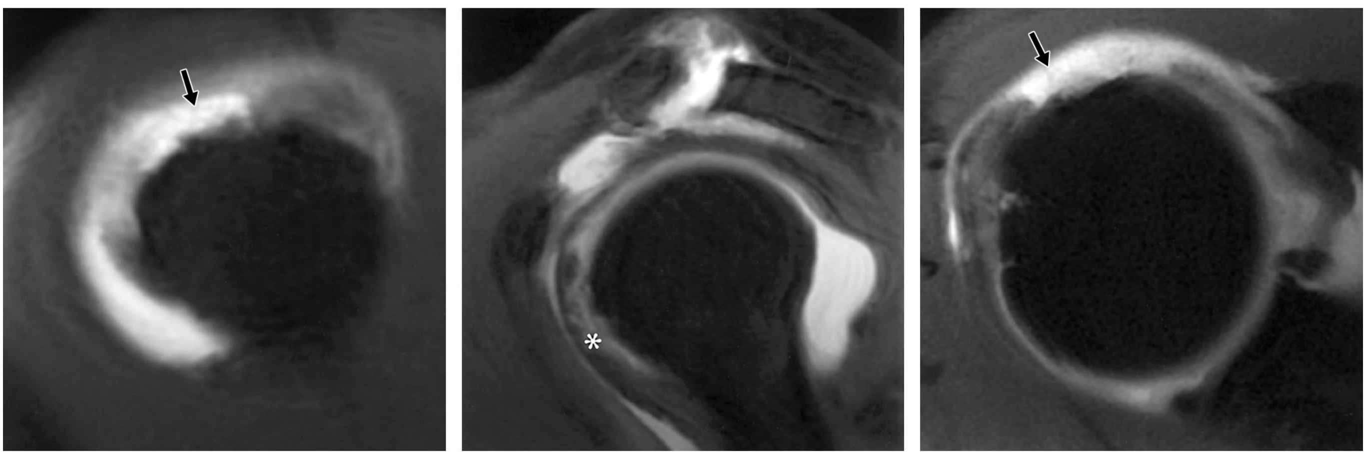


a. b. c. d.

Figure 10. Arthroscopically proved rotator interval defect after acute injury to shoulder. **(a, b)** Sagittal, **(c)** coronal oblique, and **(d)** transverse T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound show contrast agent extravasating (arrow) through large defect in the rotator interval anterior to supraspinatus musculotendinous junction (*).

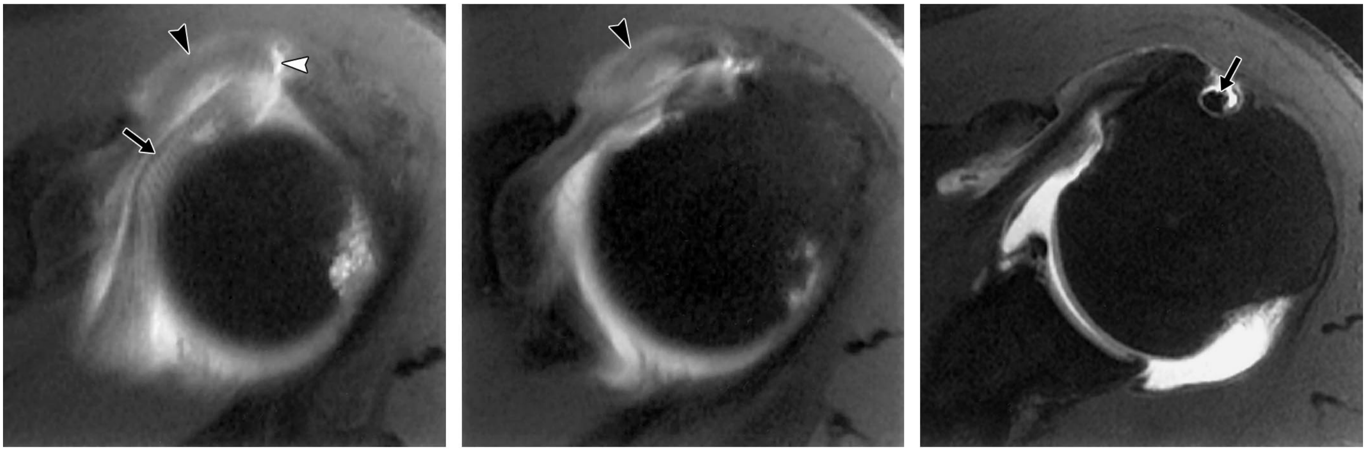
surgery had also failed to help identify rotator interval capsular defects. In an additional series by Le Huec et al (33), preoperative MR imaging with no intraarticular contrast agent failed to demonstrate surgically proved rotator interval capsular tears. Missed rotator interval lesions can be one of the reasons for failed arthroscopic glenohumeral instability repair (29). Rotator interval lesions and bicipital instability with associated biceps tendon injury not addressed during the arthroscopic rotator cuff repair may be a cause for persistent pain (18,34–36).

Evaluation of shoulder instability routinely entails an MR arthrogram, which is indicated mainly for assessment of the labrum. In a cadaveric study by Chung et al (37), the normal rotator interval anatomy was well demonstrated with MR arthrography, which was found to be superior to nonarthrographic MR imaging in depicting normal rotator interval structures. The dimensions of the rotator interval could be depicted on sagittal images obtained after MR arthrography, while the coracohumeral ligament was seen inconsistently and the superior glenohumeral ligament was not clearly identified on nonarthrographic MR images. Ho (38) presented nonarthrographic MR images of rotator interval injuries but did not compare this modality with MR arthrography. Small rotator interval defects or tears not identified at routine MR imaging may be seen at MR arthrography, with a distended joint and possible extraarticular contrast agent leak that fills an anatomic space such as the subcoracoid space (33,39). Subtle irregu-



a. b. c.

Figure 11. Anterior extension of supraspinatus tendon tear (arrow) to involve the subscapularis tendon (*). **(a, b)** Sagittal (**a,** more medial; **b,** more lateral) and **(c)** transverse T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. In this setting, rotator interval injury should be suspected.



a. b. c.

Figure 12. Arthroscopically proved rotator interval defect with thickened, scarred, and redundant rotator interval tissue. The subscapularis tendon was partially torn, with long head of the biceps brachii tendon encased by bone. **(a–c)** Transverse T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound show thickened tissue of rotator interval (black arrowhead). High-signal-intensity cleft in **a** is consistent with contrast agent extension (white arrowhead). Long head of biceps brachii tendon (arrow) is almost completely encased by bone.

larities and fraying may be better demonstrated by observing contrast agent surrounding the coracohumeral ligament, superior glenohumeral ligament, and biceps brachii tendon. Contrast agent that extends over the superior aspect of the humeral tuberosities, which are normally covered by the attaching pulley ligaments, may be the only sign of a subtle pulley tear (16)—an "uncovered" humeral tuberosity. Subluxation of the biceps brachii tendon may also be intermittent, and associated injury to the supporting structures is often the only clue to possible biceps subluxation on static images (38,40).

ROTATOR INTERVAL ABNORMALITIES

Rotator interval abnormalities encompass a spectrum of disease that may be acquired or congenital in nature. Rotator interval injury can occur as a result of a chronic derangement such as anterior instability with repetitive dislocations, acute trauma, or as part of a more diffuse degenerative process with accompanying rotator cuff tears (41,42). Injury to the rotator interval and biceps tendon can occur in an isolated fashion in the overhead-throwing athlete or in occupational injury associated with overhead labor, which repetitively stress these structures (2,38,43,44).

In the acute setting, the rotator interval capsule may be thickened, irregular, or disrupted (Fig 9) (38). As many as 50% of surgically treated cases of glenohumeral instability may have defects in the rotator interval capsule (28) (Fig 10), which are isolated findings in some cases (18). A rotator interval tear after acute trauma may extend to involve the subscapularis tendon (33). Alternatively, a rotator interval injury may occur as an extension of injury from the adjacent rotator cuff (26) (Fig 11). An arthroscopic evaluation by Bennet (2) revealed that 47% of subscapularis tendon tears involved the superior glenohumeral and medial coracohumeral ligaments. The proximal portion of the coracohumeral ligament and the distal portion of the superior glenohumeral ligament were found to be prone to injury (45). One must also be aware that rotator interval defects may be congenital, with similarity between fetuses and adults in terms of capsular defects (46). Patients with a ro-

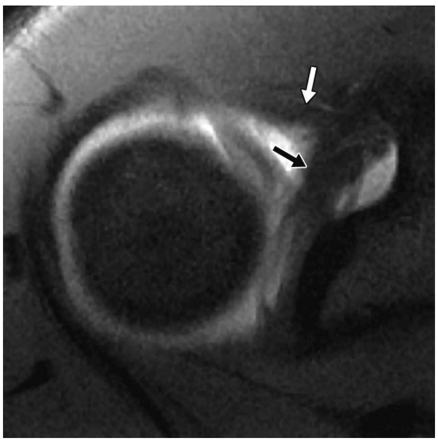


Figure 13. Arthroscopically confirmed injury with fraying of superior glenohumeral ligament. Transverse T1-weighted MR arthrographic image (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. Superior glenohumeral ligament (black arrow) is thickened and slightly irregular. A normal superior glenohumeral ligament is usually smaller than the coracohumeral ligament (white arrow).

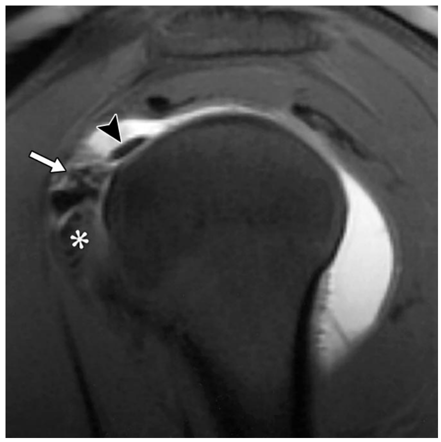
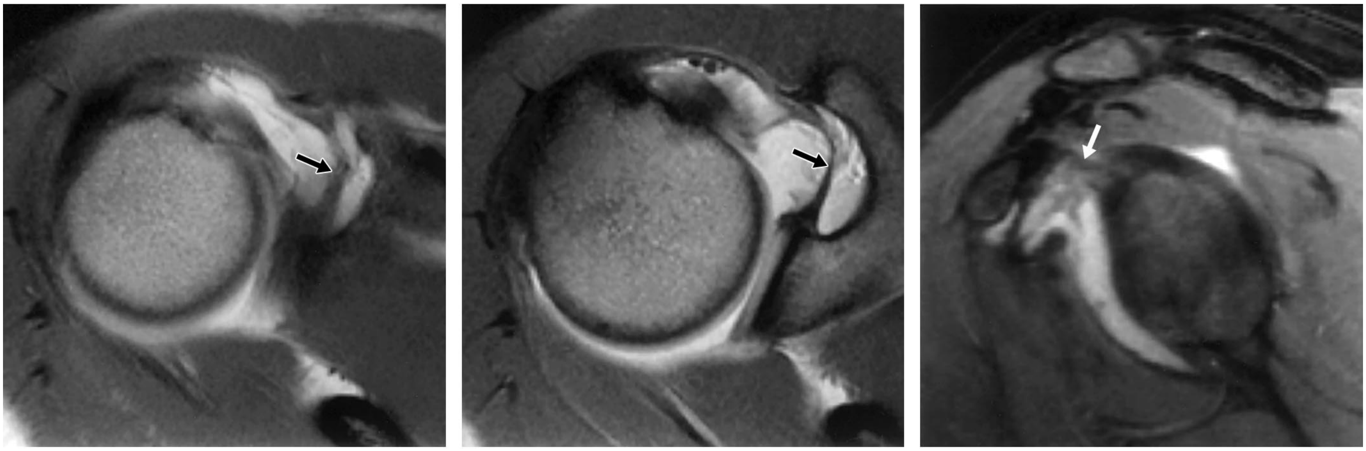
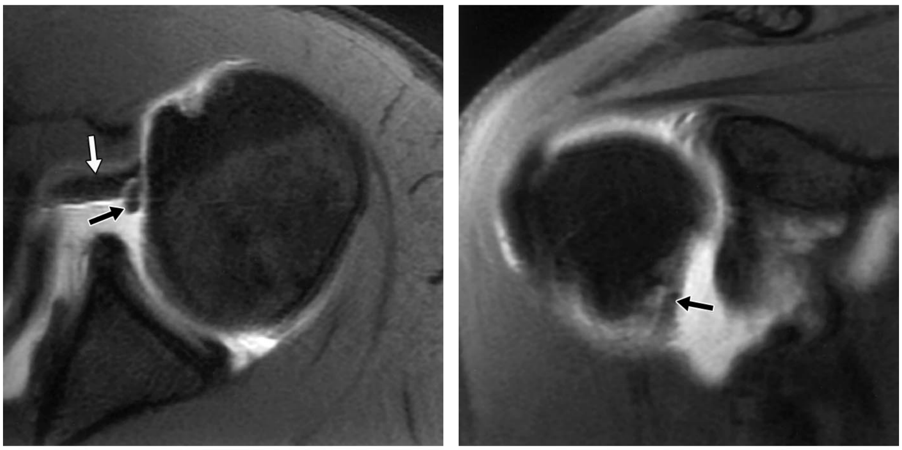


Figure 14. Arthroscopically proved bicipital sling injury with intact subscapularis tendon. Sagittal T1-weighted MR arthrographic image (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound. Bicipital sling (arrow) is thickened and inhomogeneous, with high signal intensity. Arrowhead = long head of biceps brachii tendon, * = subscapularis tendon. Compare with Figure 4.



a. b. c.

Figure 15. Arthroscopically confirmed injury to superior glenohumeral ligament on T1-weighted MR arthrographic images (700/10) obtained with intraarticular administration of dilute gadolinium compound. **(a, b)** Transverse images and **(c)** sagittal image obtained with fat saturation show attenuated and slightly irregular superior glenohumeral ligament (arrow). Compare with normal anatomy in Figure 2.



a. b.

Figure 16. Intraarticular dislocation of long head of biceps brachii tendon (black arrow). **(a)** Transverse and **(b)** coronal oblique T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound show medial displacement of tendon of long head of the biceps brachii. Also shown is torn and retracted subscapularis tendon (white arrow).

tator interval defect may be predisposed to additional injury due to humeral head instability (18).

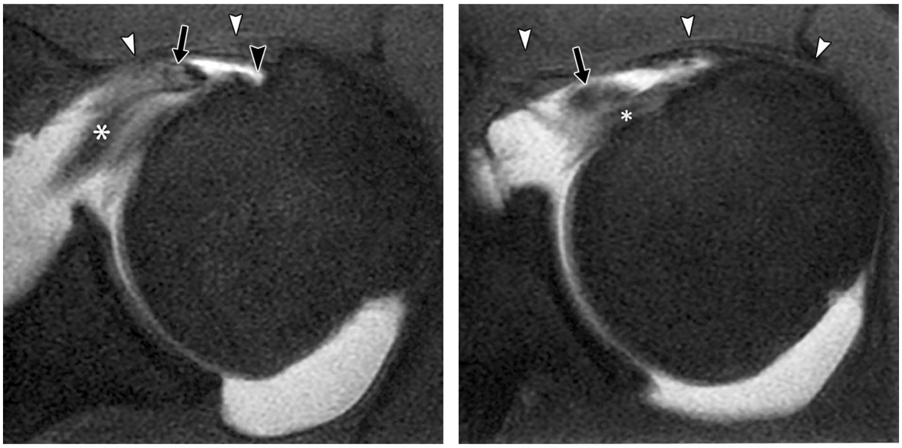
In chronic settings, the rotator interval capsule and ligaments may be thickened and scarred (Figs 12–14) with associated synovial hypertrophy and debris (38) or attenuated (Fig 15). Nobuhara and Ikeda (10) described two types of rotator interval lesions in unstable shoulders without prior trauma; their report was based on surgical observation, arthrographic findings, and motion analysis. They described type 1, a contracted state associated with inflammatory changes in superficial bursal area, and type 2, an unstable condition with inflammation in the rotator interval deep to the superficial bursae extending to the capsule and coracohumeral and superior glenohumeral ligaments. Hypertrophy of the synovium; hypertrophy, elongation, or tear of the middle glenohumeral ligament; and granulation tissue over the long head of the biceps brachii tendon and adjacent subscapularis may be seen. An association has been found between adhesive capsulitis and contractures of the coracohumeral ligament and rotator interval. Ozaki et al (47) described 17 patients with recalcitrant chronic adhesive capsulitis. At surgery, the major cause of restricted glenohumeral movement was found to be contracture of the coracohumeral ligament and the rotator interval. With an average 6.8 years of follow-up, pain relief and restoration of motion were shown in all patients after the contracted tissues were released. The rotator interval may also enlarge in a shoulder with multidirectional instability without an apparent full-thickness tear (42).

BICEPS BRACHII TENDON INSTABILITY

Instability of the long head of the biceps brachii tendon is a possible complication of pulley lesions. Walch et al (35) retrospectively evaluated surgical reports in 445 patients who had previously been treated for rotator cuff injury. Subluxations and dislocations of the long head of the biceps brachii tendon were found in 16% of the patients during surgery. Dislocation, defined as nonreducible and complete loss of contact between the long head of the biceps brachii tendon and the bicipital groove, was identified in 46 cases. Subluxation, which was surgically identified in cases where the long head of the biceps brachii tendon lies across the superior portion of the lesser tuberosity, with possible associated biceps tendonitis, was seen in 25 cases. All biceps tendon dislocations medial to the lesser tuberosity were accompanied by tears of the ligamentous pulley, while only some of the subluxations at the lesser tuberosity were accompanied by an attenuated ligamentous pulley. The transverse ligament overlying the bicipital groove is not considered a crucial stabilizing structure unless the medial coracohumeral ligament is torn (3,48). In a shallow bicipital groove, the possibility of subluxation of a tendon is potentially greater (43,48).

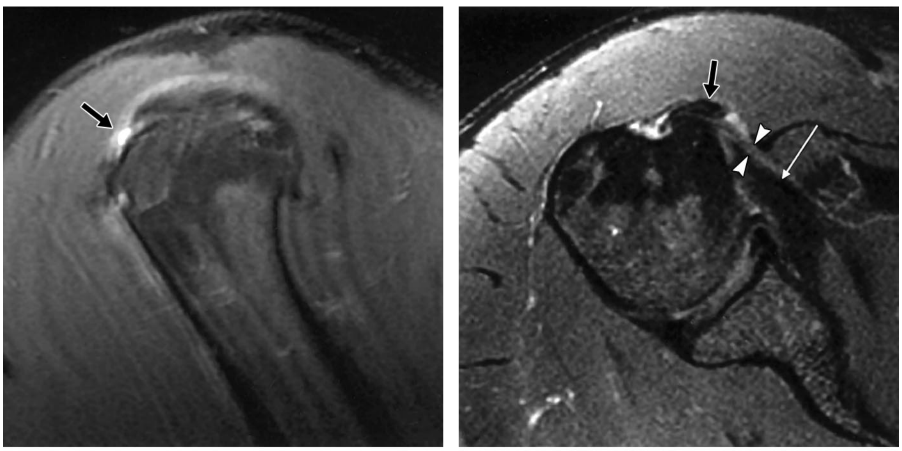
There are different patterns of biceps subluxation, which are dependent on the supporting structures injured: the coracohumeral–superior glenohumeral sling, the coracohumeral ligament, the subscapularis tendon, or injuries to a combination of structures (19,48). Biceps brachii instability patterns have been arthroscopically classified into four basic types according to the direction of the biceps tendon subluxation or dislocation (2): intraarticular, between the coracohumeral ligament and subscapularis tendon, external to the coracohumeral ligament, and within the biceps tendon sheath. Intraarticular dislocations (Fig 16) with the biceps tendon entering the medial joint space can occur only if both the insertion of the subscapularis tendon and the superior glenohumeral–medial coracohumeral ligaments are torn. Lesions of the superior glenohumeral–medial coracohumeral complex with an intact lateral coracohumeral ligament may allow the biceps to subluxate between the subscapularis tendon and the coracohumeral ligament (Fig 17). A supraspinatus tear that extends to involve the lateral coracohumeral ligament may allow the biceps tendon to subluxate medially superficial to the coracohumeral ligament and subscapularis tendon in an extracapsular location (Fig 18). Isolated subscapularis tendon tear (Fig 19) will not result in subluxation of the tendon (2,49), but there may be increased biceps tendon motion secondary to plastic deformation of the medial portion of the ligamentous sling (2). There may also be variations in lesions of the rotator interval (2) (Fig 20).

Tears of the far lateral portion of the anterior edge of the supraspinatus tendon may be associated with injury to the biceps tendon and rotator interval (48). Isolated tears of this portion of the supraspinatus tendon in the presence of an intact rotator interval may also cause biceps instability due to loss of tension of the rotator interval and pulley mechanism (16,26,38).



a. b.

Figure 17. Arthroscopically confirmed subluxated and partially torn long head of biceps brachii tendon (arrow) and partially torn subscapularis tendon. **(a, b)** Transverse T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound show long head of biceps brachii tendon is surrounded by contrast agent anterior to the superficial subscapularis tendon fibers (*), deep to the coracohumeral ligament (white arrowheads). Black arrowhead = bicipital groove.

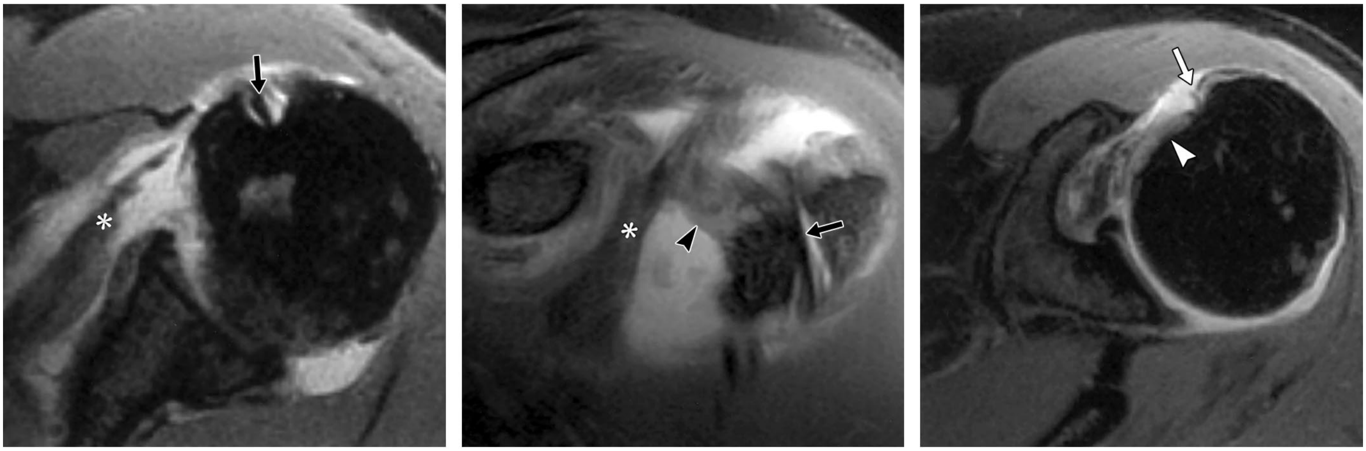


a. b.

Figure 18. Anterior supraspinatus tendon tear with associated medial subluxation of long head of biceps brachii tendon. **(a)** Sagittal and **(b)** transverse intermediate-weighted MR images (2500/28) obtained with fat saturation. **(a)** Distal anterior supraspinatus tendon tear (arrow) is visible. **(b)** Long head of biceps brachii tendon (black arrow) shows medial subluxation superficial to the subscapularis tendon (white arrow). Intermediate-signal-intensity linear structure (arrowheads) superficial to subscapularis tendon and deep to biceps tendon is compatible with coracohumeral ligament. Empty bicipital groove is fluid filled.

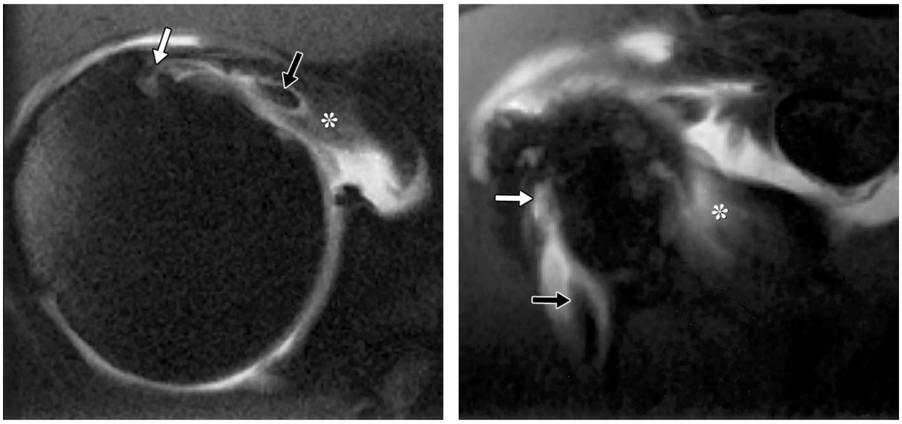
SUMMARY

The active pursuit of rotator interval abnormalities by orthopedic surgeons with intention to treat as part of shoulder instability surgery or rotator cuff repair or as a solitary finding necessitates a greater awareness by radiologists of this relatively neglected region. MR arthrography appears to be a promising modality for the evaluation of the rotator interval through the distention of the capsule and the depiction of associated ligaments. The importance of MR arthrography in depiction of these lesions is compounded when considering the difficulty in evaluating these structures both clinically and arthroscopically. Sagittal or transverse T2-weighted MR sequences may assist in identifying injury in cases without a definite contrast agent leak. When evaluating the rotator interval, it must be recognized that the different structures composing or traversing this area are a functional and anatomic unit. Injury to one of the components may be associated with findings in other parts of the rotator interval or in the long head of the biceps brachii tendon. Understanding of function through the anatomy is



a. b. c.

Figure 19. Extensive subscapularis tendon tear with nondislocated tendon of long head of the biceps brachii. **(a, c)** Transverse and **(b)** coronal intermediate-weighted MR images (2500/28) obtained with fat saturation. **(a, b)** Acute shoulder injury with “natural” arthrogram effect due to intraarticular fluid. Complete tear of subscapularis tendon (*) is visible, but long head of biceps brachii tendon (arrow) is still held in the groove by thickened pulley ligaments (arrowhead). **(c)** Section cranial to **a** shows superior portion of lesser tuberosity covered by thickened irregular tissue (arrowhead), consistent with injured but not completely disrupted medial pulley ligament complex, with partial volume averaging of long head of biceps brachii tendon proximal to entrance to the groove. Lateral portion of sling appears to be injured (arrow).



a. b.

Figure 20. Arthroscopically proved delamination-type tear of subscapularis tendon with extremely degenerative and frayed long head of biceps brachii tendon subluxated into y-shaped split. **(a)** Transverse and **(b)** coronal T1-weighted MR arthrographic images (700/10) obtained with fat saturation after intraarticular administration of dilute gadolinium compound show split subscapularis tendon (*) with subluxated long head of biceps brachii tendon (black arrow). White arrow = bicipital groove.

key in making diagnoses of subtle findings that may otherwise be missed and left untreated.

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