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Case report 815

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Clinical information

The patient is a 67-year-old right-handed male who fell and injured his left shoulder. He denied dislocation at the time of the injury as well as in the past. Radiographs revealed minimal degenerative changes of the acromioclavicular joint and a 3-mm calcific deposit in the supraspinatus tendon near its insertion. The acromiohumeral distance was normal, as was glenohumeral alignment. No fractures were identified. Magnetic resonance imaging (MRI) performed elsewhere 1 week later showed that the supraspinatus tendon was intact (1.5 T, frontal oblique plane, double echo, 5 mm thick at 4-mm intervals). Conservative treatment consisting of ultrasound, range of motion exercises, and physical therapy provided minimal relief. Subacromial injections of lidocaine and betamethasone were performed on two different occasions, which resulted in immediate but only temporary improvement in pain and range of motion. Treatment with nonsteroidal medications was not attempted since the patient had a history of peptic ulcer disease.

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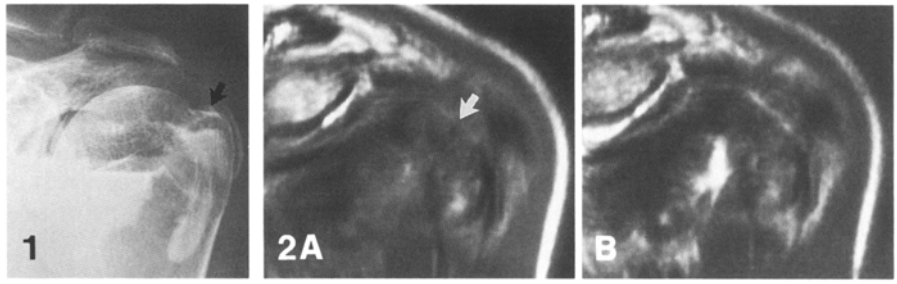
Diagnosis: Tear of the rotator interval

Six months following injury, a double contrast arthrogram was obtained. The glenohumeral joint was shown to communicate with the subacromial-subdeltoid bursa (Fig. 1), but the site of the tear could not be identified. Retrospective review of the MRI revealed a thin band of fluid between the supraspinatus and subscapularis tendons, at the rotator interval (Fig. 2).

The patient was taken to the operating room for open subacromial decompression and cuff repair. Exploration of the rotator cuff revealed a 2.5-cm tear at the rotator interval (Fig. 3). The tear did not extend into the surrounding tendons. The tear was repaired, and the patient was discharged home the following day. At 1-year follow-up, the patient was pain-free and had recovered full active range of motion.



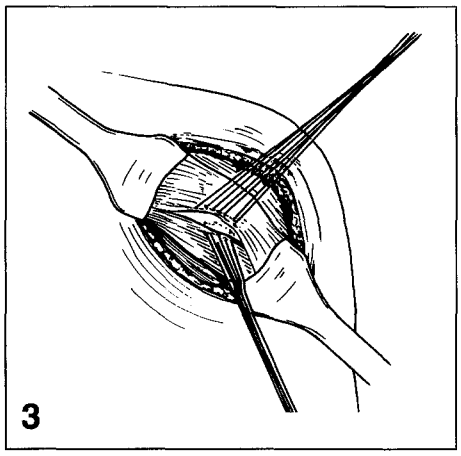


Fig. 1. External rotation anteroposterior view from double contrast arthrogram. Air and positive contrast fill the subacromial-subdeltoid space, but the site of the tear is not evident. Note focus of calcific tendinitis (*arrow*)

Fig. 2A, B. Frontal oblique magnetic resonance imaging through the anterior aspect of the humeral head. **A** SE 2000/20. Ill-defined intermediate signal intensity is seen at the interval (*arrow*) between the supraspinatus and subscapularis tendons. **B** SE 2000/70. A well-defined band of high signal intensity is now evident at the rotator interval

Fig. 3. Appearance of the tear at surgery. Sutures placed in the supraspinatus and subscapularis tendons are retracted to expose the tear

Discussion

The radiological diagnosis of rotator cuff tear has undergone dramatic evolution over the past decade. Arthrography, considered the gold standard for years, has been repeatedly shown to be an accurate means of detecting full-thickness tears and partial-thickness tears of the deep surface of the cuff. Arthrography is, however, invasive, and fails to detect partial-thickness tears which involve only the superficial cuff. More recently, MRI has been employed in the detection and documentation of rotator cuff disease [1–3, 8, 9]. While the literature has shown that this technique is sensitive and accurate, these reports either address only tears of the substance of the supraspinatus tendon [9], do not indicate the location of the tear within the cuff [1], or utilize the terms "rotator cuff" and "supraspinatus tendon" interchangeably [2, 3, 8]. Although the supraspinatus tendon is the most common site for tears of the cuff, failure to recognize MR changes associated with tears in less common locations will result in false negative diagnoses.

Anatomists and clinicians alike refer to the tendons of the rotator cuff as separate entities. In reality, however, the cuff tendons progressively interdigitate with each other such that at the insertion they are inseparable one from another. The portion of the cuff that we refer to as the supraspinatus, infraspinatus, subscapularis, and teres minor tendons are, therefore, primarily a reflection of the location of the tendon within the cuff.

The "rotator interval" was initially described in relation to proximal humeral fractures [4], and refers to the ligamentous region between the supraspinatus and subscapularis tendons. The presence of this interval is due to the protrusion of the coracoid process between the supraspinatus and subscapularis muscles, which results in an "interval" within the cuff in which there is no tendon. The coracohumeral ligament lies superficial to the rotator interval, and the long head of the biceps tendon lies deep. The rotator interval is a common surgical route used to enter the joint for arthrotomy [9].

Most commonly, reported pathological features of the rotator interval are associated with glenohumeral dislocation [6]. In the young multidirectional dislocator, the interval may enlarge due to repetitive trauma. In this instance, arthrography will usually reveal ballooning of synovium through the interval rather than an actual tear. Individuals over the age of 40 years who experience an acute glenohumeral dislocation may actually tear the interval, with or without extension of the tear into the upper subscapularis tendon. These individuals usually have a conspicuous absence of previous impingement syndrome, and thus have not weakened the supraspinatus tendon. Although lesions of the rotator interval are most commonly associated with shoulder dislocation, there is also a group of patients with such lesions who lack glenohumeral instability [7].

The difficulty in diagnosing rotator interval tears with MRI is a reflection of the configuration of the tear and its location within the cuff. In addition, capsule and synovium may normally herniate through the interval in asymptomatic individuals.

Supraspinatus tendon tears are evident in MR images as a result of the fluid within the tear, which has

a high signal intensity in T2-weighted images [1, 2, 3, 9]. This finding is especially obvious in the case of large tears, where retraction allows pooling of fluid. Rotator interval tears, on the other hand, are thin and longitudinal, and are not associated with muscle retraction. Interval tears are therefore imaged as a thin band of fluid.

Interval tears occur in a location where most imagers are not accustomed to searching for cuff pathology, and where the routine planes used for image acquisition may not optimally display disease. Standard MRI of the shoulder utilizes the axial imaging to evaluate the glenoid labrum and the subscapularis musculotendinous unit, and the frontal oblique plane to display the supraspinatus portion of the cuff and the coracoacromial arc. The rotator interval is suboptimally visualized in both of these planes, as it is located at the anterosuperior convexity of the humeral head. Although not attempted in this case, sagittal imaging might have assisted in the diagnosis by displaying the tear in profile. Demonstration of fluid in the interval would not, however, be diagnostic because normal synovium and capsule may herniate through this space in the absence of a tear.

In *summary*, rotator interval tears are an uncommon, but clinically important subtype of rotator cuff tear. As MRI assumes an ever increasing role in the imaging evaluation of the painful shoulder, radiologists must be aware of this entity and appreciate the difficulty in diagnosing these tears with MRI. Differentiation of a true rotator interval tear from normal synovium and capsule in this space is most likely not possible with MRI, and symptoms may be referred and misleading. It is therefore important to correlate the MR findings with the clinical history and physical examination.

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