[Imaging]

Sports Medicine Imaging Update

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A healthy 18-year-old right-hand-dominant high school football player presented 6 weeks following an injury to his right shoulder. While playing right defensive end, the patient made an inside move on the opposing line-man, and another player collided with the medial aspect of his arm. The collision caused abrupt deceleration of both players and forced the injured player's humerus to externally rotate. The arm did not dislocate, and the patient did not describe any instability, but he did experience acute right anterior shoulder pain and transient numbness. He finished the game and continued to play football in the intervening weeks. Initially he experienced night pain, but his main symptom was loss of strength (weakness of internal rotation) and dysesthesias in his right deltoid. He kept his arm more adducted during subsequent games to avoid pain and found it necessary to elevate his arm in order to extend the humerus to tackle. Despite aggressive training, he was unable to regain strength.

Physical examination at presentation revealed a neurovascularly intact right upper extremity and good motion of the neck without pain. He showed no muscle atrophy but struggled to lift his right arm. He had a positive lift-off test and a positive O'Brien sign on the affected shoulder. Strength testing of the rotator cuff showed internal rotation weakness. His triceps muscle was strong, and his reflexes were rated as 2+ biceps and brachioradialis bilaterally, 1+ triceps on the left, and absent on the right. Electrodiagnostic testing showed no evidence of a brachial plexopathy.

Radiographs showed a small ossific density anterior and medial to the humeral head that was seen on the West Point (Figure 1) and Stryker Notch views, possibly indicating a lesser tuberosity avulsion fracture, but only noted following magnetic resonance imaging (MRI). Magnetic resonance imaging demonstrated an avulsion of the subscapularis tendon with a fragment of bone that was displaced posteromedially (Figures 1-3). The tear comprised more than 50% of the subscapularis footprint without dislocation of the long head of the biceps tendon from the intertubercular groove. The superior-most fibers of the subscapularis were intact. There was injury to the

Figure 1. West Point radiographic projection of the right shoulder demonstrate a small ossific density (arrow) anterior to the humeral head.

anterior capsule without humeral or scapular avulsion of the anterior band of the inferior glenohumeral ligament. There was no Bankart lesion.

At arthroscopy, a small split in the tissue overlying the subscapularis was identified; within this split, the tendon of the subscapularis was medially retracted. A small bone fragment was found at the edge of the retracted tendon. Debridement of the footprint of the subscapularis tendon was performed, and an anchor was placed. Debridement of the small bone fragment was also carried out, and the subscapularis was reattached directly using 2 sutures.

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Figure 2. Axial intermediate echo-time fast-spin-echo MRI of the right shoulder demonstrates the avulsion fragment (arrow) displaced medially into the defect created by the subscapularis tendon tear. The superficial fibers of the subscapularis tendon are hyperintense but not disrupted. MRI, magnetic resonance image.

Figure 3. Oblique sagittal intermediate echo-time fast-spin-echo MRI of the right shoulder demonstrates the avulsion fragment (arrow) surrounded by high-signal intensity fluid. Note the superior and anterior subscapularis tendon fibers, which were not disrupted, outline the retracted fragment. MRI, magnetic resonance image.

DISCUSSION

Isolated avulsion of the lesser tuberosity is an uncommon injury. A recent review by Levine et al⁵ identified 76 reported cases, with only 21 cases reported in adults younger than 20 years old. The most common mechanisms of injury are a fall on an abducted and externally rotated humerus, or a strong external rotatory stress exerted on an abducted humerus. At 90° of abduction, the tendon is relaxed, while the anterior band of the inferior glenohumeral ligament (AIGHL) is taut. Further abduction and external rotation of the humerus, with superimposed muscle contraction in the opposite direction, may avulse the lesser tuberosity or tear the subscapularis tendon.⁹ Shoulder positioning at the time of injury has some effect on the resultant tissue damage. At 0° of abduction, the subscapularis is the principal check to anterior dislocation, while at 0° to 45°, the subscapularis, middle glenohumeral ligament, and AIGHL restrict anterior translation. Not surprisingly, humeral avulsion of the glenohumeral ligament (HAGL) has been reported in association with bony avulsions of the subscapularis tendon.¹ Due to the close proximity and interdigitation of the fibers of the humeral insertions of the subscapularis tendon and the superior glenohumeral ligament/coracohumeral ligament complex (pulley

system), associated biceps tendon subluxation may occur with avulsion of the superior fibers of the subscapularis tendon.⁸

Most authors have found that either open reduction and internal fixation of lesser tuberosity fractures or direct repair of the subscapularis tendon have superior results compared to conservative treatment.^{4,6} Furthermore, early repairs consistently led to a favorable outcome, whereas delayed procedures had a less than satisfactory result.

The lesser tuberosity is seen en face on anteroposterior radiographs obtained in external rotation, thus only large or moderately displaced fractures will be demonstrated in this projection. Internal rotation projects the lesser tuberosity in profile and is more useful. However, the lesser tuberosity is best seen on axillary² or West Point views, thus small or minimally displaced fractures are better detected when using one of these projections.^{3,7,10} The radiographic appearance has been shown to overlap with the appearance of calcific tendinitis and bony humeral avulsion of the inferior glenohumeral ligament (BHAGL).^{2,3,6-8,10-11} The osseous fragment is easily identified with computed tomography (CT), but the improved soft tissue contrast afforded by MRI makes it ideally suited for characterizing the extent of associated soft tissue injuries, in addition to the ability to establish the size and position of the osseous fragment.

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