[Imaging]

MRI Challenge

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CHALLENGE

A 22-year-old professional baseball pitcher presents with persistent posterior shoulder pain after throwing. A fat-suppressed T2-weighted oblique coronal image and a gradient echo T2-weighted axial image are provided with relevant findings marked with arrows (Figures 1 and 2). What are the findings? What is your diagnosis?

FINDINGS

On Figure 1, the fat-suppressed T2-weighted coronal image, a small partial articular surface tear is evident at the anterior margin of the infraspinatus insertion.

Figure 1. The fat-suppressed T2-weighted coronal image shows a small partial articular surface tear (arrow) evident at the anterior margin of the infraspinatus insertion. Underlying subchondral cystic changes and reactive marrow edema (arrowhead) are seen within the greater tuberosity.

Underlying subchondral cystic changes and reactive marrow edema are evident within the greater tuberosity. On Figure 2, the gradient echo axial image shows a complex tear of the posterosuperior glenoid labrum.

DIAGNOSIS

Internal impingement.

DISCUSSION

The extreme stress placed upon the shoulder by the throwing athlete can result in numerous causes of shoulder pain, including rotator cuff tears, labral tears, subacromial impingement, and glenohumeral instability. Internal impingement, also known as posterosuperior glenoid impingement, is one of the most common causes of posterior shoulder pain in the throwing athlete. Although overhead-throwing athletes such as baseball pitchers, tennis players, and javelin

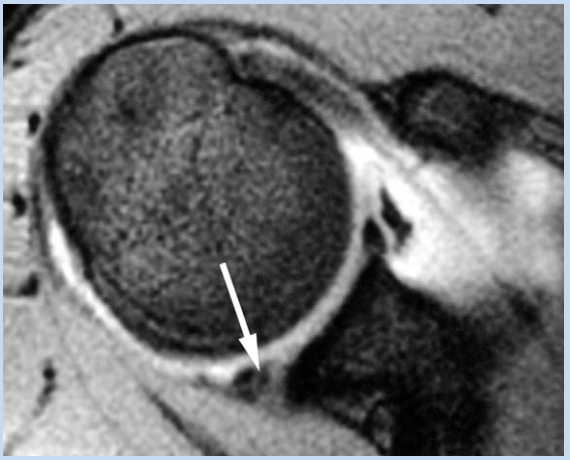

Figure 2. The gradient echo axial image reveals a complex tear of the posterosuperior glenoid labrum (arrow).

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throwers are the most at risk, internal impingement may also be seen in the general population due to occupational overhead lifting activities.

Walch et al first described internal impingement in 1992 in a study of 17 overhead-throwing athletes.[11] Walch found that in abduction and external rotation, contact occurs between the undersurface of the rotator cuff and the glenoid, and while the contact is physiologic, it may lead to disease when performed forcefully and repetitively, as in the throwing athlete (Figures 3 and 4). Jobe agreed with this concept and further expanded upon the entity[6,7] by proposing that instability caused by anterior capsular stretching in throwers allowed increased angulation/external rotation, thus increasing contact at the posterior superior glenoid. Although somewhat controversial, later work has supported the role of laxity in the pathogenesis of internal impingement.[2]

Pitchers with internal impingement typically report pain in the late cocking or early acceleration phase of throwing. The pain is usually described as posterior and occurs during and after throwing. With disease progression, loss of velocity and accuracy may ensue. On physical examination, posterior pain is re-created in abduction and external rotation. Loss of internal rotation and a positive relocation test (for instability) are common findings. Joint laxity is variably present.

Magnetic resonance imaging (MRI) is well recognized as an effective means to diagnose internal impingement of the shoulder.[4,5,10] The classic MRI findings of internal impingement, as seen in the current case, include partial articular surface tears at the posterior supraspinatus/anterior infraspinatus insertion, greater tuberosity cystic changes, and tearing of the posterosuperior glenoid labrum. This triad of structures has been documented via arthroscopy, MRI, and cadaveric studies to contact each other in the position of abduction and external rotation. Additional, less frequent findings of internal impingement include the presence of a Bennett lesion (mineralization of the posteroinferior glenoid),[12] posterior capsular contraction (indicative of a glenohumeral internal rotation deficit lesion),[2] and remodeling of the glenoid with focal alterations in glenoid version.

Although the classic MRI appearance of internal impingement involves the complete triad of findings discussed above (Figures 5 and 6), variations often occur in which lesions may predominate in 2 of the affected areas (Figure 7).

While acceptable accuracy may be achieved with noncontrast techniques performed with higher spatial resolution,[3,9] direct MR arthrography may improve the visualization of both labral tears and partial thickness articular side cuff tears.[10] We have been successful in visualizing internal impingement by using MRI following intravenous administration of gadolinium chelates. Immediate postcontrast imaging in patients with internal impingement reveals enhancement within articular surface rotator cuff tears and labral tears, and within humeral head osseous abnormalities (Figures 8 and 9).

The osteochondral lesions seen within the humeral head in internal impingement are of uncertain cause, and it should be noted that these cysts

Figure 3. Viewed from above, a pitcher in the late cocking phase of throwing places the shoulder into extreme abduction and external rotation.

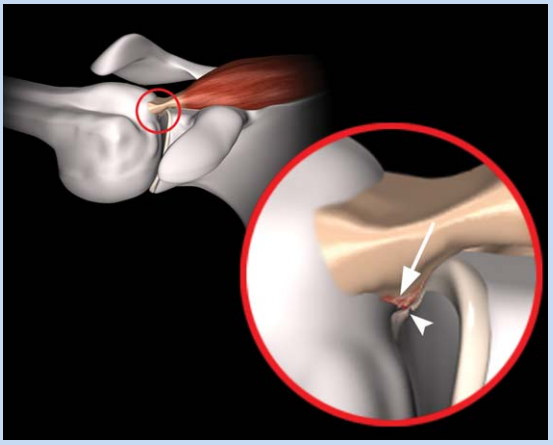

Figure 4. The close-up view of the superoanterior angle of Figure 3 demonstrates how the posterior supraspinatus may infold between the greater tuberosity and the posterior superior labrum. With forceful repetition, articular surface rotator cuff tears (arrow) and labral tears (arrowhead) result.

Figure 5. The fat-suppressed T2-weighted coronal image reveals a focal partial articular surface tear (arrow) at the anterior infraspinatus tendon. A large degenerative cyst (arrowhead) is seen within the adjacent greater tuberosity.

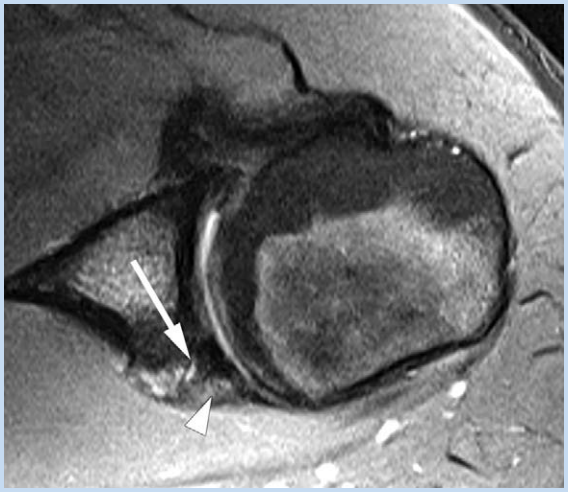

Figure 6. The fat-suppressed proton density-weighted image demonstrates irregular tearing along the base of the posterosuperior labrum (arrow), with adjacent posterior capsular thickening and ossification (arrowhead).

are nonspecific and are associated with rotator cuff pathology from causes other than internal impingement. In patients with internal impingement, some authors have suggested that the cystic changes within the humeral head in the throwing athlete are due to repetitive avulsive trauma caused by deceleration during the follow-through motion of throwing.[1] The anatomical relationships demonstrated

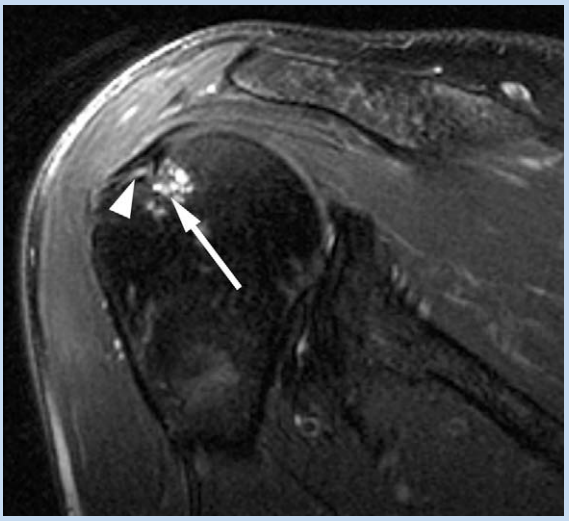

Figure 7. A fat-suppressed T2-weighted image in a professional baseball player with clinical signs of internal impingement reveals prominent cystic changes within the posterior greater tuberosity (arrow). Subtle articular surface partial tearing is seen at the anterior infraspinatus insertion (arrowhead). No labral tear was found in this patient.

in studies of internal impingement suggest impaction as perhaps a more likely cause.

Jobe has categorized the clinical presentation of internal impingement into 3 stages.[8] In stage I, athletes present with shoulder stiffness that requires an extended warm-up period. In stage II, patients complain of posterior shoulder pain and have a positive relocation test. This test, performed on the supine patient, causes apprehension when pressure is placed on the posterior aspect of the humeral head in abduction and external rotation. With a positive relocation test, pain and apprehension are relieved by application of pressure over the anterior humeral head. The relief of pain is presumably related to both a reduction of humeral head subluxation and disengagement of the rotator cuff from the region of internal impingement. Successful rehabilitation in stage II patients results in pain resolution and a negative relocation test. With stage III internal impingement, pain and a positive relocation test persist after rehabilitation. Jobe recommends that such patients require surgical repair of their rotator cuff and/or labrum as well as a modified anterior capsulolabral shift.[8]

CONCLUSION

Internal impingement is one of many potential causes of shoulder pain in the overhead-throwing athlete. The recognition on an MRI of the classic findings

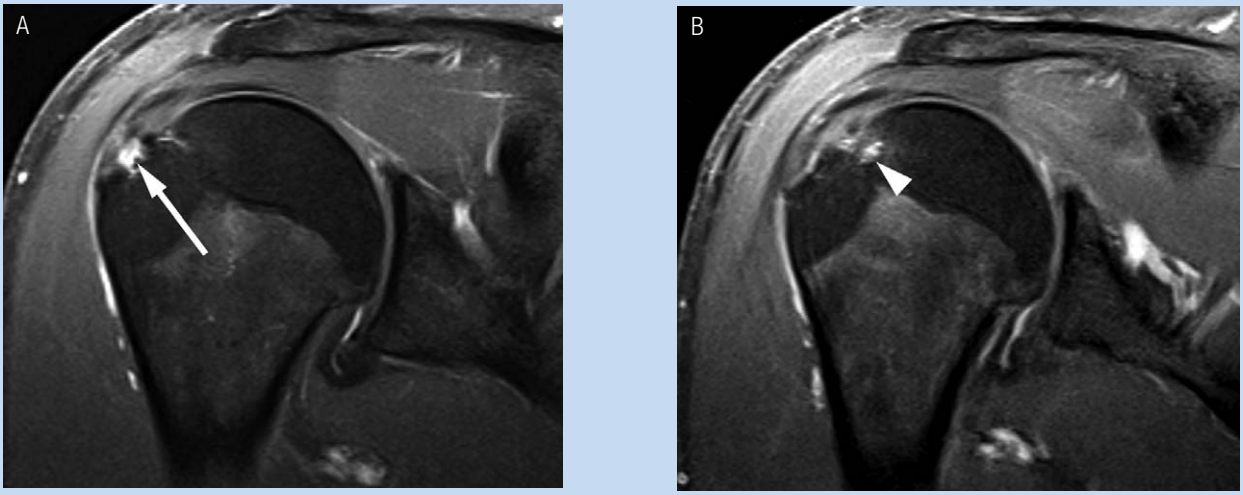

Figure 8. Fat-suppressed T1-weighted coronal images obtained following intravenous contrast administration in a professional baseball pitcher. Focal enhancement within a small partial articular surface supraspinatus tear (arrow) and within the adjacent greater tuberosity (arrowhead) is seen.

Figure 9. Fat-suppressed T1-weighted axial view demonstrates an irregular posterosuperior glenoid labrum (arrow).

of articular surface partial rotator cuff tears, greater tuberosity osseous lesions, and posterosuperior labral tears allows for an accurate diagnosis in such patients. As many clinicians suspect that instability is an important factor in the pathogenesis of internal impingement, the correct diagnosis is critical so that instability can be addressed as needed at the time of rotator cuff or labral repair, thereby increasing the chances for a successful operative outcome.

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