Pathomechanics and Magnetic Resonance Imaging of the Thrower's Shoulder

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KEYWORDS

• MR imaging • Throwing • Baseball • Shoulder • Rotator cuff • SLAP tear • Internal impingement • GIRD

KEY POINTS

- Overhead throwing generates supraphysiologic forces that lead to bone and soft tissue adaptations, chronic microtrauma, and eventually overt injury.
- Understanding the throwing motion can help radiologists understand the patterns of shoulder injury in overhead throwing athletes.
- MR imaging is useful for characterizing soft tissue and osseous changes that occur in overhead throwing athletes and can provide useful information for treatment.

INTRODUCTION

Overhead throwing by a baseball pitcher is perhaps the fastest human athletic movement. In this movement, humeral internal rotation has been documented to reach an angular velocity in excess of 7500°/s in professional athletes.[1] Such extreme velocity is achieved by the human body functioning as a kinetic chain, whereby the large muscles of the legs and trunk generate great force and transfer that energy through the shoulder and upper extremity to the ball at release.[2] Because of the complex anatomy, extremes of shoulder motion, and great force, a wide variety of injuries to the osseous and soft tissue structures of the shoulder and elbow may occur. This article focuses on the pathomechanics and MR imaging findings of overuse shoulder injuries encountered in throwing athletes.

NORMAL ANATOMY

The glenohumeral joint is a ball-and-socket joint with the greatest range of motion of all joints in the human body.[3] This range is achieved by the spherical humeral head being fitted into a cuplike depression of the bony glenoid, akin to a golf ball steadied atop a tee. To overcome the lack of osseous stability that comes with such freedom of motion, the shoulder has an elaborate system of static and dynamic soft tissue stabilizers.[4]

The static soft tissue stabilizers of the shoulder include the glenoid labrum, the glenohumeral ligaments, and the joint capsule (**Fig. 1**).[4] The glenoid labrum is a fibrocartilaginous structure that deepens the glenoid rim and provides a functional seal around the humeral articular surface, generating a weak vacuum effect that helps to keep the humeral head in place.[3] The anterior, middle, and

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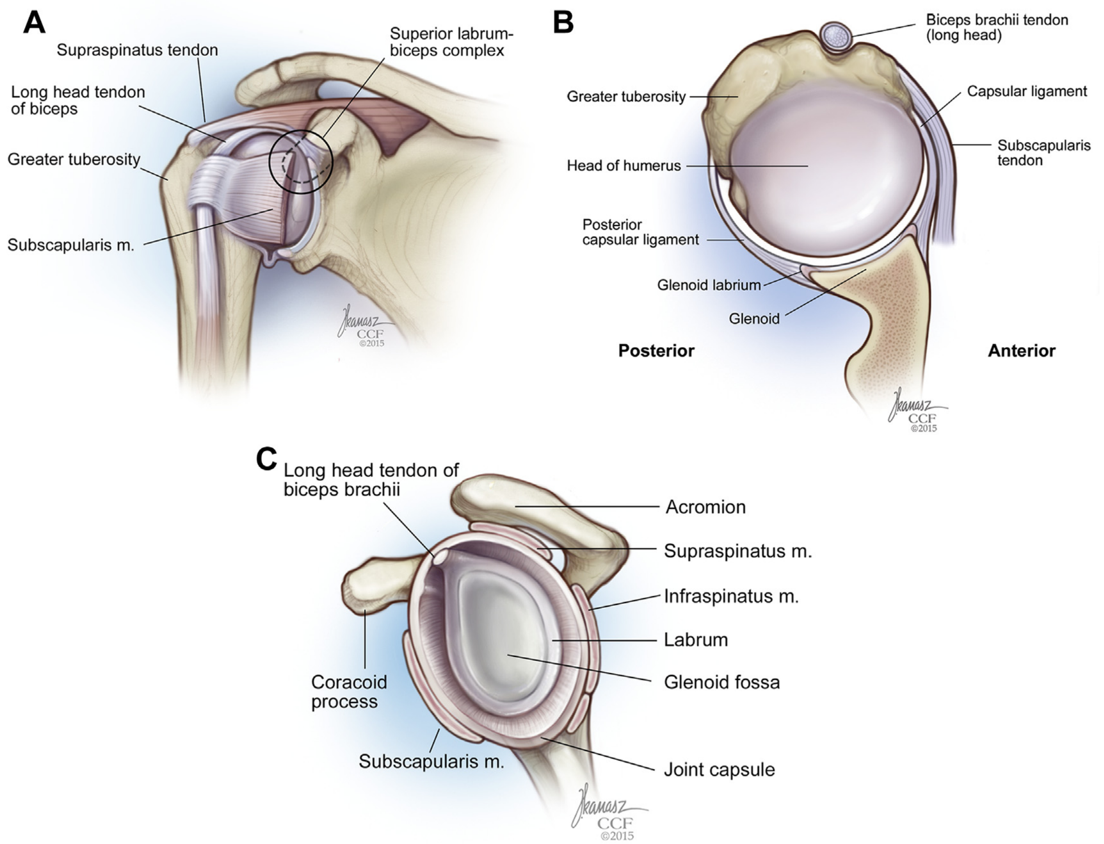

Fig. 1. Shoulder anatomy. (*A*) Anterior view of the shoulder. (*B*) Superior view. (*C*) Lateral view with humerus removed. Copyright © The Cleveland Clinic Foundation 2015.

inferior glenohumeral ligaments are focal thickenings of the joint capsule that help to resist excess motion and prevent shoulder dislocation.[4]

The dynamic stabilizers of the glenohumeral joint include the rotator cuff and the long head of the biceps tendon. The rotator cuff muscles and tendons encase the anterior, superior, and posterior aspects of the joint capsule, contracting and relaxing to resist humeral head decentering on the glenoid during shoulder motion.[4] The rotator cuff consists of 4 muscle-tendon units: the supraspinatus, infraspinatus, teres minor, and subscapularis.[3] The rotator cuff is the primary dynamic stabilizer of the glenohumeral joint.[4]

The long head of the biceps tendon and muscle reinforces the anterior-superior aspect of the glenohumeral joint.[4] It originates from the supraglenoid tubercle and passes anterolaterally over the humeral head, through the rotator interval between the supraspinatus and subscapularis tendons, and into the intertubercular groove inside a tendon sheath that is contiguous with the joint capsule.[3] The coracohumeral and superior glenohumeral ligaments, which abut the superficial side and undersurface of the long head of the biceps tendon in the rotator interval, form the biceps sling that stabilizes the biceps tendon and anterosuperior glenohumeral joint.[4]

MR IMAGING TECHNIQUE

MR imaging of the shoulder is optimally performed on either a 1.5-T or 3-T scanner (**Table 1**). Fat-suppressed fluid-sensitive sequences are useful for detecting subtle areas of injury-related edema in soft tissue structures and bone marrow. However, fat suppression results in a lower signal/noise ratio compared with non–fat-suppressed sequences. The use of intermediate-weighted sequences improves the signal/noise ratio compared with longer echo time (TE) T2-weighted sequences; however, these sequences are more prone to magic angle artifact than longer TE sequences. The authors typically rely primarily on intermediate-weighted sequences to evaluate the glenoid labrum and glenohumeral articular cartilage and confirm cuff disorders on longer TE T2-weighted sequences. The use of T1-weighted sequences or non–fat-suppressed proton-density or T2-weighted images