Shoulder Injuries in the Overhead Throwing Athlete

Ryan A. Mlynarek, MD[a], Simon Lee, MD[a],
Asheesh Bedi, MD[b,*]

KEYWORDS

• Shoulder anatomy • Shoulder abnormality • Kinetic chain • Throwing mechanics
• Glenohumeral internal rotation deficit • Microinstability • Labrum • Labral tear

KEY POINTS

- The glenohumeral joint provides greater range of motion than any other joint in the human body and is dependent on the complex interplay of static and dynamic stabilizers to maintain its congruence.
- Repetitive overhead throwing may cause adaptive and/or pathologic changes to the osseous, capsuloligamentous, and muscular structures about the shoulder.
- The overhead throwing mechanism involves the entire kinetic chain, requiring activation from the lower extremities through the core/trunk and culminating in power transfer to the upper extremity.
- Properly directed stretching, interval throwing programs, and sound mechanics may prevent shoulder injuries, but surgical intervention may be indicated in the elite thrower presenting with structural abnormality.

INTRODUCTION

Overhead throwing imposes the shoulder to extreme multidirectional forces and high-tensile loads. Injuries are most commonly described in baseball pitchers, but similar injuries may be observed in softball, tennis, football, and even javelin throwers.[1,2]

Repetitive throwing motion can cause adaptive bony, capsuloligamentous, and muscular changes to increase glenohumeral external rotation and thus limit glenohumeral internal rotation. Over time, these adaptive changes may lead to pathologic kinematics and glenohumeral internal rotation deficit (GIRD), internal impingement, rotator cuff tears, superior labrum anterior to posterior (SLAP) tears, and scapular dyskinesia.[3–8]

ANATOMY

The glenohumeral joint provides more freedom of motion than any other joint, with the sacrifice of decreased stability. The balance between stability and mobility in the shoulder is balanced with a complex network involving both static and dynamic elements. Bony elements in the joint include the humerus, glenoid, and scapula. Dynamic stabilizers include the functional muscular groups, whereas passive stabilizers include the glenoid labrum, articular cartilage, glenohumeral ligaments, and the shoulder joint capsule.

Labrum

The labrum is a triangular fibrocartilaginous structure encircling the glenoid rim and functions to

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[a] Department of Orthopaedic Surgery, University of Michigan, 2912 Taubman Center, Ann Arbor, MI 48109-5328, USA; [b] Department of Orthopaedic Surgery, Shoulder and Sports Medicine, University of Michigan, 24 Frank Lloyd Wright Drive, Lobby A, Suite 1000, Ann Arbor, MI 48106, USA
* Corresponding author.
E-mail address: abedi@med.umich.edu

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increase the articulating surface area for the humeral head as well as deepening the glenoid socket to provide improved glenohumeral stability. This structural configuration helps maintain the negative intra-articular pressure environment of the joint and centers the humeral head on the glenoid. The labrum is therefore an important shoulder stabilizer and provides up to 10% of glenohumeral stability.[9–11] The superior labrum blends onto the proximal long head of the biceps tendon immediately distal to its insertion on the supraglenoid tubercle and is the commonly injured structure in overhead throwers.[12] A fibrocartilaginous transition zone bridges the labrum to the hyaline articular cartilage.[13] The capsular attachments of the labrum further contribute to shoulder stability. Vascular supply to the labrum consists of multiple vessels, including the posterior humeral circumflex, and the suprascapular and circumflex scapular arteries. However, vascular penetration of the labrum is limited to the periphery, predisposing the superior labrum to injury and impaired healing.[13]

Long Head of the Biceps Tendon

The long head of the biceps tendon primarily originates from superior glenoid tubercle, incorporating anteriorly and posteriorly into the superior labrum. The structure is located within the rotator interval and traverses inferiorly within the bicipital groove to the distal extremity. Because of its origin and function, the long head of the biceps tendon limits translation of the humeral head and contributes to anterior shoulder stability, reducing the overall stress placed on the inferior glenohumeral ligament during the late cocking phase of overhead throwing.[14]

Scapula

The scapula serves as a mobile connection between the thorax and the upper extremity, with the serratus anterior, trapezius, rhomboids, and levator scapulae providing scapulothoracic stabilization. The scapula is a critical structure for coordinated upper extremity movement and serves as an origin or insertion for 17 periscapular muscles. The acromioclavicular and coracoclavicular ligaments are the only other indirect attachments to the thorax, thus enabling the shoulder to have the most extensive range of motion of any joint in the body. The scapula is therefore a platform that provides both the power and the flexibility required for efficient throwing biomechanics.[15]

SHOULDER HISTORY AND PHYSICAL EXAMINATION

The history and physical examination are crucial in the initial evaluation of the symptomatic overhead throwing shoulder. Even though most athletes present with pain, an unexplained loss of throwing velocity and pitch control reported by the athlete hints at potential abnormality. Identification of the throwing phase that best reproduces symptoms is particularly helpful because various abnormalities present more frequently during different phases. It is important to delineate whether the symptoms are acute or insidious onset. Recent alterations in throwing mechanics should be explored because shoulder abnormality frequently occurs when athletes modify their throwing motion too rapidly. Evaluation of the athlete's preinjury level of competition as well as their career goals is appropriate at this point, because different treatment modalities may be more appropriate depending on each athlete's desired outcome.

Physical examination begins with direct observation of the undressed shoulder girdles, comparing the symptomatic shoulder to the contralateral side. Appropriate alignment of the glenohumeral, acromioclavicular joint, and scapulothoracic joint should be evaluated. Muscular hypertrophy may be noted in the dominant arm as a result of progressive adaptive changes. Active and passive shoulder range of motion should be performed. Overhead athletes often exhibit increased external rotation and concomitantly decreased internal rotation as a result of adaptive changes due to repetitive throwing. However, limited internal rotation may also reflect posterior capsule tightness secondary to abnormality. Palpation and visualization of the scapula are important to evaluate for abnormal or asymmetric motion concerning for scapula dyskinesia. Strength testing should be performed to the various functional muscle groupings. Shoulders that are painful with both active and passive motion are concerning for true shoulder stiffness, whereas restricted active motion and relatively pain-free passive motion may be the result of pain or weakness of muscular origin. Direct observation of the athlete's throwing motion for any obvious abnormalities should be performed if the patient's clinical condition allows. A thorough evaluation of the neurovascular status as well as a complete cervical spine examination should be performed. Multiple provocative tests exist for evaluation of the symptomatic shoulder and are discussed later in relation to each relevant condition.

A conventional shoulder radiograph series is the initial imaging of choice in the evaluation of a