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Journal of Orthopedic Research and Therapy

Willen J, et al. J Orthop Ther: JORT-189.

DOI: 10.29011/2575-8241. 000089

Review Article

The Glenohumeral Ligaments: Anatomy, Clinical Presentation, and Review of the Literature

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Citation: Willen J, Mooney M, Andrews K, Ebraheim N (2018) The Glenohumeral Ligaments: Anatomy, Clinical Presentation, and Review of the Literature. J Orthop Ther: JORT-189. DOI: 10.29011/2575-8241. 000089

Received Date: 05 April, 2018; **Accepted Date:** 10 April, 2018; **Published Date:** 16 April, 2018

Abstract

The glenohumeral ligaments are the static stabilizers of the shoulder joint and are important in limiting humeral head motion relative to the glenoid. Demonstrating the greatest range of motion of any joint in the body, the glenohumeral joint is prone to dislocation and instability [1]. The glenohumeral ligaments have a complex, variable anatomy with multiple components that can be injured. A single dislocation or traumatic event can lead to injury of the glenohumeral ligaments, resulting in recurrent dislocation or instability. After obtaining a thorough history and physical, the diagnosis is usually made with advanced imaging, such as an MRI. While minor lesions may heal with non-operative management, most patients are recommended to undergo surgical repair to restore stability. A thorough understanding of the variable anatomy of the glenohumeral ligaments and their function can aid in proper diagnosis and treatment of resultant injuries.

Keywords: Anatomy; Bankart; Dislocation; Glenohumeral Ligaments; Instability

Introduction

Shoulder pain and disability can be debilitating to patients and drastically affect their quality of life. The glenohumeral joint is inherently unstable and exhibits the greatest range of motion of any joint in the body. Additionally, it is the most commonly dislocated major joint [1]. Zacchilli et al. analyzed the epidemiology of shoulder dislocations presenting to emergency departments throughout the US in a sample population from 2002 to 2006. They estimated a glenohumeral dislocation rate in the US of 23.9 per 100,000 person-years (a rate of 69,897 per year). A large portion of the dislocations, 46.8%, occurred in individuals between fifteen and twenty-nine years of age. Additionally, males were found to be more than 2.5 times more likely to sustain glenohumeral dislocations than women [2].

Thus, due to this instability, the joint is prone to dislocation and injury of important structures including the rotator cuff musculature, labrum, glenoid, humeral head, capsule, and the glenohumeral ligaments. This review will focus on the anatomy and pathology related specifically to the glenohumeral ligaments. An accurate diagnosis can be difficult in cases of shoulder instability; therefore, an appropriate understanding of the anatomy, biomechanics, and pathology of the glenohumeral ligaments is vital to guide appropriate diagnostic work-up and treatments. The glenohumeral ligaments insert on the glenoid via the labrum. Many studies have found that the functional significance of the glenohumeral ligament labral complex is to maintain stability of the shoulder throughout range of motion [3]. The three main ligaments surrounding the glenohumeral joint are the superior, middle, and inferior glenohumeral ligaments respectively (Figure 1). Each ligament has a specific role in stabilization of the glenohumeral joint at varying arm positions and as a result can lead to differing degrees of pathology affecting joint stability [4].

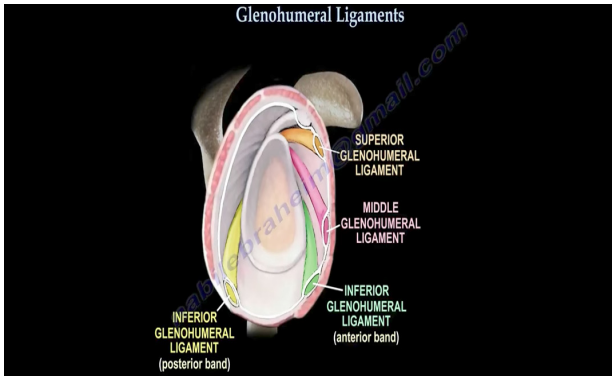

Figure 1: Sagittal plane view of the glenohumeral ligaments at their glenoid attachments.

Anatomy

Four soft-tissue layers, described by Cooper et al., surround the glenohumeral joint. The first, most superficial layer includes the deltoid and pectoralis major muscles with their associated fascia and epimysium. Anteriorly, the second layer consists of the clavipectoral fascia, conjoined tendon of the short head of biceps and the coracobrachialis, and the coracoacromial ligament. Posteriorly, layer two consists of the posterior scapular fascia overlying infraspinatus and teres minor. The deeper third layer contains the subdeltoid bursa and underlying musculotendinous units of the rotator cuff. Layer four is comprised of the capsule, including the glenohumeral ligaments and the coracohumeral ligament (Figure 2) [5].

Figure 2: Anterior view of intact glenohumeral ligaments and glenohumeral joint capsule.

The Superior Glenohumeral Ligament (SGHL) runs from the superior labrum to the proximal lesser tubercle of the humerus [4,6]. The fibers of the SGHL are split into two distinct groups- the oblique and direct fibers. The direct fibers originate from the glenoid labrum and course parallel with the tendon of the long head of the biceps brachii towards the lesser tubercle. A portion of the direct fibers continue to the inferior aspect of the bicipital groove and form the superior part of transverse humeral ligament. The oblique fibers arise from the supraglenoid tubercle, run over the intra-articular part of the tendon of the long head of the biceps brachii and insert below the coracohumeral ligament into the humeral semicircular ligament [7]. When the arm is held at 0° adduction, the SGHL prevents anterior-inferior translation of the humerus relative to the glenoid [4,6].

The Middle Glenohumeral Ligament (MGHL) runs from the anterosuperior labrum, inferior to the SGHL, coursing to the anterior aspect of the anatomic neck of the humerus. An anatomic study performed by Beltran et al. found the MGHL absent in 30% of the specimens [8]. The origin of the MGHL is a common site for normal anatomical variants, which includes ones in which the MGHL shares a common origin with the SGHL alone, the long head of biceps tendon and SGHL, or solely with the tendon of long head of biceps [8]. The buford complex, as seen in (Figure 3), is a common variant in which there is a cord-like MGHL with an absent antero-superior labrum, which can be easily mistaken for a labral tear.[4] When the arm is held at 45° of abduction with external rotation, the MGHL resists anterior and posterior translation of the humerus relative to glenoid.

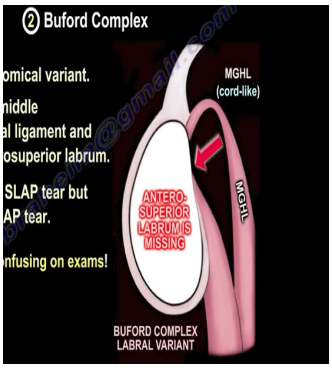

Figure 3: Sagittal view of a buford complex glenoid in which the antero-superior labrum is missing and the MGHL is cord-like.

The Inferior Glenohumeral Ligament (IGHL) consists of two bands, a posterior and an anterior band, each of which runs from the inferior glenoid labrum to the lateral side of the humerus. The IGHL also forms an axillary pouch between the anterior and posterior bands. O'Brien et al. identified two distinct patterns of IGHL attachments to the humerus. The first configuration, a collar-like attachment, occurs when the IGHL complex attaches inferior to the articular edge of the humeral head. The second configuration demonstrates a V-shaped attachment of the IGHL where the anterior and posterior bands attach adjacent to the articular edge and the axillary pouch [9]. With the arm held at 90°of abduction and externally rotated, the anterior band of the IGHL resists anterior-inferior translation of the humerus relative to the glenoid. Furthermore, when the arm is held in adduction and internal rotation, the posterior IGHL resists posterior-inferior translation [4]. Of the three ligaments glenohumeral ligaments, the IGHL is most susceptible to injury.

Classification

Morgan et al. classified the glenohumeral ligaments into four different anatomic arrangements. Type I configurations consisted of all three glenohumeral ligaments in the classic arrangement described previously and was present in 66% of subjects. The type II arrangements had a confluence between the MGHL and IGHL, with a small MGHL, representing 7% of the subjects. Type III involved a cord-like MGHL similar to the buford complex and was present in 19% of the subjects. Lastly, the type IV classifications lacked all three glenohumeral ligaments, which represented 8% of subjects [10].

Associated Conditions

There are several associated conditions in which the ligamentous structures are compromised, which include bankart lesions, Anterior Labral Periosteal Sleeve Avulsions (ALPSA)

lesions, Glenoid Labral Articular Defects (GLAD), and Humeral Avulsion of Glenohumeral Ligament (HAGL) lesions (Figure 4).

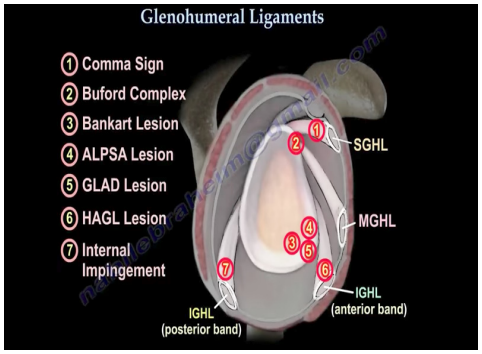

Figure 4: Common lesions involving the glenohumeral ligaments.

Patients that have a weak anterior band of IGHL can be predisposed to Bankart lesions (Figure 5) which is an avulsion of the anterior-inferior labrum off of the glenoid [4]. ALPSA lesions (Figure 6) involve the anterior band of the IGHL, where the labral-ligament complex is displaced medially and shifted inferiorly with intact underlying periosteum.

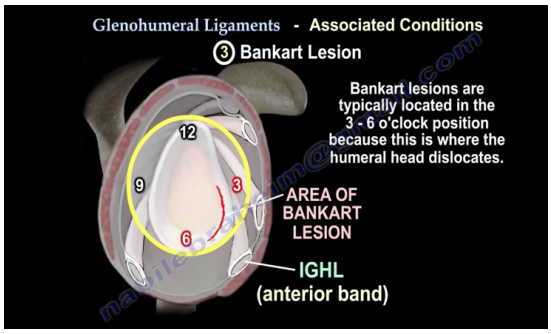

Figure 5: Sagittal view of a bankart lesion, which is typically located at the 3-6 o'clock position on the labrum because the humerus typically dislocates in that direction.

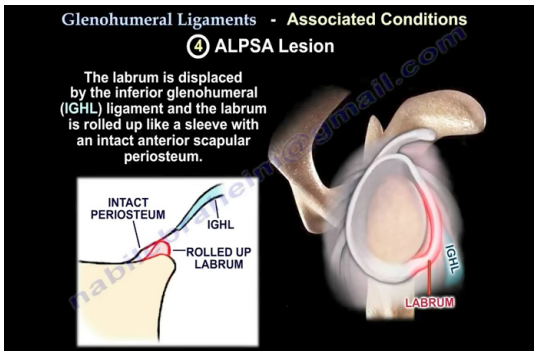

Figure 6: Anterior Labral Periosteal Sleeve Avulsion (ALPSA) where the labrum is forced up into a sleeve.

With ALPSA lesions, the IGHL displaces the anterior labrum, which becomes rolled up or condensed [4]. Avulsion injuries of the glenohumeral ligaments and/or ligamentous complexes can also occur. A tear of the anterior-inferior labrum with avulsion of adjacent glenoid cartilage is termed a GLAD lesion (Figure 7).

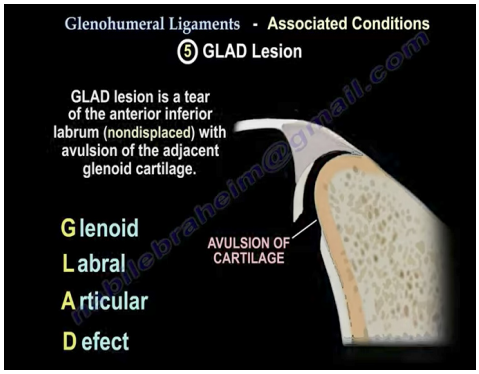

Figure 7: Glenoid labral articular defect consists of an avulsion of the glenoid articular cartilage as well as a tear of the anterior inferior labrum.

Impaction of the humeral head against the glenoid in abduction and external rotation injuries causes GLAD Lesions. Typically, the labrum remains attached with no capsular involvement [4]. Additionally, a lesion involving the anterior band of IGHL where the ligamentous complex is avulsed off of the humerus is termed a HAGL lesion, as seen in (Figure 8).

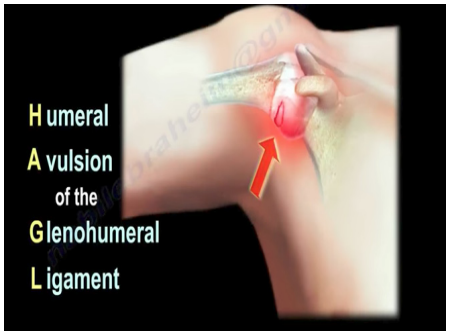

Figure 8: Anterior view of a HAGL lesion.

These lesions occur due to anterior shoulder dislocation caused by hyper-abduction and external rotation causing the capsule and ligament to avulse from the humeral neck. Lastly, there are lesions associated with the glenohumeral ligaments as a result of muscular injury and avulsion. A tear of the superolateral margin of the subscapularis can result in what is referred to as the comma sign. The comma sign is best evaluated arthroscopically when fibers of the SGHL/coracohumeral ligament complex are oriented perpendicular to the subscapularis musculature fibers, representing a superolateral subscapularis tear [4].

Diagnosis

The history and physical exam are critical in diagnosis and treatment options for injuries to the glenohumeral ligaments. The classic history of diagnosing anterior shoulder instability is one of a traumatic event occurring with the arm in abduction and external rotation followed by sudden pain and a reduction

maneuver to reduce the shoulder. The first event is typically followed by recurrent events or feelings of apprehension [11]. In addition to standard shoulder examinations, tests used to confirm anterior shoulder instability include apprehension, relocation, and surprise tests. The apprehension test involves placing the arm in 90 degrees of abduction and applying an anteriorly directed force or external rotatory force. A positive test is one in which the patient feels that the shoulder will dislocate. The relocation maneuver is performed with the shoulder in the abducted and maximally externally rotated position. A posteriorly directed force is applied to proximal humerus. A positive result occurs when the patient notes a decrease in pain or apprehension and can tolerate increased external rotation. The most accurate test is the surprise test (release test) which involves the sudden removal of the posteriorly directed force from the relocation test, and a feeling of apprehension is considered a positive result [11]. If there is suspicion that the shoulder is dislocated or subluxed, standard radiographs including an AP, lateral, and scapular Y view should be obtained.

A study compared the prevalence of glenohumeral ligament lesions after anterior shoulder dislocation identified by MRI in the acute phase of injury versus MR-arthrography 3 weeks to 3 months after injury. With every patient receiving both MRI and MRA, they found that capsular lesions found on initial MRI are likely to disappear on follow-up MRA. Therefore, they recommended only an initial MRI, as opposed to routine MRIs in the acute stage of injury. If further diagnostic imaging is required, a follow-up MRA in several months can be performed since it is probably a more reliable modality than MRI to detect labroligamentous pathology [12]. Multidirectional shoulder instability may occur due to ligamentous laxity secondary to connective tissue disorders. Patients with suspected systemic connective tissue disorders should receive a thorough physical examination to evaluate other joints for hypermobility [13].

Treatment and Complications

In young patients, recurrent instability is the most frequent complication of dislocation, while patients older than 40 years of age typically have other complications such as rotator cuff pathology, fracture of greater tuberosity, or nerve injury. The overall probability of recurrent dislocation that Slaa et al. found was 26% in four years. Age was the most significant prognostic factor of recurrence, which took place in 64% of patients younger than 20 years of age and in 6% of patients older than 40 years [14]. Therefore, appropriate treatment of ligamentous injury is necessary to prevent recurrent dislocation. Typically, surgery is required for stabilization for the lesions as previously described. Arthroscopic ligamentous repair of the labrum and/or glenohumeral ligaments aids in obtaining a conclusive diagnosis and restoring the stability of the joint. An Instability Severity Score can be used to guide whether the patient would best benefit from an open or arthroscopic procedure. Variables including age, degree of sports participation, type of sport, shoulder hyper-laxity, associated humeral or glenoid lesions noted on radiographs factor into the overall score. If the score is less than 6, there is an acceptable 10% risk of recurrent dislocation with arthroscopic repair. Likewise, if the score is greater than 6, there is an unacceptable 70% risk of recurrent dislocation and the patient should undergo open surgical repair [15].

Summary

Soft tissue injury after traumatic dislocation should be considered if there are recurrent dislocations or shoulder instability. A detailed history and physical examination aid in narrowing the differential diagnosis, which ultimately requires an MRI/MRA to definitively identify the pathology. Proper identification and treatment of labroligamentous injuries allows patients to return to normal daily activities. Knowledge of each glenohumeral ligament and its role in stabilizing the shoulder can help providers in their work-up and treatment plan.

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