



# Understanding the Glenoid Avulsion of the Glenohumeral Ligaments as a Cause of Shoulder Instability: Surgical and Postsurgical Management

Olivia C. O'Reilly, M.D., Kyle A. Andrews, M.D., and Patrick N. Siparsky, M.D.

**Abstract:** In adolescents and young adults, instability is a common shoulder pathology with a myriad of coexisting soft tissue and bony lesions. When evaluating a patient for the cause of instability, care must be given to assess for the infrequent lesions, including glenoid avulsion of the glenohumeral ligaments. This case example illustrates key points in the diagnosis, surgical, and postsurgical management of this less common cause of anterior shoulder instability.

## Introduction

Shoulder instability is a common shoulder pathology in adolescents and young adults, with traumatic anterior dislocations accounting for the majority of cases.<sup>1-6</sup> The full separation of the capsular ligaments and labrum from the anterior glenoid rim, known as the Bankart lesion, is classically described as soft tissue copathology with anterior dislocation.<sup>1-11</sup> Whereas Bankart lesions are common, multiple pathologies frequently present as a result of anterior dislocation, including Hill-Sachs lesions, anterior labroligamentous periosteal sleeve avulsion (ALPSA), humeral avulsion of the glenohumeral ligaments (HAGL, or BHAGL if bony involvement), rotator cuff injury, labral tears, biceps tendon pathology, and bony injury.<sup>1,2,4-9</sup> Even more rare is the glenoid avulsion of the glenohumeral ligaments (GAGL), in which the labrum remains attached to the glenoid while the

inferior glenohumeral ligament complex detaches from the labrum and glenoid.<sup>1,3,7,12</sup>

Regardless of pathology, accurate diagnosis is critical for appropriate treatment. Magnetic resonance arthrography (MRA) is especially useful in the diagnosis of labral and ligamentous pathology.<sup>4</sup> In determining the difference between a labral tear and a GAGL lesion, imaging can be difficult to interpret, leaving arthroscopy as the definitive diagnostic tool. Multiple arthroscopic views are critical to assess the extent of injury. With a GAGL lesion, the anterior portal is useful to identify and evaluate the lesion. Here, we present a traumatic anterior shoulder dislocation with a GAGL lesion, including physical examination, imaging, and repair of the injury.

## Technique

### Indications

Surgical repair of the glenohumeral ligaments is critical to restoring stability in the shoulder. As previously described in the literature, the glenohumeral ligaments stabilize the shoulder throughout motion, with the inferior glenohumeral ligament responsible for preventing anterior and inferior shoulder translation.<sup>1,4-7,9-11</sup> This function is compromised in anterior shoulder dislocations. Repair of this structure is crucial to restoring anatomical function, as well as preventing further dislocations.

Riboh et al.<sup>3</sup> previously described indications for the procedure, including history of a traumatic anterior shoulder dislocation that results in a GAGL lesion, and normal bone stock in both the humerus and glenoid. In addition, any discovery of a GAGL lesion under

*From the Department of Orthopaedics and Rehabilitation, The University of Iowa Hospitals and Clinics (O.C.O.), Iowa City, Iowa; and the Department of Orthopedic Surgery, The University of Toledo (K.A.A., P.N.S.), Toledo, Ohio, U.S.A.*

*The authors report that they have no conflicts of interest in the authorship and publication of this article and that no funding or financial remuneration was received. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).*

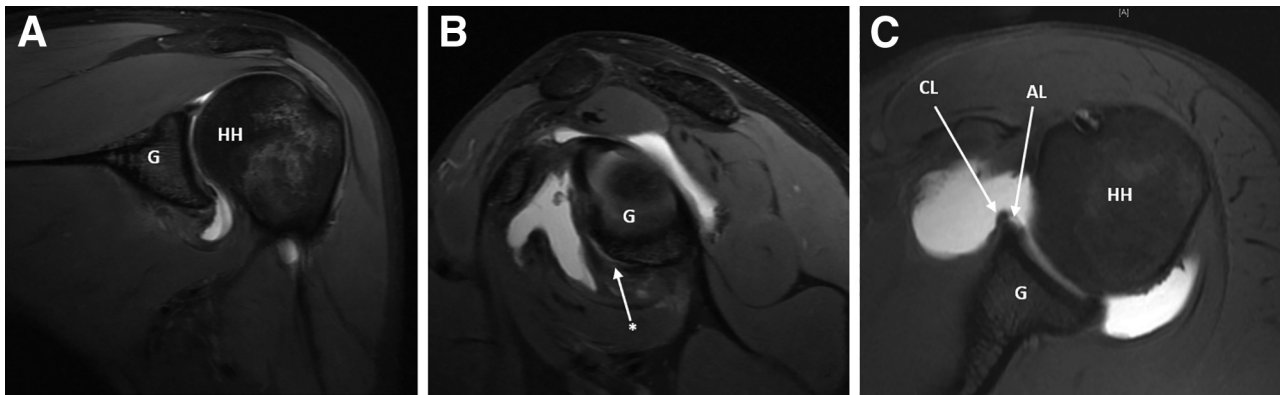
*Received March 19, 2019; accepted June 8, 2019.*

*Address correspondence to Olivia C. O'Reilly, M.D., The University of Iowa Hospitals and Clinics, 200 Hawkins Drive, 01019 JPP, Iowa City, IA 52242, U.S.A. E-mail: [olivia-oreilly@uiowa.edu](mailto:olivia-oreilly@uiowa.edu)*

*© 2019 by the Arthroscopy Association of North America. Published by Elsevier. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).*

*2212-6287/19384*

*<https://doi.org/10.1016/j.eats.2019.06.001>*



**Fig 1.** Left shoulder magnetic resonance arthrogram, coronal (A), sagittal (B), and axial (C) views. Dye is well visualized between the glenoid and the capsular tissue, but labrum is not clearly disrupted. \*capsular detachment from the glenoid/labrum; AL, anterior labrum; G, glenoid; HH, humeral head.

diagnostic arthroscopy for alternatively diagnosed shoulder instability pathology also necessitates fixation.

### Clinical Evaluation

Patient evaluation includes a full instability workup. With traumatic anterior dislocations, special attention must be given to possible axillary nerve injury. It is in the opinion of the authors that identifying axillary nerve palsy has significant implications for specific postoperative physical therapy management. The authors also advise observing for adhesive capsulitis in the time between traumatic injury and operative fixation, because damage to the capsule and bleeding may lead to stiffening in the preoperative period.

### Imaging

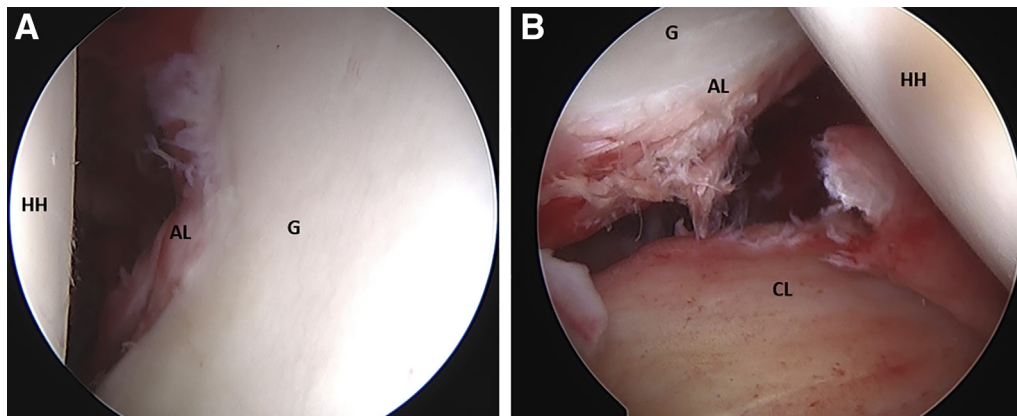
Radiographs are crucial to confirming the diagnosis after dislocation, traumatic or otherwise. At least 2 views are required to prove a dislocation. After reduction, MRA is used to assess for soft tissue injury. Imaging would show disruption of the capsular fibers with

possible extravasation of contrast through the deficiency.<sup>12</sup> MRA can be limited in its clarity and, in the case of a GAGL lesion, may not clearly delineate the separation of the glenohumeral ligaments from the intact labrum, leading to a misdiagnosis of an anterior capsulolabral injury (Fig 1). Because of the possible limitations of this imaging modality, diagnostic arthroscopy with proper portal placement becomes integral to identifying this often-missed pathology.

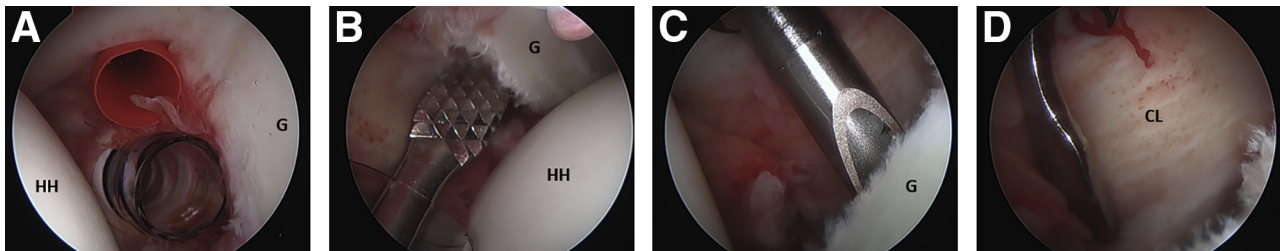
## Surgical Technique and Postoperative Management

### Patient Positioning, Presurgical Examination, and Portal Placement

Based on surgeon preference, either modified beach chair or lateral positioning is used for this procedure. Our preference in this case is modified beach chair positioning. Before surgery, examination under anesthesia commonly exhibits instability with load and shift



**Fig 2.** Left shoulder arthroscopic view in the modified beach chair position. (A) View from the posterior portal showing inflammatory changes to the labrum, but no definitive tear. The capsular attachments to the labrum are not well visualized. (B) View from the anterior superior portal shows the anterior labrum to be intact, but there is capsular avulsion from the labrum and anterior glenoid. AL, anterior labrum; CL, capsular ligaments; G, glenoid; HH, humeral head.



**Fig 3.** Preparation for glenoid avulsion of the glenohumeral ligament repair, left shoulder arthroscopic view in modified beach chair position. (A) Anterior superior and anterior inferior cannula location, viewed from posterior portal. (B) Preparation of the glenoid with rasp to remove any remnant capsular or scar tissue, viewed from anterior superior portal. (C) Burr applied glenoid to prepare for good capsular healing to the bone, viewed from posterior portal. (D) Preparation of the capsular tissue with a rasp for good healing to the bone, viewed from the posterior portal. AL, anterior labrum; CL, capsular ligaments; G, glenoid; HH, humeral head.

testing. In cases with subsequent adhesive capsulitis, limited shoulder external rotation and abduction may be present. Initial diagnostic arthroscopy is performed through the standard posterior arthroscopy portal, allowing for spinal needle-guided placement of an anterosuperior portal just inferior to the long head of the biceps tendon. Initial diagnostic arthroscopy through the posterior portal can be used to confirm other soft tissue and bony sequelae of dislocation, including the presence of a Hill-Sachs lesion (Video 1). The camera is then transferred into the anterosuperior portal for better visualization of the anterior labrum and the anterior capsuloligamentous structures. Further exploration reveals the GAGL lesion with complete tearing of the capsular attachment to the labrum and glenoid from the 1- to 6-o'clock position in this particular case (Fig 2). Most of the anterior labrum remains intact and attached to the glenoid.

Anterior capsular injury, whether humeral (HAGL) or glenoid (GAGL) in nature, is likely best visualized from the anterior viewing portals. Once the pathology is recognized, the placement of an additional antero-inferior cannula just superior to the subscapularis tendon is useful. Two anterior cannulas allow for visualization and preparation for repair to be completed simultaneously from the anterior aspect of the shoulder (Fig 3A). Later, during repair, it also allows for suture shuttling and arthroscopic knot tying. The final repair

should be visualized anteriorly and posteriorly to confirm adequate restoration of capsulolabral anatomy (Table 1).

### Glenoid and Capsular Preparation for Repair

To optimize postoperative healing, both capsular and glenoid aspects of the injury must be addressed. The glenoid is roughened with a rasp to remove residual soft tissue such as capsular remnant or scar tissue (Fig 3B). Then a burr is used to gently decorticate the glenoid to stimulate good healing (Fig 3C).

The surgeon must also address the capsule tissue, as would be done in a capsular-only procedure such as capsulorrhaphy for multidirectional instability. The capsular tissue should be rasped to stimulate healing to bone and labral tissue once repaired (Fig 3D). This increases the likelihood of healing compared with preparation of the bone alone.

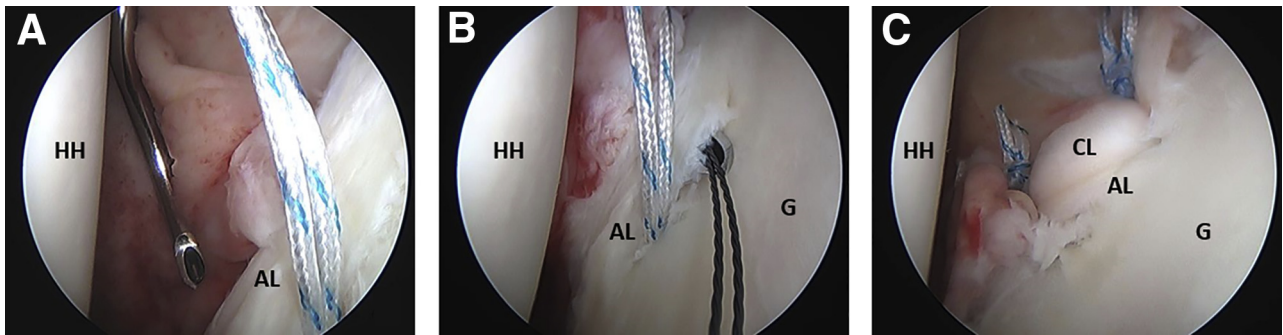
### Anchor Placement and Repair Completion

Although a suture-only technique may be used, allowing the capsule and labrum to be restored to an anatomical location, the authors prefer an anchor-based technique using 1.8-mm suture anchors to reattach any avulsion of capsular tissue. Presuming the bulk of the anterior and antero-inferior capsular tissue separates from the glenoid in the injury, the initial anchor is placed low on the glenoid, near the 6-o'clock

**Table 1.** Pearls and Pitfalls of Surgical Technique

Pearls	Pitfalls
MRI arthrogram may be limited in delineating a GAGL lesion from an anterior capsulolabral injury.	Inadequate visualization can prevent proper soft tissue mobilization and repair.
Diagnostic arthroscopy with the use of anterior portals for visualization is important to definitively differentiate between a GAGL lesion and a Bankart lesion.	Unlike a soft tissue or bony Bankart, the capsule must heal to the labrum and bone, theoretically making healing less robust.
Preparing the glenoid surface and capsular tissue prior to suture-anchor fixation is important to stimulate healing to both the bone and the labrum.	Recognition of this entity does not exclude the possibility of additional bony or soft tissue pathology.
Pre-operative identification of axillary nerve palsy and/or adhesive capsulitis is crucial to post-operative physical therapy management.	





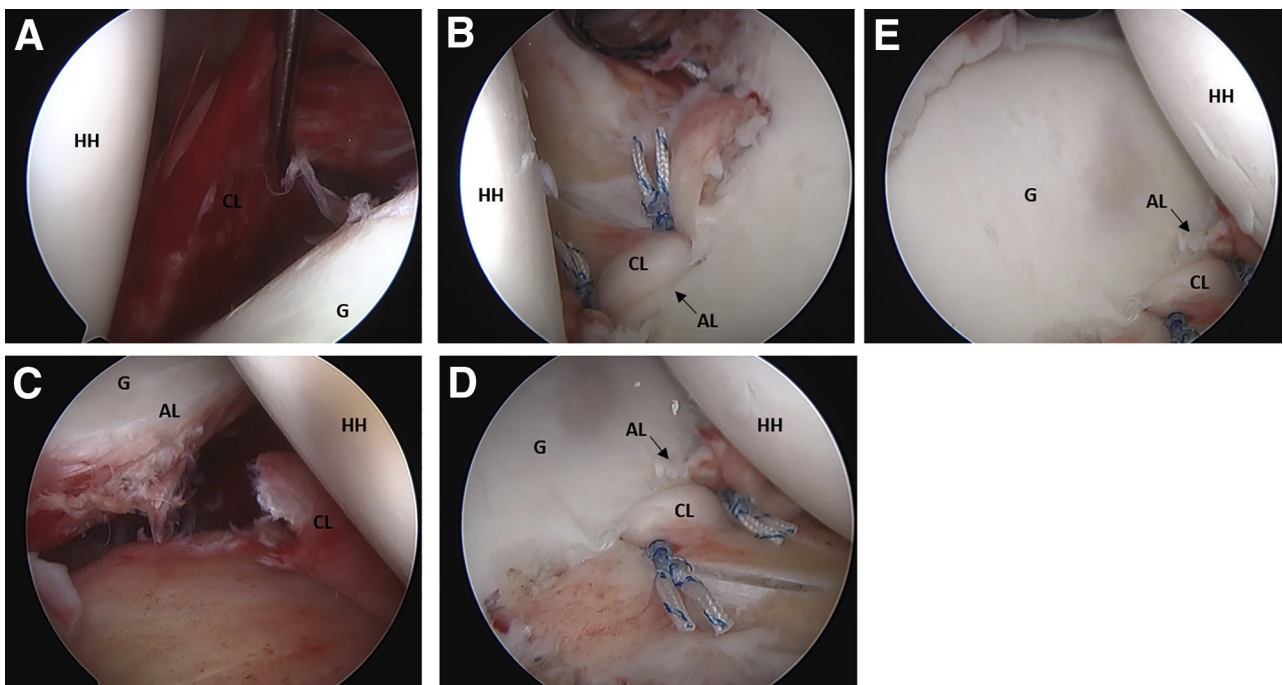
**Fig 4.** Left shoulder arthroscopic glenoid avulsion of the glenohumeral ligament (GAGL) repair process visualized from posterior portal in modified beach chair position. (A) After preparation of the glenoid and capsular aspects of the GAGL lesion, an anchor is placed on the glenoid face next to the intact anterior labrum. A suture shuttling device is seen penetrating the anterior inferior capsular for repair. (B) Capsular tissue is shuttled back to anatomic location abutting the anterior labrum. (C) Completed capsulolabral repair. AL, anterior labrum; CL, capsular ligaments; G, glenoid; HH, humeral head.

position. Any suture-shuttling technique may be used; however, the authors prefer a suture-shuttling device with a higher degree of curvature to ensure acquisition of capsular tissue more distally, allowing greater advancement of the tissue when returned to its anatomic position against the glenoid and labrum (Fig 4A). Penetration under the labrum can be difficult because the labrum remains intact; however, it is critical in the restoration of the anatomic relationship of repaired tissues (Fig 4B and C). Arthroscopic knots are tied with great effort to keep off the articular cartilage

face. Figure 5 demonstrates anterior and posterior portal views before and after repair. Figure 5E shows a well-centered humeral head relative to the glenoid, as the anterior capsulolabral complex has been restored to anatomic position with appropriate tension.

#### Axillary Nerve

In the senior author's experience, significant axillary nerve palsy is more commonly found in patients presenting with a GAGL lesion than in those presenting with a soft tissue or bony Bankart lesion. This



**Fig 5.** Left shoulder glenoid avulsion of the glenohumeral ligament repair in modified beach chair position. (A) Anterior capsular disruption viewed from posterior portal. (B) Capsulolabral repair visualized from posterior portal. (C) Anterior capsular disruption visualized from the anterior superior portal. (D) Capsulolabral repair visualized from the anterior superior portal. (E) Well-centered humeral head with restoration of the anterior capsulolabral tissue viewed from anterior superior portal. AL, anterior labrum; CL, capsular ligaments; G, glenoid; HH, humeral head.

**Table 2.** Advantages and Disadvantages

Advantages	Disadvantages
<p>An additional anterior portal allows for better visualization and definitive diagnosis of GAGL pathology that may be ambiguous or unrecognizable on imaging.</p> <p>Multiple anterior portals can aid in suture shuttling and arthroscopic knot-tying during repair.</p> <p>Preparing both the capsular and glenoid surfaces prior to fixation of the glenohumeral ligaments allows for increased likelihood of healing</p> <p>Early identification of axillary nerve injury and/or adhesive capsulitis allows for accurate post-operative planning and guides patient and physician expectations for recovery.</p>	<p>There is a risk of iatrogenic axillary nerve injury with arthroscopic capsular manipulation.</p> <p>Arthroscopic visualization can be technically difficult about the inferior glenohumeral joint.</p>

presumably occurs secondary to the significant trauma to the inferior capsule near the nerve's location. Physical examination of the axillary nerve sensory and motor distribution is critical to identifying this sequela. Some may suggest waiting for return of the axillary nerve function before surgery, but the trauma of injury often initiates posttraumatic adhesive capsulitis, making motion increasingly difficult and painful for the patient, and not greatly benefitting return of axillary nerve function. In our experience, the nerve function begins to improve almost immediately after surgery as a result of restoration of anatomic position of the capsular tissue.

Postoperatively, restoration of axillary nerve function is critical to rehabilitation. The surgeon and physical therapy team must appreciate the progressive improvement of deltoid function with time and adjust rehabilitation accordingly. Once stability has been restored, the deltoid serves as the power lifter of the arm, whereas the rotator cuff can function to depress the humeral head and compress it into the glenoid. If deltoid motor function has not fully returned, care must be taken to avoid creating imbalance in the shoulder. This may present as postoperative upper trapezius pain (knots and/or cramping) and bursitis symptomatology. The rotator cuff may also exhibit tendonitis symptoms as a result of abnormal shoulder mechanics from lack of full deltoid function. As axillary nerve palsy resolves, more exercises involving forward elevation and abduction can be initiated actively. Early focus on scapular stabilization and passive range of motion usually allows sufficient time for axillary nerve function to return completely.

### Adhesive Capsulitis

It may seem counterintuitive to have an unstable shoulder with adhesive capsulitis, but this entity is possible. In several cases of this injury, the senior author has found significant restriction to abduction and external rotation that is not limited by patient apprehension or excessive anterior translation of the humeral head on the glenoid but rather by adhesive capsulitis. This is likely the result of extensive trauma

and bleeding that occurs into the shoulder from capsular tearing at time of injury.

### Discussion

The glenohumeral ligaments and the glenoid labrum are key static stabilizers of the shoulder joint.<sup>1,4-7,9,10</sup> Of the ligaments, the inferior glenohumeral ligament is the most important for providing stability to the joint.<sup>4,6</sup> The anterior band helps prevent anterior dislocation of the humeral head in abduction and external rotation.<sup>5-7,9,10</sup> The anatomic insertion of the inferior glenohumeral ligament directly to the glenoid labrum explains the prevalence of the Bankart lesion in anterior dislocations.<sup>4-6</sup> However, the possibility of a GAGL lesion should be explored in patients with anterior instability, particularly if imaging suggests the labrum is intact. The surgical technique detailed describes use of an additional anterior portal for diagnosis and therapeutic intervention, which can be advantageous in accurately repairing glenohumeral ligament injury (Table 2).

### Limitations

There are relatively few limitations regarding this technique. First, focus on this capsular injury without sufficient evaluation for additional pathology can result in inferior results. For example, ignoring a large bony defect such as a Hill-Sachs lesion can lead to further instability-related complications in the future. Second, unlike a soft tissue or bony Bankart, where healing mostly occurs through bony preparation only, this technique is largely based on the repair of capsule to the labrum and bone, rather the capsulolabral complex to the bone, so healing can be theoretically less robust.

### Conclusion

GAGL lesions are an uncommon cause of anterior shoulder instability and require high level of suspicion. By using an anterior portal for complete diagnostic visualization of the joint, these injuries can be identified in cases where imaging is misleading or inconclusive. Accurate identification of these lesions facilitates proper repair and subsequent improved surgical outcomes.

## References

1. Mannem R, DuBois M, Koegerl M, Kosempa D, Erickson S. Glenoid avulsion of the glenohumeral ligament (GAGL): A case report and review of the anatomy. *Skeletal Radiol* 2016;45:1443-1448.
2. Forsythe B, Frank RM, Ahmed M, et al. Identification and treatment of existing copathology in anterior shoulder instability repair. *Arthroscopy* 2015;31:154-166.
3. Riboh JC, Khair MM, Romeo AA. Arthroscopic repair of a glenoid avulsion of the glenohumeral ligament. *Arthrosc Tech* 2015;4:e795-e799.
4. Massengill AD, Seeger LL, Yao L, et al. Labroscapular ligamentous complex of the shoulder: Normal anatomy, anatomic variation, and pitfalls of MR imaging and MR arthrography. *Radiographics* 1994;14:1211-1223.
5. Streubel PN, Krych AJ, Simone JP, et al. Anterior glenohumeral instability: A pathology-based surgical treatment strategy. *J Am Acad Orthop Surg* 2014;22:283-294.
6. Bencardino JT, Gyftopoulos S, Palmer WE. Imaging in anterior glenohumeral instability. *Radiology* 2013;269:323-337.
7. Wolf EM, Siparsky PN. Glenoid avulsion of the glenohumeral ligaments as a cause of recurrent anterior shoulder instability. *Arthroscopy* 2010;26:1263-1267.
8. Taylor DC, Arciero RA. Pathologic changes associated with shoulder dislocations: Arthroscopic and physical examination findings in first-time traumatic anterior dislocations. *Am J Sport Med* 1997;25:306-311.
9. Wolf EM, Cheng JC, Dickson K. Humeral avulsion of the glenohumeral ligaments as a cause of anterior shoulder instability. *Arthroscopy* 1995;11:600-607.
10. Pagnani MJ, Warren RF. Stabilizers of the glenohumeral joint. *J Shoulder Elb Surg* 1994;3:173-190.
11. Field LD, Bokar DJ, Savoie FH III. Humeral and glenoid detachment of the anterior inferior glenohumeral ligament: A cause of anterior shoulder instability. *J Shoulder Elb Surg* 1997;6:6-10.
12. Passanante GJ, Skalski MR, Patel DB, et al. Inferior glenohumeral ligament (IGHL) complex: Anatomy, injuries, imaging features, and treatment options. *Emerg Radiol* 2017;24:65-71.