

## SHORT ABSTRACT

# Glenohumeral Ligaments and Unstable Shoulder: CT and MR Arthrography

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**Keywords:** shoulder instability; glenohumeral ligaments; CT; MR; arthrography

### Background

The glenohumeral ligaments are the most important passive stabilizers of the shoulder. The superior (SGHL), middle (MGHL) and inferior (IGHL) glenohumeral ligaments are currently evaluated by shoulder arthroscopy. To avoid surgery as a diagnostic procedure, optimization of MR imaging parameters could help to detect lesions of the glenohumeral ligament complexes. Recognition of acute and chronic glenohumeral ligament pathologies is important for the preoperative evaluation of the unstable and/or traumatic shoulder. Clinical classification of instability is made by the degree, direction, chronology, etiology and the associated lesions. The degree of instability can be divided in dislocation, subluxation and microinstability. The direction can be anterior, posterior or multidirectional. Etiology can be traumatic or atraumatic (voluntary) [2, 3].

### Imaging findings and procedure details

The presentation reviews the literature on imaging of glenohumeral ligaments with CT arthrography (CTA) and MR arthrography (MRA). Our experience is based on CTA and MRA performed in young patients with unstable shoulders and compared retrospectively to arthroscopy [1, 5].

MR arthrography is useful for direct visualization of all glenohumeral ligaments including most lesions of their intra-articular portion and associated capsulolabral pathologies. Sprains, midsubstance tears, avulsion or fibrous infiltration can be identified on MRA images using fast spin echo PD with fat saturation in the three planes and PD and T2-weighted sequences without fat saturation in the sagittal oblique plane. Although CTA is reputed to better depict associated bone and cartilage lesions, it allows only indirect evaluation of the glenohumeral ligaments by outlining their contour or showing contrast penetration.

The anatomic and pathologic appearance of the three ligamentous complexes are illustrated on CTA and MRA images as well as during arthroscopy. Imaging signs include discontinuity, non-visualization, changes in

signal intensity on MRA, contrast extravasation, contour irregularity and waviness as well as periligamentous infiltration by edema, granulation or scar tissue. Normal variants and pitfalls (not to confuse with ligament injuries) are also described in the lecture. Think of a normal variation especially in an isolated finding. But normal variations can have clinical impact.

SGHL and MGHL are best visualized on axial or sagittal oblique images. IGHL on the three planes.

The *SGHL complex* comprises an anterior limb (CHL = coracohumeral – SGHL – CGL = coracoglenoid), a posterior limb (so-called Posterior SGHL). Both limbs merge with the rotator cable (the Rotator cable appearing as a thin line of intermediate signal interposed between cartilage of humeral head and supraspinatus tendon on MR images). A normal SGHL runs almost straight from the superior labrum in the direction of the coracoid process.

In a partial humeral avulsion tear, the SGHL could appear frayed and detached from the humeral head with a torn and displaced flap interposed between biceps and subscapularis tendons. On sagittal images, a thickened structure with inhomogeneous signal could be described associated to a synovitis of the rotator interval [4].

A normal *MGHL* originates most commonly from the anterior portion of labrum. It presents the greatest variation in size and attachment. It could be cordlike with triangular or rounded appearance or duplicated. A sprained MGHL can present an irregular outline with a more oblong appearance on axial views or appear undulated with a more vertical course on sagittal views, indicating an elongation. In a midsubstance rupture of MGHL, the medial stump can remain attached to the labrum; the lateral stump is found between subscapularis tendon and humeral head. A torn MGHL may appear as absent with an open and broad rotator interval (between CHL and subscapularis tendon) [4].

The *IGHL complex* is the most important passive stabilizer of the glenohumeral joint. It comprises anterior bands (often thicker than the posterior) and a posterior band (the posterior band is often more difficult to visualize at arthroscopy). A less well-known compound is the *fasciculus obliquus* also called the spiral ligament (because of its spiral course), best visualized on axial and sagittal oblique images. In anterior instability

demonstration of capsulolabral detachments next to bony lesions is essential (including Bankart, Perthes, ALPSA, GLAD and HAGL lesions). IGHL tears may occur at three locations separately or together: at the glenoid neck (most frequent and often associated with a labral tear), at the humeral insertion (less common, so-called HAGL for humeral avulsion of IGHL) or midsubstance (uncommon). An ALPSA (Anterior Labroligamentous Periosteal Sleeve Avulsion) is a detachment of the anterior band (ABIGHL) at the glenoid side lateral to the labrum. This is a more chronic instability lesion. The HAGL lesion can be diagnosed by the J-sign (axillary pouch changing from a U-shape to a J-shape with contrast extravasation). HAGL lesions can present a bony avulsion from the medial cortex of the humeral neck (bony HAGL or BHAGL). Most HAGL lesions are associated to labrum, subscapularis, Hill Sachs and/or osteochondral injuries. At arthroscopy, a HAGL lesion can be overlooked if the appropriate area is not specifically searched for. Therefore, a correct preoperative diagnosis of HAGL lesions on imaging is important and has significant clinical implications. Humeral avulsions are also described at MGHL and SGHL humeral attachment. Posterior instability of the shoulder occurs less frequently (5% of all instabilities) and can be caused by a traumatic posterior dislocation, redundant posterior capsule, posterior labroligamentous tears, osteochondral lesions and recurrent atraumatic posterior subluxations as in overhead athletes. As for anterior dislocations, posteroinferior labral tears, reverse Bankart and POLPSA, Kim, GLAD lesions are described. Avulsion of the posterior band (PBIGHL), Posterior HAGL (PHAGL) or Reversed Humeral Avulsion (RHAGL) can occur. The PBIGHL is an important soft tissue restraint to posterior subluxation of the humeral head. A tear of the PBIGHL could be associated with posterior or multidirectional instability. At arthroscopy these can be missed especially if the anterior ports are not used for visualization of the posterior capsular structures. Atraumatic multidirectional instability is predominantly a clinical diagnosis. This may be seen in athletic and non-athletic individuals with bilateral excessive hypermobility. There are no specific MRI criteria to diagnose this disorder. The most common finding is an increased capsular volume based on a redundant axillary

recess. In adhesive capsulitis (frozen shoulder), the IGHL (and axillary capsule) may be infiltrated by scarring and granulation tissue, appear thickened (especially on non-saturated T2-weighted sequences) and show contrast enhancement. The rotator interval can also be obliterated by abnormal tissue with contrast enhancement in adhesive capsulitis [1, 2, 3, 4, 5].

### Conclusion

Based on this preliminary experience, we believe that MRA using fast spin echo PD with fat saturation in the three planes and T2-weighted sequences without fat saturation in the sagittal plane could help to evaluate the glenohumeral ligament complexes. This could reduce the number of diagnostic arthroscopies in the future and help the surgeon in therapeutic decision making of unstable shoulders.

### Competing Interests

The authors have no competing interests to declare.

### References

1. **Shahabpour, M, De Maeseneer, M, Doering, S and Pouliart, N.** Glenohumeral ligaments including anatomy and pathology. In: Shahabpour, M, Sutter, R and Kramer, J (eds.), *MRI of the shoulder*. 2017; 113–134: 296. Vienna, Austria: Breitenseher publisher.
2. **Fritz, LB and Sutter, R.** Shoulder instability. In: Shahabpour, M, Sutter, R and Kramer, J (eds.), *MRI of the shoulder*. 2017; 135–155: 296. Vienna, Austria: Breitenseher publisher.
3. **Shahabpour, M, Dalili, D, Isaac, A and Pouliart, N.** Shoulder instability: A perspective for surgeons. In: Shahabpour, M, Sutter, R and Kramer, J, (eds.), *MRI of the shoulder*. 2017; 157–176: 296. Vienna, Austria: Breitenseher publisher.
4. **Woertler, K.** Rotator interval. *Seminars in Musculoskeletal Radiology*. 2015; 19(3): 243–253. DOI: <https://doi.org/10.1055/s-0035-1549318>
5. **Pouliart, N, Boulet, C, De Maeseneer, M and Shahabpour, M.** Advanced imaging of the glenohumeral ligaments. *Seminars in Musculoskeletal Radiology*. 2014; 18(4): 374–397. DOI: <https://doi.org/10.1055/s-0034-1384827>

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