

Arthroscopic Repair of Humeral Avulsion of the Glenohumeral Ligaments Based on Location



Douglas Navasartian, M.D., M.S., Robert Hartzler, M.D., M.S., Thomas DeBerardino, M.D., and Stephen Burkhart, M.D.

Abstract: Humeral avulsion of the glenohumeral ligament (HAGL) can be a difficult problem to treat. HAGL lesions can be particularly challenging to repair when approached arthroscopically. Because of the technical difficulties of HAGL repair, the surgeon must be strategic to successfully address these lesions arthroscopically. The purpose of this article is to propose a surgical technique that can be used in the arthroscopic treatment of HAGL lesions based on their location.

The term “humeral avulsion of glenohumeral ligaments (HAGL)” was not coined until 1995.^{1,2} Even in the original study of Wolf et al.,² 4 of the 6 cases of HAGL lesions discussed were repaired arthroscopically with excellent results. Arthroscopic HAGL repair has been reported as successful by additional authors.³⁻⁵ Although arthroscopic repair can be technically difficult, it does offer the benefit of significantly less tissue dissection and less trauma to the subscapularis tendon than with a more traditional open approach.^{6,7}

Even so, some authors advocate an open repair of HAGL lesions.^{6,8,9} One of the reasons cited for not performing HAGL repair arthroscopically has been the technically demanding nature of arthroscopic repair.^{8,9} Another reason cited for performing open repair is that the neurovascular structures, which lie in close proximity to the glenohumeral ligament insertion, can potentially be directly visualized during

an open repair.⁶ Although the subscapularis-sparing mini-open approach described by Bhatia et al.⁹ does allow for less subscapularis dissection, the approach, by nature of being an open procedure, still requires more overall soft-tissue disruption. Conversely, Provencher et al.¹⁰ have advocated performing a partial subscapularis tenotomy to prevent axillary nerve injury when performing anterior HAGL repair.

HAGL lesions present in a variety of locations and configurations in shoulder instability cases. They must be approached differently depending on these characteristics.^{11,12} In this article, we review our current techniques for arthroscopic HAGL repair, with particular attention paid to the strategy of approach based on the HAGL location.

General Concepts

For arthroscopic instability cases, we recommend the lateral decubitus position, with the arm in approximately 20° to 30° of abduction and 20° of forward flexion.³ Five to ten pounds of traction is applied, and an assistant is positioned across from the surgeon to manipulate the arm to achieve the best view and angle of approach.³ Both 30° and 70° arthroscopes should be available and used interchangeably.³ The pump pressure is routinely set to 60 mm Hg to maximize visualization.³ The key issue in HAGL repair is achieving the exact angle that is required for safe and proper anchor placement along the humerus.³ Because of this, correct portal placement is critical for a successful repair and is performed using a spinal needle under direct visualization instead of blindly using anatomic landmarks. The approach and portal placement are dependent on the location of the specific HAGL lesion as well as concomitant pathology.

From The San Antonio Orthopaedic Group Orthopaedics, San Antonio; Burkhart Research Institute for Orthopaedics, San Antonio; and Department of Orthopedic Surgery, Baylor College of Medicine, Houston, Texas, U.S.A.

The authors report the following potential conflicts of interest or sources of funding: R.H. receives personal fees from Arthrex. T.D. receives grant support and personal fees from Arthrex, personal fees from Aesculap/B.Braun, and personal fees from Musculoskeletal Transplant Foundation. S.B. receives personal fees from Arthrex. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received December 9, 2018; accepted March 24, 2019.

Address correspondence to Robert Hartzler, M.D., M.S., The San Antonio Orthopaedic Group, 150 E Sonterra Blvd, Ste 300, San Antonio, TX 78232, U.S.A. E-mail: rhartzler@saog.com

© 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/>).

2212-6287/181499

<https://doi.org/10.1016/j.eats.2019.03.024>

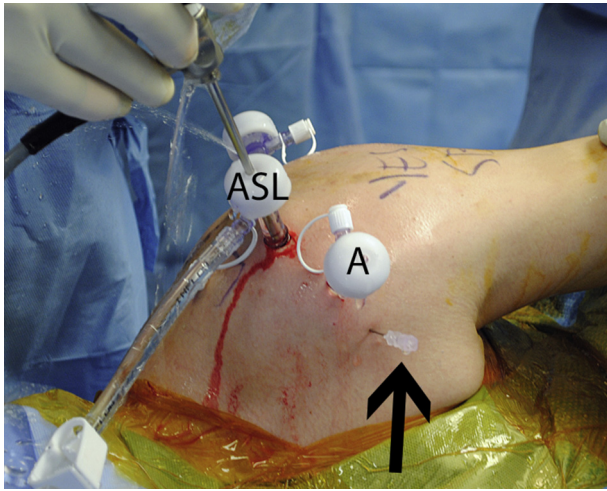


Fig 1. Left shoulder, external view, showing the creation of a low anteromedial (5-o'clock) portal with spinal needle localization (arrow). Reproduced with permission from Burkhart et al.¹¹ (A, anterior portal; ASL, anterosuperolateral portal.)

Anterior HAGL

Anterior HAGL lesions are generally repaired via anterior working portals while viewing from an anterosuperolateral (ASL) portal. A low anterior working portal can be used to address some anterior HAGL lesions. However, the creation of a trans-subscapularis working portal (5-o'clock portal) is critical for anchor placement for most HAGL lesions because the location of the capsular tear from the humerus is usually anteroinferior.¹¹

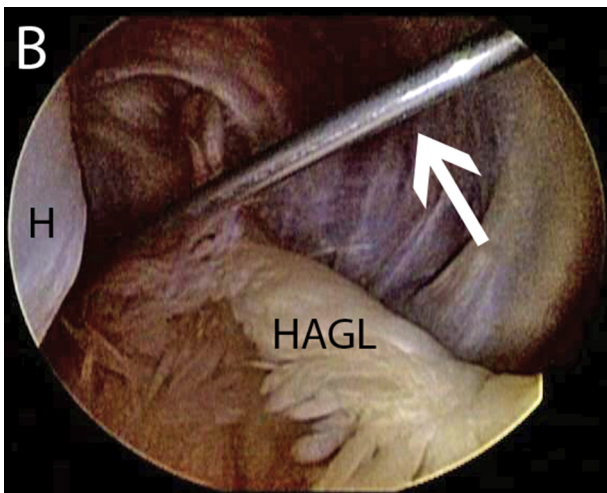


Fig 2. Left shoulder, anterosuperolateral view, with visualization of anterior HAGL tear. The steep angle of approach needed for access to the humeral footprint of the glenohumeral ligaments and the narrow window of space available are shown by the spinal needle (arrow). Reproduced with permission from Burkhart et al.¹¹ (H, humeral head; HAGL, humeral avulsion of glenohumeral ligaments.)

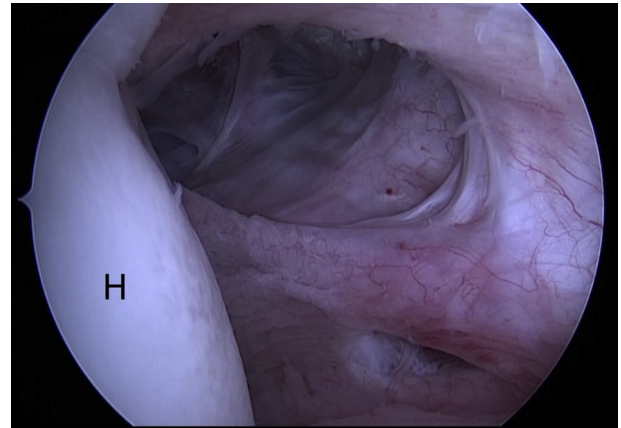


Fig 3. Arthroscopic image of the right glenohumeral joint from the anterosuperolateral portal with visualization of posterior humeral avulsion of the glenohumeral ligaments with a longitudinal tear in the posterior capsuloligamentous complex. Reproduced with permission from Burkhart et al.¹¹ (H, humeral head.)

After the patient is sterilely prepared and draped, the bony anatomic landmarks are delineated on the skin. A posterior viewing portal is made, followed by creation of an ASL portal over the bicipital groove anterior to the supraspinatus. The ASL portal will be used for viewing during anterior portal creation, preparation of the HAGL footprint, and anchor placement. A spinal needle is used to guide subsequent anterior portal creation based on the location of the pathology such that the correct working angles are obtained.

An important step to highlight is the creation of the 5-o'clock (trans-subscapularis) portal, which is necessary

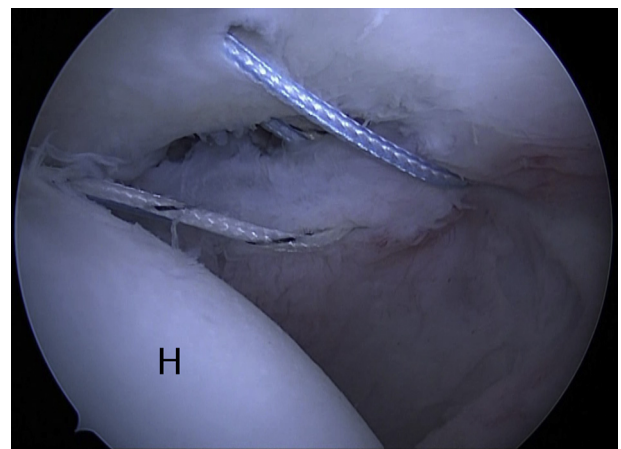


Fig 4. Arthroscopic image of the right glenohumeral joint from the anterosuperolateral portal with visualization of posterior humeral avulsion of the glenohumeral ligaments after suture passage. One should note the reduction of the longitudinal tear, with the suture limbs being tied extracapsular. Reproduced with permission from Burkhart et al.¹¹ (H, humeral head.)

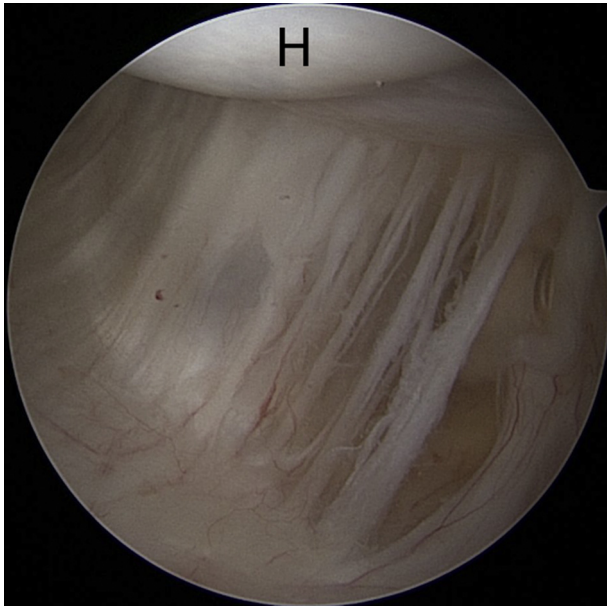


Fig 5. Arthroscopic view (70°) of the right glenohumeral joint from a posterosuperior portal with visualization of low (6-o'clock) humeral avulsion of the glenohumeral ligament. Reproduced with permission from Burkhart et al.¹¹ (H, humeral head.)

for lesions that are in the 4- to 5-o'clock position.¹¹ The 5-o'clock portal is created with the shoulder held in 0° of abduction to avoid injury to the musculocutaneous nerve while viewing from the ASL portal (Fig 1).³ The “window” for this low anteromedial portal is very narrow: if placed too inferiorly or medially, the neurovascular structures in the axilla are at risk; if placed too laterally, the instruments will skive off the humerus (Fig 2).

After appropriate portal placement, attention is turned to the humeral footprint of the avulsion. The footprint is gently debrided to a bleeding surface. This can be performed with a burr or ringed curettes. Preloaded suture anchors (4.5- to 5.5-mm BioComposite FT Corkscrew; Arthrex, Naples, FL) are placed in the prepared surface on the humerus. Alternatively, tape suture (LabralTape or SutureTape; Arthrex) can be passed through the torn capsule and fixed with knotless anchors (3.5-mm BioComposite SwiveLock or 2.9-mm BioComposite PushLock anchors; Arthrex). Suture passage through the lateral capsule and glenohumeral ligaments is accomplished using a passing device such as the SutureLasso or Scorpion (Arthrex). It is important to note that all sutures must first be passed before any fixation to the humerus takes place because fixation eliminates the space available for working and visualization.

Posterior HAGL

Posterior HAGL lesions are approached differently than anterior HAGL lesions.¹¹ The anterosuperior portal is used for viewing, and a posterior portal is used as the

main working portal for footprint decortication, as well as anchor placement. An 8.25-mm Twist-In cannula (Arthrex) is used in this posterior portal.¹¹ A posterolateral percutaneous portal is created under spinal needle localization that can be used for suture passage from the outside of the capsule to the inside of the joint after piercing through the capsular or ligamentous avulsion.¹¹ If the capsuloligamentous attachments are avulsed from the bone, then suture anchor fixation can be made directly to the bone after it is gently debrided. If there is a longitudinal tear of the capsuloligamentous attachments (Fig 3), then the sutures can be passed from outside the capsule to inside the capsule while viewing the reduction intra-articularly (Fig 4). The knots are tied within a cannula placed just outside the capsule (submuscular) “by feel” (i.e., without direct visualization).

Low Inferior HAGL

The low inferior HAGL lesion (Fig 5), which generally lies in the 5:30 to 6:30 clock-face position, is a subtype that also requires a unique treatment strategy.¹¹ Lesions in this position are in close proximity to the axillary nerve. Because of this, the low inferior HAGL lesion is best approached posteriorly because an anterior approach would endanger the neurovascular structures. Two posterior portals are created, with the posterosuperior portal being a viewing portal and the posteroinferior portal (7-o'clock position) being a working portal.¹² A 70° arthroscope is used in this approach because it allows for visualization of the acute angle needed for anchor placement into the anatomic footprint of the capsuloligamentous complex on the humerus.¹² In addition, the positioning of the arm can be a significant factor in the successful repair of a very low inferior HAGL lesion. The shoulder should be

Table 1. Pearls and Pitfalls of Arthroscopic HAGL Repair

Pearls

- A spinal needle should be used to guide portal placement and left in place until the portal has undergone initial instrument placement.
- For an anterior HAGL lesion, a trans-subscapularis working portal should be used in most cases.
- For a posterior HAGL lesion, traumatic or iatrogenic posterior capsular splits should be repaired.
- For an inferior HAGL lesion, 2 posterior portals should be used with internal arm rotation to improve access to the humeral neck and capsule.

Pitfalls

- A narrow window (Fig 1) exists for working portal placement in anterior HAGL repair such that instruments remain lateral to the conjoint tendon.
- Portal placement too laterally will force an angle of approach to the humerus that is too shallow (Fig 2).
- In combined HAGL lesion—Bankart tear cases, performing HAGL repair first risks iatrogenic disruption during subsequent Bankart repair.

HAGL, humeral avulsion of glenohumeral ligament.

Table 2. Advantages and Disadvantages of Arthroscopic HAGL Repair

Advantages	
Less surgical morbidity than open surgery	
Ability to address concomitant pathology arthroscopically	
Disadvantages	
Technically demanding	
No direct visualization of neurovascular structures	
HAGL, humeral avulsion of glenohumeral ligament.	

internally rotated during preparation of the bone bed and during anchor insertion to rotate the 6-o'clock position to a more posterior location (approximately the 8-o'clock position). This allows access to the humeral bone bed from posteroinferior. Sutures may be passed using a Scorpion or SutureLasso and secured to the humerus after passage using knotless fixation (Video 1).

Combined HAGL and Bankart Tear

On rare occasions, the capsuloligamentous structures will be torn from both the humerus and glenoid in either anterior or posterior shoulder instability cases (combined HAGL-Bankart lesion). The main technical consideration in these cases is deciding which lesion should be repaired first.^{13,14} The HAGL repair is more technically demanding, and often it is beneficial to repair this first before significant swelling occurs. However, if the HAGL lesion is to be repaired first, the surgeon must be certain that a trans-subscapularis portal is not necessary for the Bankart repair. If a 5-o'clock portal is necessary to approach the glenoid for the Bankart repair, the surgeon should create this portal through the HAGL lesion (on the lateral aspect of the humeral avulsion), perform the Bankart repair, and lastly, repair the HAGL. If the surgeon repairs the HAGL lesion first and then later realizes that the low glenoid anchors cannot be placed through a standard anterior portal above the subscapularis, the HAGL repair will be jeopardized by the creation of a trans-subscapularis portal. In general, if there is any doubt about the correct order of repairs, we currently recommend that the Bankart repair be performed first.

Discussion

The arthroscopic treatment of HAGL lesions, although a technical challenge, can be successful if the surgeon understands the keys to approaching the pathoanatomy of each subtype. For each HAGL location (anterior, posterior, and inferior), specific and usually narrow angles of approach are needed to gain access to the torn capsule and humeral insertion for proper footprint preparation and anchor placement. When technical mastery of working portal placement has been achieved, HAGL lesions, regardless of location, can be safely treated arthroscopically. Pearls and pitfalls of arthroscopic HAGL

repair are shown in Table 1, and advantages and disadvantages are shown in Table 2.

Risks and Limitations

Iatrogenic injury to the axillary nerve with arthroscopic HAGL repair represents the most concerning potential complication versus open surgery. Neurovascular injury does not appear to have been reported as a complication in the published literature on arthroscopic HAGL repair.^{5,15-17} Nevertheless, the axillary nerve has been reported to be approximately 4 to 5 mm from the free lateral edge of the HAGL lesion on preoperative magnetic resonance imaging and during open surgery.¹⁸ The closest major structure to the arthroscopic HAGL repair portals is the cephalic vein (mean distance from 5-o'clock portal, 10 mm; range, 3-23 mm).¹⁹ The axillary and musculocutaneous nerves are typically at a distance of at least 20 mm from the anterior portal (mean, 44 mm and 33 mm, respectively) and the 5-o'clock trans-subscapularis portal (mean, 37 mm and 28 mm, respectively).¹⁹ Posteriorly, the axillary nerve is typically greater than 30 mm from the posterior portals.¹⁹ If the surgeon cannot safely repair the HAGL lesion arthroscopically, conversion to open repair is recommended.

References

- Martetschlager F, Ames JB, Millett PJ. HAGL and reverse HAGL lesions. In: Milano G, Grasso A, eds. *Shoulder arthroscopy*. London: Springer, 2014;411-418.
- Wolf EM, Cheng JC, Dickson K. Humeral avulsion of glenohumeral ligaments as a cause of anterior shoulder instability. *Arthroscopy* 1995;11:600-607.
- Richards DP, Burkhart SS. Arthroscopic humeral avulsion of the glenohumeral ligaments (HAGL) repair. *Arthroscopy* 2004;20:134-141.
- Bruce B, Gupta A, McCormick F, Bach B, Romeo AA. Arthroscopic technique provides effective repair of HAGL lesions. *Orthop Today* 2013;33:4.
- Huberty DP, Burkhart SS. Arthroscopic repair of anterior humeral avulsion of the glenohumeral ligaments. *Tech Shoulder Elbow Surg* 2006;7:186-190.
- Godin JA, Sanchez G, Kennedy NI, Ferrari MB, Provencher MT. Open repair of an anterior humeral avulsion of the glenohumeral ligament. *Arthrosc Tech* 2017;6:e1367-e1371.
- Bruce B, Gupta A, McCormick F, Bach B, Romeo A. Open technique offers safe, effective repair of HAGL lesions. *Orthop Today* 2012;32:5.
- Arciero RA, Mazzocca AD. Mini-open repair technique of HAGL (humeral avulsion of the glenohumeral ligament) lesion. *Arthroscopy* 2005;21:1152.e1-1152.e4.
- Bhatia DN, DeBeer JF, van Rooyen KS. The "subscapularis-sparing" approach: A new mini-open technique to repair a humeral avulsion of the glenohumeral ligament lesion. *Arthroscopy* 2009;25:686-690.
- Provencher MT, McCormick F, LeClere L, et al. Prospective evaluation of surgical treatment of humeral avulsions of the glenohumeral ligament. *Am J Sports Med* 2017;45:1134-1140.

11. Burkhart SS, Brady PC, Denard PJ, Adams CR, Hartzler RU. *The Cowboy's Conundrum: Complex and advanced cases in shoulder arthroscopy*. Philadelphia, PA: Wolters Kluwer, 2017.
12. Chhabra A, Diduch DR, Anderson M. Arthroscopic repair of a posterior humeral avulsion of the inferior glenohumeral ligament (HAGL) lesion. *Arthroscopy* 2004;20:73-76.
13. Page RS, Bhatia DN. Arthroscopic repair of humeral avulsion of glenohumeral ligament lesion: Anterior and posterior techniques. *Tech Hand Up Extrem Surg* 2009;13:98-103.
14. Field LD, Bokor DJ, Savoie FH. Humeral and glenoid detachment of the anterior inferior glenohumeral ligament: A cause of anterior shoulder instability. *J Shoulder Elbow Surg* 1997;6:6-10.
15. Schmiedem U, Watson A, Perriman D, Liodakis E, Page R. Arthroscopic repair of HAGL lesions yields good clinical results, but may not allow return to former level of sport. *Knee Surg Sports Traumatol Arthrosc* 2019. <https://doi.org/10.1007/s00167-019-05414-5>.
16. Flury M, Rickenbacher D, Audigé L. Arthroscopic treatment of anterior shoulder instability associated with a HAGL lesion—A case series. *J Shoulder Elbow Surg* 2016;25:1989-1996.
17. Longo UG, Rizzello G, Ciuffreda M, et al. Humeral avulsion of the glenohumeral ligaments: A systematic review. *Arthroscopy* 2016;32:1868-1876.
18. Bokor DJ, Raniga S, Graham PL. Axillary nerve position in humeral avulsions of the glenohumeral ligament. *Orthop J Sports Med* 2018;6. 2325967118811044.
19. Lo IK, Lind CC, Burkhart SS. Glenohumeral arthroscopy portals established using an outside-in technique: Neurovascular anatomy at risk. *Arthroscopy* 2004;20:596-602.