Technical Note

Arthroscopic Subdeltoid Humeroplasty in the Beach-Chair Position for Reverse Hill-Sachs Lesions

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Abstract: Reverse Hill-Sachs lesions (HSLs) often involve a greater percentage of the humeral head articular surface than posterior HSLs and frequently require surgical treatment in the setting of posterior shoulder instability. Multiple techniques have been described to treat these lesions depending on their size, acuity, and location. The (modified) McLaughlin procedure is widely used to treat smaller engaging lesions, whereas larger lesions involving a greater percentage of the humeral head articular surface require anatomic disimpaction, termed "humeroplasty." Humeroplasty is traditionally performed via an open approach. This technical note describes an arthroscopic subdeltoid humeroplasty technique for the reduction and fixation of reverse HSLs in the beach-chair position.

Posterior shoulder dislocations are relatively rare injuries that are often associated with impaction fractures of the anteromedial humeral head. These reverse Hill-Sachs lesions (RHSLs) are often larger and involve a greater percentage of the humeral head articular surface than posterior Hill-Sachs lesions (HSLs) encountered in the setting of anterior shoulder instability. When the lesion size exceeds 10% to 20% of the articular surface, it must be addressed at the time of surgery to reduce the risk of engagement and recurrent posterior shoulder instability.[1]

The size and location of RHSLs dictate their surgical management. Common surgical options include transfer of the subscapularis tendon and transfer of the lesser tuberosity into the defect, termed the "McLaughlin procedure" and "modified McLaughlin procedure," respectively, which render the defect extra-articular.[2,3] In the case of larger defects affecting more than 20% to 40% of the articular surface, the articular surface needs to be reduced or reconstructed (Fig 1). In chronic injuries, this often requires a humeral head allograft procedure, whereas acute injuries can be treated with disimpaction and bone grafting.[4]

Historically, humeral head disimpaction and bone grafting had been performed via an open anterior approach to the shoulder, with a trapdoor created to access the subarticular bone and pack the defect with bone graft or with bone graft substitute. A newer technique of humeroplasty has been described that uses the same principles as kyphoplasty, whereby a balloon is used to perform disimpaction of the fracture and the void is filled with cement or another osteoconductive matrix. Recently, an arthroscopic technique for this procedure was published, providing a minimally invasive option for the treatment of RHSLs.[5] Unfortunately, the instrumentation required to perform kyphoplasty is costly and relatively unfamiliar to most shoulder surgeons.

The purpose of this technical note is to describe an arthroscopic anterior subdeltoid humeroplasty technique for the reduction and fixation of RHSLs. This procedure draws from the technique of arthroscopic-assisted reduction and fixation of lateral tibial plateau fractures and uses instruments readily available in most operating rooms (Table 1).

Surgical Technique

The procedure is performed with the patient under general anesthesia in the modified beach-chair position, with a 45° elevation of the torso relative to the floor (Video 1). Anatomic landmarks are identified and

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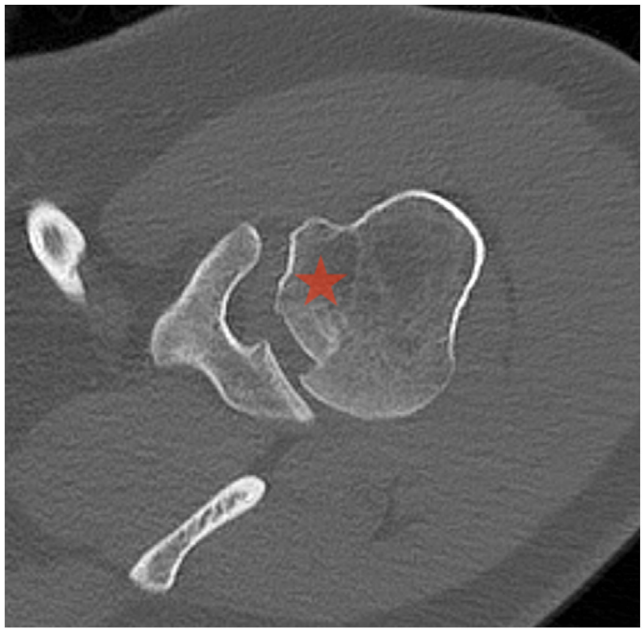

Fig 1. Axial computed tomography image of a left shoulder showing a reverse Hill-Sachs lesion (star) involving 35% of the humeral head articular surface.

Table 1. Pearls and Pitfalls of Arthroscopic Subdeltoid Humeroplasty Technique

Pearls	Pitfalls
The posterior labrum should be carefully inspected and repaired if torn prior to addressing the RHSL.	A switching stick should be used to maintain easy access to the posterior portal given frequent viewing portal changes. This is especially true if posterior labral repair and capsulorrhaphy are performed.
The RHSL is best visualized via the ASL portal.	Incomplete rotator interval release prior to camera placement in the ASL portal will result in an obstructed view of the RHSL.
The distal PL portal should be created once the tibial ACL guide is positioned on the RHSL to better estimate placement.	Guide placement too proximal on the lateral humerus risks injury to the infraspinatus tendon, whereas too distal placement risks injury to the axillary nerve.
Over-reduction of the articular surface can be easily corrected using a blunt instrument inserted through the AS portal.	Tricalcium phosphate cement can extravasate in both the intra-articular and subdeltoid spaces during tunnel backfilling; this should be avoided as much as possible.

ACL, anterior cruciate ligament; AS, anterosuperior; ASL, anterosuperolateral; PL, posterolateral; RHSL, reverse Hill-Sachs lesion.

marked on the skin (Fig 2). The patient is prepared and draped in the usual sterile fashion, and the arm is secured in a pneumatic positioner (Spider; Smith & Nephew, Andover, MA).

Arthroscopy

The surgical procedure begins with a diagnostic arthroscopy from a standard posterior portal. An anterosuperior (AS) portal is created high in the rotator interval. A motorized shaver is introduced, and the glenohumeral joint is irrigated and debrided of any debris. The posterior labrum is probed and evaluated for the presence of a tear, which if present should be repaired prior to proceeding using a standard technique.[6] A rotator interval release is then started with a radiofrequency ablator (Edge; ConMed, Largo, FL) and completed with the shaver. Next, an anterosuperolateral (ASL) portal is created approximately 2 cm distal and lateral to the anterolateral acromial edge, parallel to the superior border of the subscapularis tendon (Fig 3), and the arthroscope is repositioned into this portal.

Visualization and Targeting of RHSL

Given its anterior location, the RHSL is best visualized through the ASL portal (Fig 4). Viewing from this portal, the fracture site is debrided with the shaver in the AS portal. Next, a flexible cannula (PassPort; Arthrex, Naples, FL) is placed in the AS portal, and a tibial anterior cruciate ligament (ACL) guide (Smith & Nephew, Andover, MA) is introduced through the cannula and targeted on the central axis of the RHSL (Fig 5). A distal posterolateral portal measuring 2 cm is then created approximately 3 fingerbreadths distal to the lateral acromial edge, and the angle of the guide is adjusted such that it can be seated on the lateral humeral cortex just distal to the greater tuberosity. A 2.4-mm guidewire is advanced and stopped once subchondral bone is felt, just short of reaching the tip of the guide. The ACL guide is then disassembled and removed, and an 11-mm cannulated reamer (ConMed) is placed over the guidewire and used to create a tunnel about half the coronal width of the humeral head, which is confirmed fluoroscopically. The guidewire is removed, and a 10-mm Schatzker bone tamp is inserted in the tunnel.

Reduction and Fixation

The bone tamp is gently impacted with a mallet while an assistant maintains direct visualization of the RHSL via the ASL portal. Unlike depressed lateral tibial plateau fractures, less force is required to achieve reduction of the humeral head articular surface. Any slight over-reduction can be corrected by partially withdrawing the bone tamp and reducing the articular surface with a Freer instrument placed in the AS portal. Once the articular surface is anatomically reduced (Fig 6), the bone tamp is removed and the tunnel is filled with 10 mL of tetracalcium phosphate cement (HydroSet; Stryker, Kalamazoo, MI) under direct

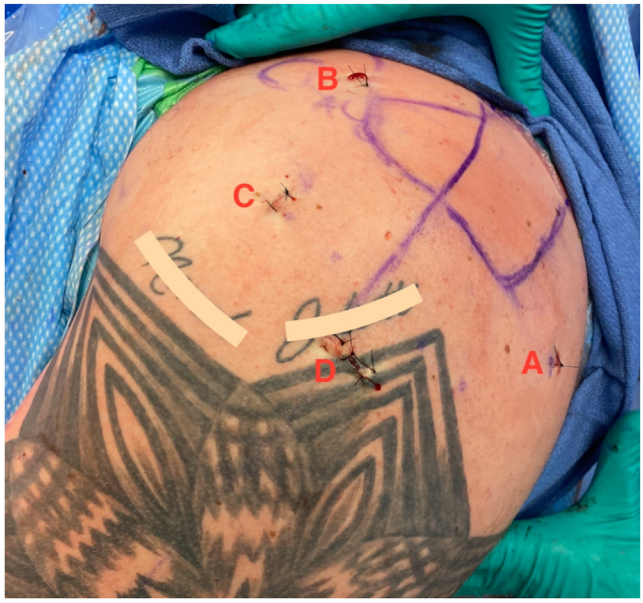

Fig 2. The patient is in the modified beach-chair position with the shoulder prepared and draped. The coracoid and acromion are drawn on the skin with a line dividing the lateral border of the acromion into an anterior half and a posterior half. Skin markings show the 4 portals used in our technique: posterior (A), anterosuperior (B), anterosuperolateral (C), and lateral (D).

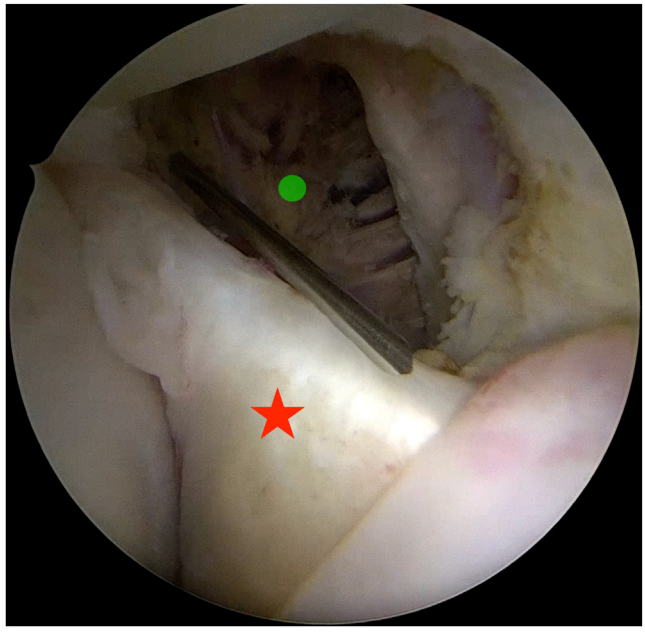

Fig 3. Arthroscopic view of left shoulder through posterior portal with patient in modified beach-chair position. A complete rotator interval release (dot) is performed, with needle-guided anterosuperolateral portal creation parallel to the upper border of the subscapularis tendon (star).

arthroscopic visualization to ensure the absence of articular extravasation. The tunnel can be plugged either with an ACL tunnel plug or by digital impaction while waiting for the substrate to harden.

Postoperative Rehabilitation

Patients are placed into a neutral rotation abduction brace for 6 weeks and instructed to avoid internal rotation past neutral for 6 weeks but are otherwise permitted to begin elbow range of motion and shoulder forward flexion to 90° immediately. The protocol is advanced in a systematic fashion, with resumption of unrestricted range-of-motion exercises at 6 weeks and institution of a strengthening program at 3 months.

Discussion

RHSLs are rare but have been shown to occur in up to 30% of posterior shoulder dislocations.[7] If left untreated, these may predispose patients to recurrent posterior shoulder instability and the development of post-instability glenohumeral arthropathy. Similarly to HSLs, many surgical procedures aimed at addressing this pathology at the time of surgery have been described, but given the relatively smaller incidence of RHSLs, there is less consensus regarding the optimal treatment of these lesions.

Nonanatomic procedures such as the McLaughlin and modified McLaughlin procedures have been widely used and have yielded good results in the setting of posterior shoulder instability with engaging RHSLs.[8-10] Multiple techniques for performing these procedures have been described, including both open and arthroscopic approaches. However, these procedures are nonanatomic and less indicated in the acute setting, particularly in the presence of larger lesions involving more than 20% to 40% of the anterior humeral head. In this setting, there exists general agreement that the RHSL should be treated with disimpaction and bone grafting to reconstruct the humeral head articular surface.[4]

Disimpaction and bone grafting of RHSLs, combined with the McLaughlin procedure or not, are generally performed via an open deltopectoral approach to the shoulder.[1,11] Humeroplasty, a procedure in which the fracture is elevated, reduced, and supported with bone cement, has been described in the setting of anterior shoulder instability with small- to moderate-sized HSLs. In a study of 14 cadaveric shoulders, Kazel et al.[12] were able to perform successful disimpaction of artificially created HSLs via a fluoroscopically assisted percutaneous technique using bone tamps. Sandmann et al.[13] were the first authors to use a kyphoplasty balloon technique to reduce HSLs; they achieved 80% reduction of the articular surface based on computed tomography assessment performed before and after the procedure in a cadaveric study of 6 shoulders. Similarly, Stachowicz et al.[14] used a kyphoplasty balloon technique augmented with bone cement to backfill the

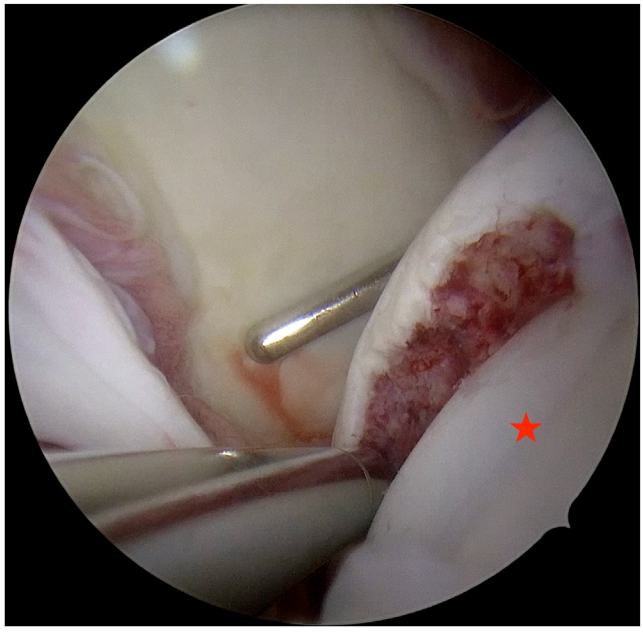

Fig 4. Arthroscopic view of left shoulder from anterosuperolateral portal with patient in modified beach-chair position. The reverse Hill-Sachs lesion (star) is visualized through the released rotator interval. The motorized shaver is inserted through the cannula placed in the anterosuperior portal, and the fracture is debrided. A switching stick is parked in the posterior portal to maintain access.

defect and achieved a 99.3% articular reduction in 18 cadaveric specimens as assessed by computed tomography. The first in vivo description of

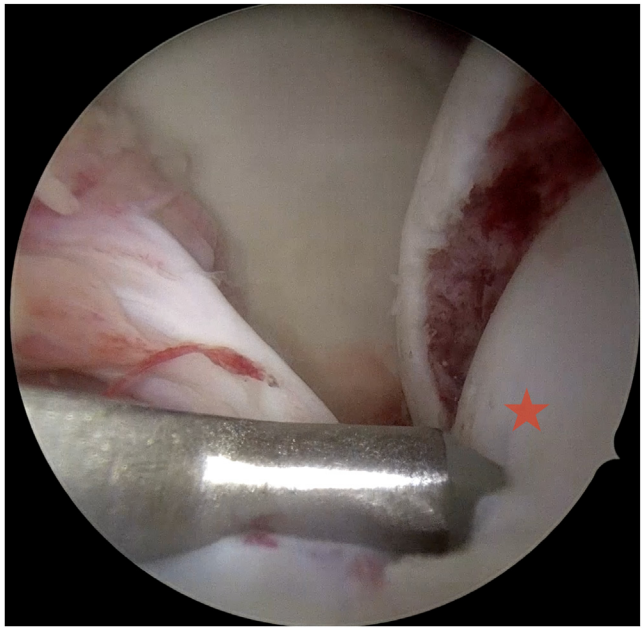

Fig 5. Arthroscopic view of left shoulder from anterosuperolateral portal with patient in modified beach-chair position. The tibial anterior cruciate ligament guide is inserted through the cannula placed in the anterosuperior portal and centered on the reverse Hill-Sachs lesion (star).

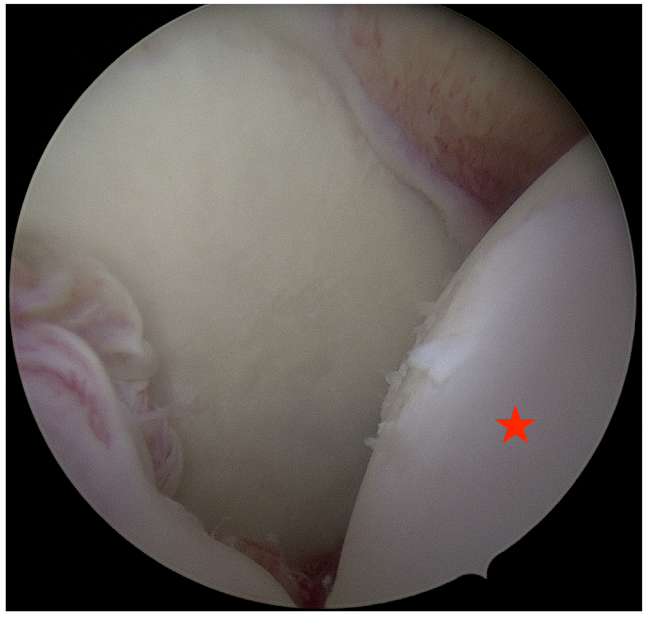

Fig 6. Arthroscopic view of left shoulder from anterosuperolateral portal with patient in modified beach-chair position showing anatomic reduction and successful humeroplasty of reverse Hill-Sachs lesion (star).

fluoroscopically assisted open balloon humeroplasty was presented in a study by Jacquot et al.,[15] in which 3 patients with posterior shoulder instability and RHSLs were successfully treated using this technique. More recently, Ratner et al.[5] described an arthroscopic-assisted balloon humeroplasty technique for the reduction and fixation of RHSLs in the lateral decubitus position. They used an ACL guide inserted via a posterior portal to target the lesion, inflated a kyphoplasty balloon to reduce the defect, and then backfilled it with bone filler to maintain articular reduction.

The arthroscopic anterior subdeltoid humeroplasty technique described in this article draws inspiration from the technique of arthroscopic-assisted reduction and fixation of lateral tibial plateau fractures. There are several potential advantages to this technique over the traditional open technique of disimpaction and bone grafting, as well as previously described arthroscopic techniques. First, the patient is positioned in the beach-chair position, which may be more familiar to many shoulder surgeons and allows for easy conversion to an open procedure via a deltopectoral approach should it be required. Second, visualization of the lesion via the ASL portal provides the surgeon with a head-on view of the entire defect, which can then be easily instrumented and manipulated via the AS portal. Third, introduction of the ACL targeting guide via the AS portal rather than the posterior portal reduces the risk of articular cartilage injury from incidental contact between the frame of the guide and the humeral head or glenoid. Finally, this technique provides a less costly

alternative to humeroplasty for RHSLs given that it does not require the use of a kyphoplasty balloon to achieve reduction. However, one must take care not to over-reduce the fracture and create an articular step-off. Tricalcium phosphate cement might also extravasate into the joint or displace the fracture if the pressure at which it is applied is too high.

In conclusion, large RHSLs in the setting of acute posterior shoulder instability should be treated with articular reduction and fixation by either humeroplasty or disimpaction and bone grafting. This technique note offers a relatively inexpensive arthroscopic anterior subdeltoid approach for the reduction and fixation of RHSLs by means of humeroplasty in the beach-chair position.

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