Arthroscopic Remplissage for Moderate-Size Hill-Sachs Lesion

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Abstract: Humeral bone loss has been shown to be a risk factor for failure after arthroscopic treatment of instability. We present the arthroscopic remplissage technique originally described by Koo and Burkhart et al. with a modification in the percutaneous anchor placement and suture tying that is reproducible and effective. We percutaneously place 2 suture anchors, which require no additional suture passing across the tissue, to create a double pulley technique, filling the defect with posterior capsule and rotator cuff. Therefore, the Hill-Sachs defect becomes extra-articular, eliminating the potential engagement of the anterior glenoid and contribution to recurrence of instability. This technique is applicable broadly for most Hill-Sachs lesions that need addressing. By not having to pass or shuttle any suture through tissue after anchor placement and by eliminating the necessity to go subacromially to retrieve or tie suture, the technique saves time and improves reproducibility. The compression of tissue into the Hill Sachs surface area also is improved by double-reinforced suturing through the double-pulley technique. The combination of these advantages creates a sound and efficient technique for remplissage.

The engaging Hill-Sachs lesion has been shown to be a significant risk factor for failure in shoulder instability treated arthroscopically. More recently, an appreciation for bipolar bone loss (glenoid bone loss with a Hill-Sachs lesion) has increased, leading to a more critical evaluation of the Hill-Sachs role in instability surgery. Both preoperative imaging and dynamic intraoperative assessment are used to predict the potential contribution of the Hill-Sachs lesion to recurrent instability. Different surgical options to address the humeral head defect and decrease the risk have been described. These techniques include remplissage, humeral osteochondral grafts, osteotomy, arthroplasty, Latarjet, and open Bankart procedures. Traditional techniques have focused on an open capsular shift and the Latarjet. In 2008, Purchase et al. described the remplissage as a technique to address humeral-sided bone loss in instability cases in conjunction with Bankart repair.

Remplissage is a safe procedure with low complication rates, low recurrent instability rates, good patient outcome scores, and minimal loss of range of motion compared with many of the other alternative techniques. In 2008, Purchase et al. modified the open Connolly procedure to fill in the Hill-Sachs defect with an arthroscopic posterior capsulodesis and infraspinatus tenodesis. Several technical variations of the arthroscopic remplissage exist. The purpose of this paper is to describe and illustrate our modification of the simple, reliable “double-pulley” technique described by Koo et al. that has the advantages of percutaneous anchor placement through a single percutaneous incision, requires no additional suture passage through tissue after anchor placement, and creates a double-reinforced fixation for filling of the defect with posterior capsule and infraspinatus tendon. Thereby, the Hill-Sachs becomes an extra-articular defect, eliminating the potential engagement of the anterior glenoid and contribution to recurrent instability.

Surgical Technique

The patient is positioned in the lateral decubitus position with the affected arm in 10 lbs. of balanced longitudinal and lateral suspension via use of the STAR device (Arthrex, Naples, FL). A standard posterior portal is created for initial intra-articular visualization. Under direct visualization, anterior-superior and mid-glenoid portals are created with cannulas (Arthrex) placed that will later serve as both working and...
visualization portals. Diagnostic arthroscopy is performed by careful examination of the entire joint for concurrent pathology and to identify the Bankart and Hill-Sachs lesions.

Along with the preoperative measures, intraoperative inspection of the glenoid is performed to determine there is no significant glenoid bone loss. Standard arthroscopic Bankart techniques are used to first mobilize and biologically prepare the Bankart lesion and anterior-inferior glenoid rim for labral repair; however, the surgeon may wish to delay repair until after the remplissage is performed to ensure visualization. Dynamic humeral defect evaluation in abduction and external rotation and anterior shear forces during remplissage anchor placement would stress a completed repair while assessing and instrumenting the humeral defect. To avoid this problem, the Hill-Sachs often is repaired before completion of the Bankart repair.

For better visualization of the Hill-Sachs, the patient’s arm is placed into increased abduction and the arthroscopic camera (Arthrex) is switched to the anterior superior portal for viewing (Fig 1). The Hill-Sachs lesion is inspected for size and position relative to the articular surface and posterior rotator cuff insertion, then the arm is taken dynamically into abduction and external rotation to check for engagement of the Hill-Sachs over the anterior glenoid rim, which complements the preoperative assessment and measurement of the glenoid track.

After determination that the Hill-Sachs lesion warrants remplissage in addition to arthroscopic Bankart repair, the Hill-Sachs is prepared biologically for healing of the infraspinatus into the defect with a 4-mm bone cutter shaver, burr, or rasp (Arthrex). This is done by viewing from the anterior superior portal and placing the shaver or rasp from the posterior portal. With only 1 incision for the 2 anchors, portal position is critical. A spinal needle is used to localize the path off the lateral and posterior acromial angle that perpendicularly enters central in the defect, so that the single skin fascial path can reach the anterior and posterior extent of the defect, allowing the 2 anchors to be placed. Our modification from the original technique by Koo et al.9 is this single percutaneous skin/deltoid incision for both anchors to pass through into the subacromial space, allowing the avoidance of having to go to the subacromial space to retrieve and tie the sutures.

Once localized, a portal is established into the subacromial space, down to the infraspinatus, but the cuff is not violated by the cannula. A blunt narrow switching stick is placed through the cannula, and while viewing from the underside of the cuff, the switching stick indents the cuff to ensure ideal placement. It is then advanced through the rotator cuff at the posterior extent of the Hill-Sachs lesion. A Suture Tak drill guide (Arthrex) is then advanced over this switching stick perpendicularly oriented into the posterior aspect of the defect and drilled to the depth stop. A 3-0 biocomposite suture anchor (Suture Tak; Arthrex) is then placed and the sutures exit through the cuff and out the cannula (Fig 2).

Next, the blunt switching stick is again placed through the cannula and redirected to indent the cuff at the anterior extent of the Hill-Sachs lesion. Once this position is determined, the switching stick is passed bluntly through this separate anterior aspect of the infraspinatus and capsule and docked into the anterior extent of the Hill-Sachs lesion. The process of anchor placement is repeated, and the result is 2 anchors at the margins of the Hill-Sachs lesion with separate passes through the rotator cuff and capsule with both sets of sutures coming out the same percutaneous hole in the subdeltoid fascia and skin (Fig 3).

Next, outside the shoulder, 1 limb from each anchor is taken and the 2 are tied together and cut above the knot (Fig 4). This leaves 2 free suture ends untied, 1 from each anchor. A double-pulley technique has now been created. On pulling on the 2 free ends simultaneously, the eyelets in the 2 anchors function as pulleys, and the tied ends slide down the percutaneous

Fig 1. Left shoulder visualization of Hill-Sachs posterior humeral defect through anterior superior portal. (HH, humeral head; HS, Hill-Sachs.)

Fig 2. First percutaneous anchor through capsule and infraspinatus into posterior-inferior aspect of humeral defect. (HS, Hill-Sachs; IS, infraspinatus.)
path through the deltoid to the outer infraspinatus tendon, thus reducing the intra-articular portion of the capsule-tendon in to the humeral defect (Fig 5). This is shown in Video 1 as the suture tension is applied and the humeral head moves posterior reducing against the rotator cuff tendon. The knot is not tied at this time, as the Bankart repair needs to be completed before the final reduction to improve visualization for Bankart repair and limit the stress applied to the remplissage.

Once the Bankart and any other intra-articular work is completed (Fig 6), the final remplissage reduction is secured. While the rotator cuff tendon is viewed arthroscopically directly reducing into and filling the humeral head defect (Fig 5), the 2 free suture ends from opposing anchors are tensioned and tied down with a surgeon’s knot backed up by 3 half hitches on alternating posts. Excess suture is then cut to complete the double-reinforced remplissage. Direct arthroscopic visualization confirms the humeral head is now centered on the glenoid face and the remplissaged tendon has completely filled the humeral defect, thus excluding it from the intra-articular shoulder.

Discussion

Posterior superior humeral head defects, known as Hill-Sachs lesions, are reported to occur in 47% of first-time glenohumeral dislocations and up to 84% of recurrent dislocations.10,11 The “engaging Hill-Sachs lesion” was termed by Burkhart and De Beer to describe a compression fracture of the humeral head that engages the anterior glenoid rim when the arm is placed in abduction and external rotation. Such defects are related to a greater rate of recurrent instability after arthroscopic Bankart repair alone.12 The idea further evolved in 2007 with Yamamoto et al.’s publication in the Journal of Shoulder and Elbow Surgery describing the new concept of glenoid track and the significance of “off-track” lesions causing recurrent instability.2 With the increasing awareness of the effects on glenoid bone loss on outcomes and recurrence rates with instability, surgical techniques for effective management are evolving.

In 2008, Purchase et al.6 described the remplissage, French for “filling,” because the procedure filled
the Hill-Sachs defect with capsule and infraspinatus tendon. By filling the humeral defect with cuff tendon and the underlying capsule, the defect was no longer intra-articular. Therefore, it functioned to prevent the defect from engaging the anterior glenoid rim. Many authors have documented the recurrence rates after remplissage and concurrent Bankart repair to range from 0% to 8%. Boileau et al. reported on 47 patients with arthroscopic Bankart repair combined with remplissage, showing 98% of patients had a stable shoulder at time of latest follow-up. In this same study, the authors used computed tomography or magnetic resonance imaging to evaluate the healing of the infraspinatus into the humeral defect in 42 patients, with healing confirmed in all patients imaged. Multiple other authors have studied these same concepts of tendon healing and their effect on external rotation. Zhu et al. and Merolla et al. both found 100% healing rates on postoperative evaluation with magnetic resonance imaging and ultrasonography. These authors also measured infraspinatus strength, showing it remained normal after the postoperative recovery period.

Theoretical concerns exist regarding loss of external rotation with remplissage. Biomechanical studies on cadavers have reported loss of external rotation, including Grimberg et al., who found a 11.7° loss in external rotation after Bankart plus remplissage compared with the intact cadaveric specimen; however, their Bankart plus remplissage restored stiffness equal to the intact model unlike Bankart repair alone in cadavers with concurrent Bankart and Hill-Sachs defects. The same results of improved stiffness and stability with loss of external rotation in the cadaveric model were found by Giles et al. and Elkinson et al.

The clinical studies measuring range of motion, however, have not demonstrated this to be a significant problem. In their original publication, Boileau et al. reported 8° loss of external rotation; however, they concluded the slight restriction in external rotation did not significantly affect return to sports, including those that involved overhead throwing. Their reported loss of motion is greater than many of the other studies that report either no loss of external rotation or less than 2°. Two recent systematic reviews by Buza et al. and Leroux et al. demonstrated a 2.6° loss in external rotation and no significant loss in external rotation, respectively; the authors concluded clinically that loss of external rotation has not been proven to be an issue after remplissage.

Many other alternative techniques for management of humeral-sided bone loss have been used. Biomechanically, in vitro, the remplissage and Latarjet both stabilized against dislocation and increased stiffness. In a systematic review, Longo et al. compared management options of remplissage, humeral osteochondral grafts, arthroplasty, and Weber osteotomy. They found arthroplasty to have the greatest recurrence rates and lowest outcomes, whereas remplissage demonstrated the lowest recurrence rates, lowest complications, and greatest outcome scores. Garcia et al. also found worse outcomes with osteochondral grafts versus remplissage with 2-fold recurrence rates and lower Western Ontario Shoulder Instability scores with grafts.

Overall, studies in which authors examine the outcomes of remplissage have demonstrated consistently high satisfaction and good-to-excellent outcome scores. The technique we demonstrate is designed to be simple, effective, and reproducible. Through the percutaneous placement of the 2 suture anchors in the single skin and deltoid incision, the double-pulley technique allows reduction of the posterior cuff tissue into the superior posterior humeral defect for a double reinforced fixation. The subsequent posterior capsulodesis and infraspinatus tenodesis into the Hill-Sachs lesion makes it an extra-articular defect, thus diminishing the tendency for it to engage the anterior glenoid rim and cause recurrent instability or symptoms. The advantages of this technique over other described techniques are the efficiency of not going into the subacromial space to retrieve or tie sutures, no additional suture shuttling or passing through tissue after percutaneous anchor placement, and no cannulas or other large portals through the infraspinatus tendon that may leave a residual tendon defect.

With this bridge technique of suturing, one potential weakness is the knot is a further distance from the tissue penetration site, which could have theoretical increased weakness compared with other suturing techniques. We have found the technique, however, to be strong and give good compression of the tissue into the humeral defect. We believe this technique can be used successfully concurrent to arthroscopic Bankart repair in patients with “engaging” or “off-track” Hill Sachs defects that have mild-to-moderate glenoid bone loss.

References


