Technical Note

Arthroscopic Double-Pulley Remplissage Using a 2-Portal Technique for Hill-Sachs Lesions in Recurrent Anterior Shoulder Instability

Moyukh O. Chakrabarti, M.B.B.S., James Gwosdz, M.D., Alexander Rosinski, M.S., Alvarho J. Guzman, B.A., Patrick J. McGahan, M.D., and James L. Chen, M.D., M.P.H.

Abstract: Hill-Sachs lesions of the humeral head are associated with recurrent anterior shoulder instability. Arthroscopic double-pulley remplissage has emerged as the leading alternative to the open Latarjet procedure to address recurrent shoulder instability with comparable recurrence rates and favorable complication rates. This Technical Note describes our adaptation of the double-pulley remplissage technique by using 2 portals, with the anterior portal used as the viewing portal and suture passage through the posterior portal. This technique eliminates the need for a lateral percutaneous portal, consequently minimizing operative time and postoperative morbidity. Furthermore, using the anterior portal as the viewing portal allows for direct visualization of the reduction of the infraspinatus into the Hill-Sachs defect. The drawback of this technique is that there is no view of the subacromial space during knot tying.

Historically, the Hill-Sachs lesion was described by Hill and Sachs[1] in 1940. However, as early as 1861, Flower described the presence of a groove on the articular head posterior to the greater tuberosity, and multiple case reports between 1880 and 1900 described this as a "typical defect."[1] A contemporary, Bankart,[2] published his article on the pathology and treatment of recurrent shoulder dislocation in 1938, in which he identified detachment of the glenoid ligament from the anterior margin of the glenoid cavity as the primary pathology and described his repair technique. At that time, neither Hill, Sachs, nor Bankart himself recognized the significance of what is now known as the Hill-Sachs lesion. It was realized later, in 2000, when Burkhart and De Beer[3] reported their now oft-quoted 67% and 4% recurrence rates in patients with and without bony defects, respectively, after arthroscopic Bankart repair. They concluded that patients with recurrent dislocations and structural bone deficiency would instead benefit from open surgery.[3]

Numerous surgical techniques attempting to repair the Hill-Sachs defect have been discussed in the literature. These include osteochondral grafts, humeral head osteotomy, anterior capsule plication, and humeroplasty.[4-7] Although these techniques do achieve acceptable results, they are open procedures and are associated with complications such as implant malfunction, nonunion, and glenohumeral osteoarthritis.[8-10]

In 2004, Wolf and Pollack described their remplissage technique for engaging Hill-Sachs lesions, in which arthroscopic capsulotenodesis of the posterior capsule and infraspinatus tendon is performed to fill the Hill-Sachs defect.[11] In 2009, Koo and Burkhart[12] published their variation of the arthroscopic remplissage technique, detailing their use of a double-pulley remplissage. In 2014, Wolf and Arianjam[13] published their case series on arthroscopic remplissage outcomes, reporting a 4.4% recurrence rate over a period of 10 years. Multiple technique articles on arthroscopic remplissage have since been published, including a previous article from the senior author (J.L.C.) describing a knotless adaptation of the remplissage

From Advanced Orthopaedics and Sports Medicine, San Francisco, California, U.S.A.

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Address correspondence to Moyukh O. Chakrabarti, M.B.B.S., Advanced Orthopaedics and Sports Medicine, 450 Sutter St, Ste 400, San Francisco, CA 94108, U.S.A. E-mail: moyukh.o.chakrabarti@gmail.com

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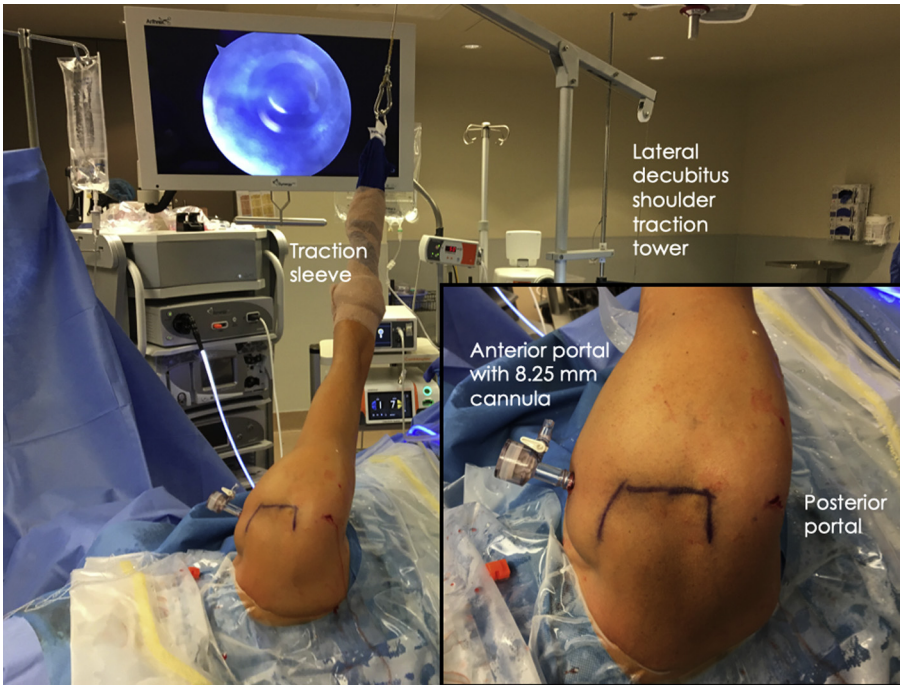

Fig 1. The patient is in the left lateral position using a lateral wedge. Ten pounds of skeletal traction is applied to the right arm through a traction sleeve and a lateral decubitus traction tower. The anterior portal contains an 8.25-mm cannula and is used as the primary working portal to repair the Bankart lesion and as the viewing portal for the remplissage.

double-pulley technique.[14-19] The technique described here differs from other techniques in that only 2 portals are used without the need for percutaneous access and that the double-pulley remplissage is completed without direct visualization of knot tying.

Surgical Technique

Patient Positioning

The patient is placed supine on a standard operative table and anesthetized using general anesthesia. The patient is repositioned into the lateral decubitus position, and all bony prominences are cushioned. The shoulder is positioned using a Lateral Decubitus Shoulder Traction Tower (Arthrex) (Fig 1). The operative shoulder is prepared with preoperative skin preparation solution, and the patient is then draped in the usual sterile fashion.

Arthroscopic Portal Placement

Anatomic landmarks are identified and marked. A standard posterior portal is created for initial

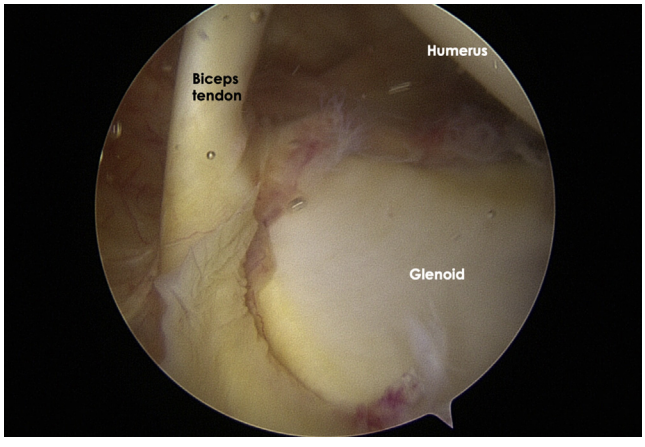

Fig 2. Arthroscopic view from the posterior portal in the right glenohumeral joint showing an intact biceps tendon, as well as healthy glenoid and humeral head articular cartilage. A SLAP tear is also evident.

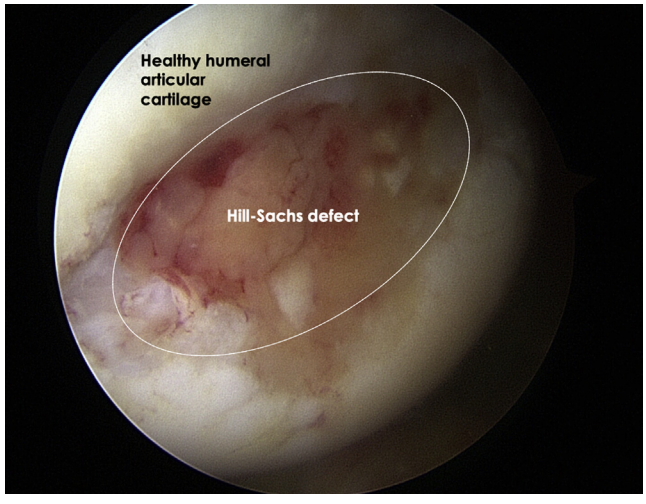

Fig 3. Arthroscopic view from the posterior portal with the right arm in external rotation showing a 3-cm Hill-Sachs defect on the posterior humeral head surrounded by healthy humeral head articular cartilage.

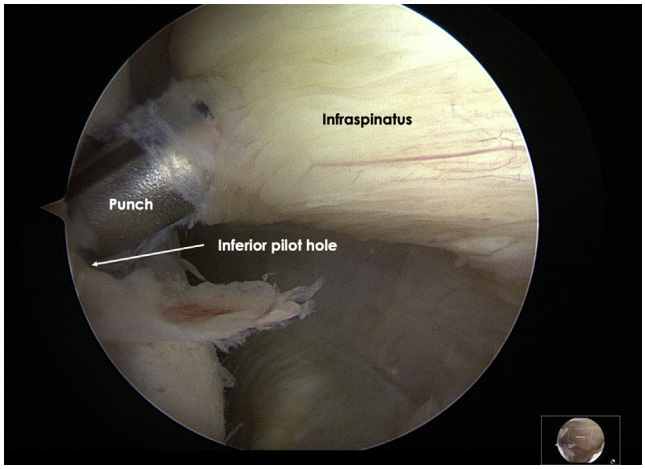

Fig 4. Arthroscopic view from the anterior portal in the right shoulder showing a bone punch inserted through the posterior portal and infraspinatus. The punch is tapped into the inferior portion of the Hill-Sachs defect to create a pilot hole for a 5.5-mm Corkscrew (Arthrex).

intra-articular visualization using a No. 11 blade to make a vertical incision. The glenohumeral joint is entered using a blunt trocar and arthroscope sheath. Diagnostic arthroscopy is performed (Fig 2). The anterior viewing portal is localized through an outside-in technique. Another vertical incision is made, followed by placement of an 8.25-mm cannula.

Remplissage

Viewing from the posterior portal, the surgeon identifies the Hill-Sachs lesion (Fig 3, Video 1). The soft tissue is debrided using a No. 4-0 shaver. The arthroscope is then moved to the anterior portal. A punch is passed through the posterior portal and used to create a pilot hole within the Hill-Sachs lesion (Fig 4). A double-loaded 5.5-mm BioComposite anchor (Arthrex) is screwed into the Hill-Sachs lesion, perpendicular to the surface (Fig 5). A second suture anchor is implanted in similar fashion (Figs 6 and 7), resulting in an inferior-superior configuration of the anchors, which are spaced evenly within the lesion. Both sets of sutures exit through the posterior portal. After suture anchor placement, attention is turned to the repair of any existing Bankart and/or SLAP lesions (Figs 8 and 9). The placement of remplissage

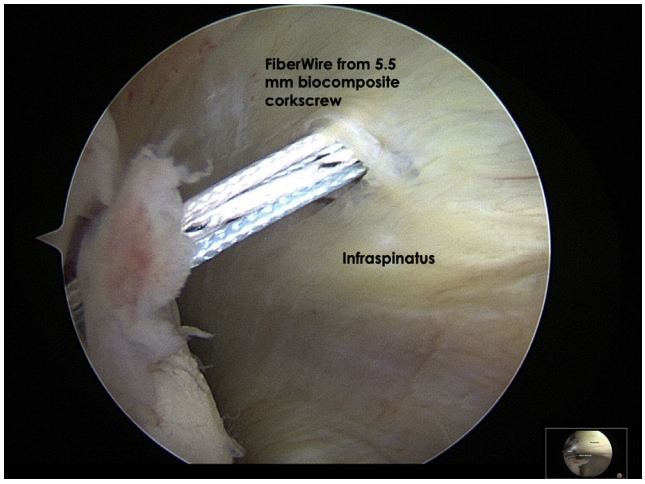

Fig 5. Arthroscopic view from the anterior portal in the right shoulder showing FiberWire (Arthrex) coming from the 5.5-mm Corkscrew, which was inserted into a pilot hole in the inferior portion of the Hill-Sachs defect. The FiberWire courses through the infraspinatus and exits through the posterior portal. This is the inferior pulley in the double-pulley system.

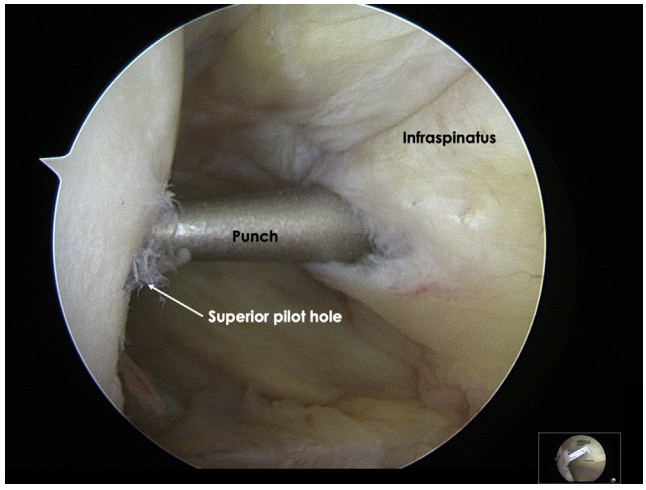

Fig 6. Arthroscopic view from the anterior portal in the right shoulder showing a bone punch inserted through the posterior portal and infraspinatus. The punch is tapped into the superior portion of the Hill-Sachs defect to create a pilot hole for a 5.5-mm Corkscrew.

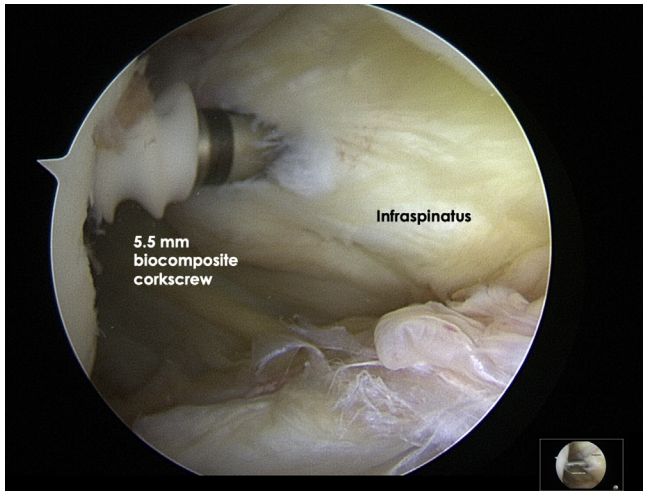

Fig 7. Arthroscopic view from the anterior portal in the right shoulder showing a 5.5-mm Corkscrew and driver inserted through the posterior portal. The screw is placed into a pilot hole in the superior portion of the Hill-Sachs defect.

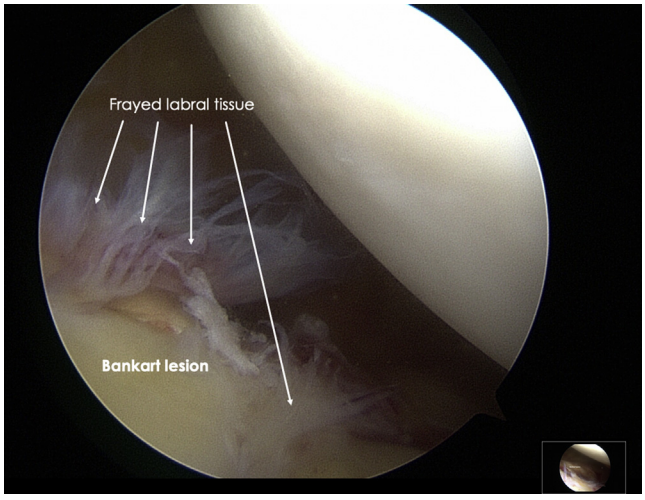

Fig 8. Arthroscopic view from the posterior portal in the right shoulder. The anterior-inferior labrum is torn and frayed, which is known as a Bankart lesion.

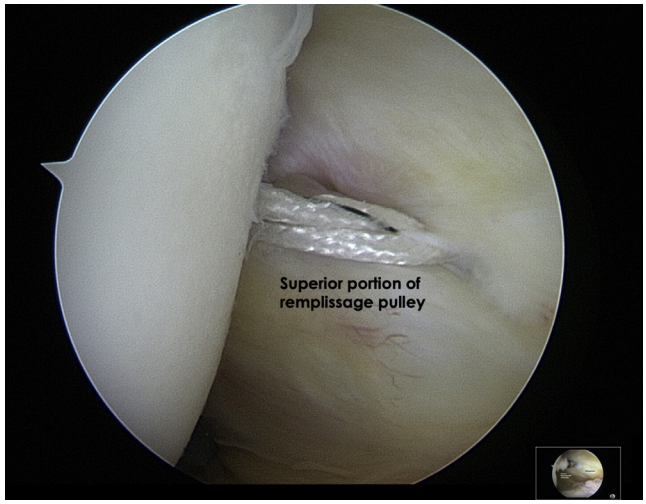

Fig 10. Arthroscopic view from the anterior portal in the right shoulder showing FiberWire coming from a 5.5-mm Corkscrew, which was inserted into the superior portion of the Hill-Sachs defect. The FiberWire courses through the infraspinatus and exits through the posterior portal. This is the superior pulley in the double-pulley system.

anchors is completed first to avoid disruption of the labral repair. After labral repair, attention is returned to completing the remplissage.

Outside of the shoulder, the double pulley is created by tying 1 suture from each anchor together to create an "air knot." The sutures are cut above the knot, leaving 2 free suture ends untied (1 from each anchor). When these free ends are pulled simultaneously, the eyelets in the 2 anchors function as 2 pulleys (Fig 10), and the tied ends reduce the infraspinatus (Fig 11) and posterior capsule into the Hill-Sachs lesion. The reduction is tensioned and secured by a surgeon's knot through the use of a knot pusher (Fig 12). Excess suture is cut, completing the double-pulley remplissage. The camera is placed in the subacromial space through the posterior portal for a final view (Fig 13).

This technique differs from other variations of the double-pulley technique in that the suture ends are passed and tied through the posterior portal, eliminating the need for an additional portal to view the subacromial space. In addition, this 2-portal technique allows for direct visualization of the Hill-Sachs defect being "filled" by the infraspinatus without the need to view the subacromial space during knot tying.

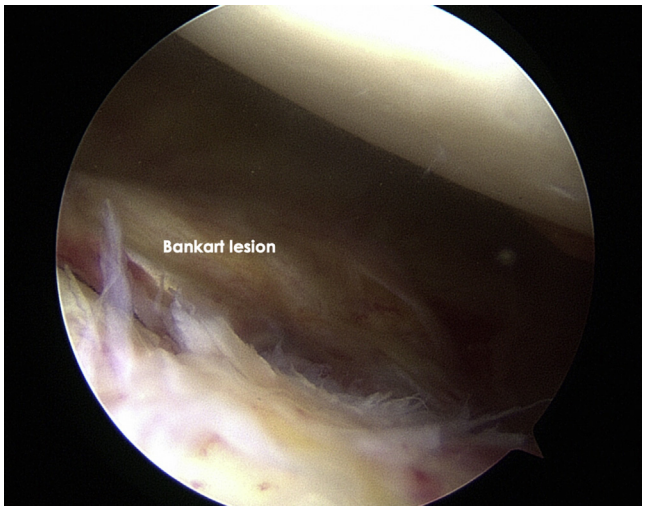

Fig 9. Arthroscopic view from the posterior portal in the right shoulder. The anterior-inferior labrum is torn, showing a Bankart lesion. The flattening of the anterior-inferior glenoid should be noted.

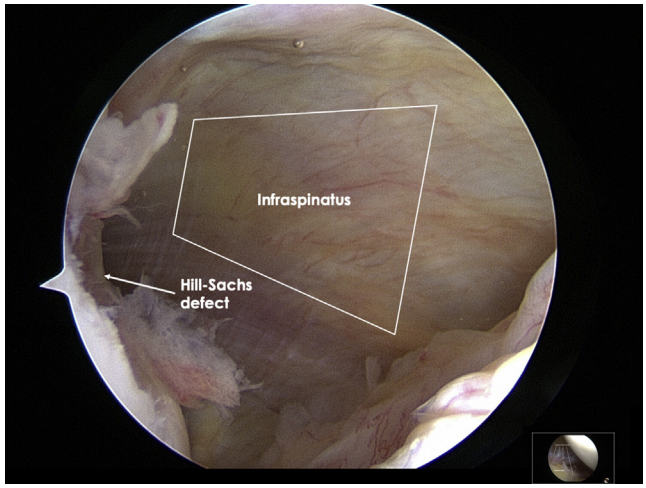

Fig 11. Arthroscopic view from the anterior portal in the right shoulder showing a portion of the Hill-Sachs defect. The articular side of the infraspinatus is also well visualized from this position.

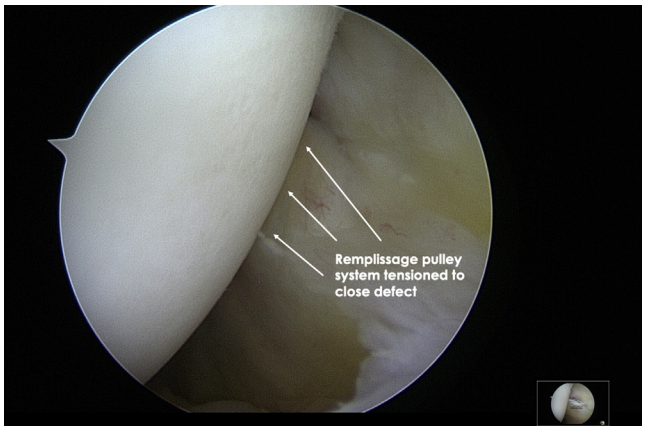

Fig 12. Arthroscopic view from the anterior portal in the right shoulder showing the result of the double-pulley system when tensioned and tied down. The superior portion of the Hill-Sachs lesion is completely covered with the capsular tissue from the articular side of the infraspinatus.

Postoperative Care

Postoperatively, the shoulder is stabilized with an immobilizer sling for 6 weeks. The goal during these 6 weeks is to avoid elevation and lifting with the operative limb. Scapular isokinetic and pendulum exercises are performed in physical therapy. From 6 weeks postoperatively onward, sling use is discontinued and the patient begins strengthening physical therapy. Advantages and disadvantages of the technique are shown in Table 1, and pearls and pitfalls are presented in Table 2.

Discussion

In their 2000 article, Burkhart and De Beer[3] reported that arthroscopic Bankart repair patients with bony defects were at a greater risk of recurrent dislocation. This has been echoed in subsequent studies.[20-24] Currently, arthroscopic Bankart repair and the open Latarjet procedure are the preferred surgical techniques when addressing recurrent shoulder dislocation. Several studies have suggested that arthroscopic Bankart repair with remplissage has a comparable recurrent dislocation rate to that of the Latarjet procedure, whereas others have reported higher recurrence rates in patients who have undergone remplissage.[25-27] Several meta-analyses examining patient outcomes after Bankart repair with remplissage exist in the literature. Buza et al.[28] conducted a review of 6 studies and found recurrence and complication rates of 5.4% and 0.6%, respectively. In their meta-analysis of 22 studies, Liu et al.[20] reported a recurrence rate of 4.7%. These studies support remplissage as an alternative to the Latarjet procedure with comparable recurrence rates and a favorable complication rate. In contrast, a recent cohort study by Yang et al.[25] compared patient outcomes of Bankart repair with remplissage versus the Latarjet procedure and found that the remplissage group had higher postoperative pain scores and less internal rotation in abduction (40.9° vs 53.2°) whereas the Latarjet group had a higher complication rate (12.1% vs 1.0%).

There is equipoise in the literature as to whether remplissage reduces postoperative range of motion. Deutsch and Kroll[29] were among the first authors to publish a case report showing loss of external rotation (ER) after arthroscopic remplissage. Whereas some larger studies have reported losses in ER after remplissage, others have reported no statistically significant difference.[20,28-33] Remplissage continues to have comparable return-to-sport rates to the open Latarjet procedure; however, some concern exists for throwing athletes.[34-36] In their 2016 case series, Garcia et al.[36] reported that 65.5% of their patients had difficulty throwing and 58.6% felt "they could not

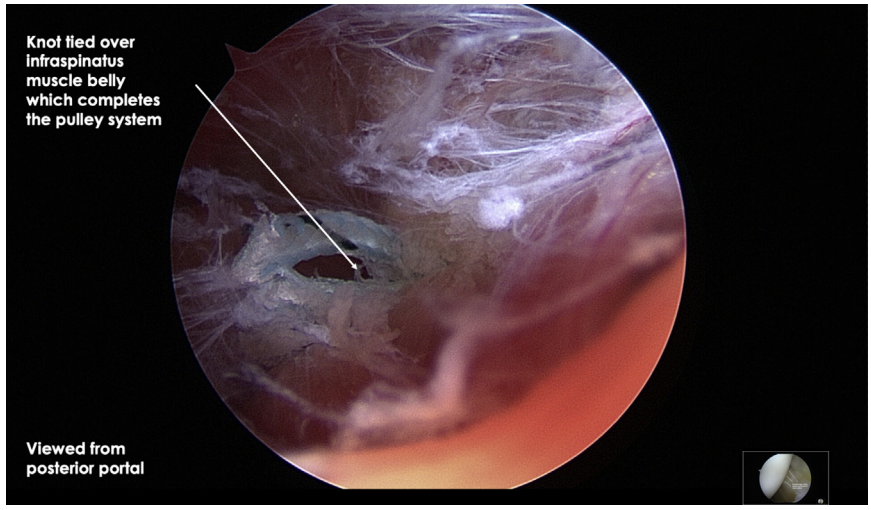

Fig 13. Extra-articular arthroscopic view from the posterior portal in the right shoulder showing the tied knot over the infraspinatus muscle that completes the double-pulley system. When cinched down and tied, the infraspinatus and underlying capsular tissue reduce securely into the Hill-Sachs defect, completing the remplissage repair.

Table 1. Advantages and Disadvantages of 2-Portal Remplissage Technique

Advantages	Disadvantages
Requires fewer portals	Can be technically challenging
Reduces operative time	Cannot visualize knots as they are tied
Eliminates need for percutaneous access	
Allows visualization of infraspinatus reduction	

normally wind up throwing a ball." However, Garcia et al. also noted a statistically insignificant reduction in ER (−5.3°). This finding highlights a potential pitfall in analyzing remplissage outcomes: Statistically insignificant reductions in range of motion may still be clinically significant to the patient, particularly the elite athlete.

Another potential concern regarding remplissage is postoperative pain. A number of studies have commented that remplissage patients have higher postoperative pain scores.[26,32,36,37] In their cohort study, Nourissat et al.[32] found that a third of patients had persistent posterosuperior pain. They provided 2 possible explanations: (1) The pain is related to partial healing of the infraspinatus tendon, and (2) impingement between the posterior labrum and the footprint of the rotator cuff could be a contributing factor. Lädermann et al.[38] conducted a cadaveric study of remplissage, discovering that the procedure is a capsulomyodesis of the infraspinatus and teres minor rather than a capsulotenodesis of the infraspinatus. They believe that muscular damage from the capsulomyodesis contributes to the persistent pain that some remplissage patients experience.

Compared with the Latarjet procedure, arthroscopic Bankart repair with remplissage is less technically demanding and reduces the likelihood of complications. This Technical Note describes a double-pulley remplissage using a 2-portal technique. Previously, the senior author described his knotless adaptation of the remplissage, modifying the double-pulley technique of Koo and Burkhart[12] by eliminating knot tying.[19] Using the anterior portal as the viewing portal allows for sutures to be passed through the posterior portal, eliminating the need for lateral percutaneous access. In addition, it allows for visualization of the infraspinatus being reduced to the Hill-Sachs defect. The cost of this technique is the inability to visualize the knots as they are tied. In experienced hands, reducing the number of portals and percutaneous access points minimizes operative time and confers theoretical reductions in postoperative morbidity.

Table 2. Pearls and Pitfalls of 2-Portal Remplissage Technique

Pearls	Pitfalls
The remplissage anchors should be spaced appropriately within the lesion to ensure proper coverage when reducing the infraspinatus.	Improper portal placement can make placing anchors challenging.
The remplissage anchors should be placed first to prevent disruption of labral repairs.	Poor suture management can lead to the suture ends from the same anchor being tied.

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