Technical Note

Arthroscopic Remplissage Using a Double-Pulley System for Hill-Sachs Lesions for Recurrent Shoulder Instability

Brittany M. Woodall, D.O., Nicholas Elena, M.D., Danoush Paborji, B.A., Edward C. Shin, M.D., Neil Pathare, M.D., Patrick J. McGahan, M.D., and James L. Chen, M.D., M.P.H.

Abstract: Hills-Sachs lesions are bony lesions in the humeral head that occur as a result of an anterior shoulder dislocation. These lesions often happen in conjunction with tears of the labrum, and large, engaging lesions must be addressed in order to avoid recurrent instability. Moderate to large (≥3 mm deep) Hill-Sachs defects can be treated using arthroscopic remplissage to reduce the rotator cuff down into the lesion. We describe in this Technical Note and accompanying video an adaptation of the classic arthroscopic remplissage that uses a knotless double-pulley technique with 2 suture anchors, which increases the footprint of fixation, reduces the technical difficulty of the procedure, and minimizes the number of portals that need to be made.

The treatment of choice for patients with anterior shoulder instability is currently the arthroscopic Bankart repair.[1-6] However, even with soft-tissue stabilization surgery, patients with osseous defects in the humeral head, such as Hill-Sachs lesions, are at increased risk for recurrent instability.[1-6] Recurrent instability occurs when the osseous defect in the humeral head engages the glenoid rim and can lead to failure of soft-tissue stabilization surgery.[1-6] When a Hill-Sachs lesion is identified in a patient with shoulder instability, additional procedures are indicated in conjunction with arthroscopic soft-tissue stabilization surgery.[1-6] Many different procedures have been performed to attempt to correct the defect such as open capsular shift, coracoid transfer to the anterior glenoid, humeral head-plasty, osteochondral allograft transplantation, disimpaction, and remplissage.[1] Variations of the remplissage technique have been studied and have shown a recurrence rate between 5% and 20% depending on the technique used.[3-13] The remplissage technique can be used in conjunction with a soft-tissue stabilization technique such as a Bankart repair and/or SLAP repair.[1-13] The purpose of this Technical Note is to describe the use of a knotless double-pulley system in an arthroscopic remplissage procedure. The technique is a knotless adaptation of the double-pulley technique using 3.9-mm PEEK (polyether ether ketone) knotless corkscrew suture anchors (Arthrex, Naples, FL) through a posterior cannula. Our technique provides a broad footprint of fixation and reduces the number of portals required to perform the procedure. This procedure differs from the previously described techniques in that it is a knotless technique with different size and types of anchors used and with the use of percutaneous access, avoiding the need for additional portals.[14-20]

Surgical Technique

Preoperative Evaluation

The diagnosis of shoulder instability is determined using a combination of patient history, clinical examination, and medical imaging. The history is typically that of a patient who sustained an initial shoulder dislocation through trauma or repetitive strain and continues to

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

The authors report the following potential conflicts of interest or sources of funding: J.L.C. receives support from Arthrex. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received February 23, 2018; accepted March 26, 2018.

Address correspondence to Brittany M. Woodall, D.O., Advanced Orthopaedics and Sports Medicine, 450 Sutter Street, Ste 400, San Francisco, CA 94108, U.S.A. E-mail: Brittany@aosportsmed.com

2212-6287/18260

https://doi.org/10.1016/j.eats.2018.03.013

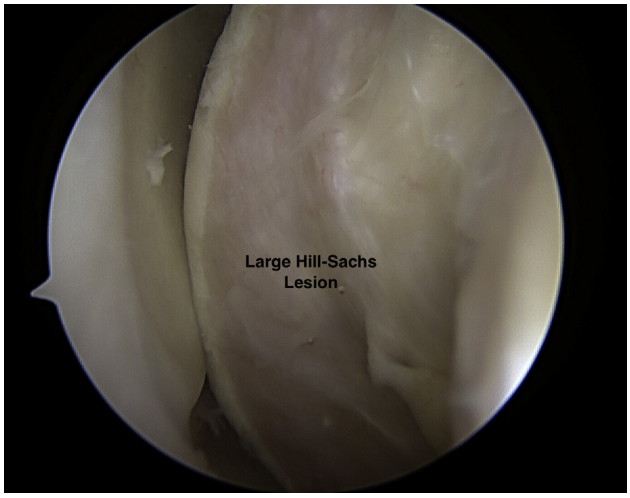

Fig 1. Large Hill-Sachs defect of the posterior humeral head viewed from the posterior portal within the subacromial space of the right shoulder.

have shoulder pain with recurrent subluxations or dislocations. The patient may or may not have a history of failed surgeries. Sulcus sign, apprehension test, relocation test, and anterior and posterior translation tests may be positive, indicating shoulder instability. The injured shoulder is always compared with the contralateral shoulder during physical examination. Plain x-ray of the shoulder is typically normal unless the patient presents with an acute dislocation, large Hill-Sachs, or bony Bankart lesion. Diagnosis is confirmed with magnetic resonance imaging, which may show a labral tear, Bankart tear, or Hill-Sachs lesion. Indications for surgical repair of a Hill-Sachs lesion are $<25\%$ bone loss of the glenoid and/or Hill-Sachs lesions that are ≥ 3 mm deep. Larger defects are better addressed with a Latarjet or other bone grafting procedures.

Patient Setup

The patient is placed supine on a standard operative table with a shoulder positioner attachment and anesthetized using general anesthesia. The patient is then placed into the beach chair position with the shoulder and arm positioned using a Spider limb positioner (Arthrex). The operative shoulder is prepared with preoperative skin prep solution proximally from the shoulder to the hand and is draped in the usual sterile fashion.

Arthroscopic Portal Placement

Standard shoulder arthroscopy is performed using a 30° 4.0-mm arthroscope. The anatomical landmarks are identified and marked. To establish the posterior viewing portal, a vertical incision is made in the soft spot of the shoulder using a no. 11 blade. The glenohumeral joint is entered using a blunt trocar and scope sheath. A complete diagnostic arthroscopy is performed, inspecting for chondral damage, bony defects, labral damage, and tendon tears. A spinal needle is used to localize the anterior viewing portal under arthroscopic visualization, an incision is made in the same vertical fashion, and an 8.25-mm cannula is then placed. A switching stick is then placed in the posterior portal.

Remplissage

Viewing from the anterior portal with a 4-0 mm 30° angled arthroscopic camera, the damaged labrum is identified. Then viewing from the posterior portal, the Hill-Sachs defect (Fig 1) is identified and prepared using a 4-0 shaver to gently debride soft tissue. Percutaneous access is placed, via needle localization, superolateral and posterolateral to the posterior portal for anchor placement. A tap is used to create a pilot hole (Fig 2), and a double-loaded 3.9 PEEK knotless corkscrew suture anchor (Arthrex) is placed within the defect perpendicular to the lesion (Fig 3). A second suture anchor of the same type is placed in the same fashion so that they are spaced evenly within the lesion, sitting in an inferior/superior configuration. Each suture anchor is loaded with a repair suture (white with light blue stripe) and a FiberLink suture (Arthrex; white with black stripe). After anchor placement, the Bankart and/or SLAP repairs are completed to allow for easier access to the labrum and to avoid disruption of Bankart and/or SLAP repairs. After completion of the labral repair, the sutures from anchor 1 sit inferior to the infraspinatus tendon, while the sutures from anchor 2 sit superior to the infraspinatus tendon (Fig 4). The repair suture from anchor 1 and the FiberLink sutures from anchor 2 are retrieved through the percutaneous portal. The repair suture from anchor 1 is then threaded through the eyelet end of the FiberLink suture from anchor 2. The noneyelet end of the FiberLink is then pulled to shuttle

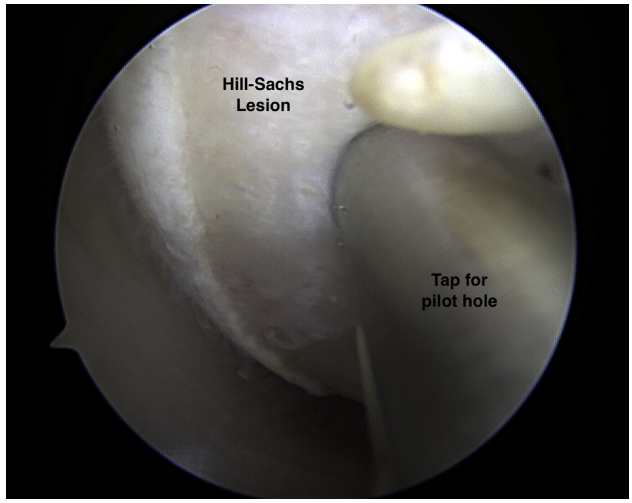

Fig 2. Tap used to create a pilot hole in the Hill-Sachs defect for suture anchor placement, viewed from the posterior portal within the subacromial space of the right shoulder.

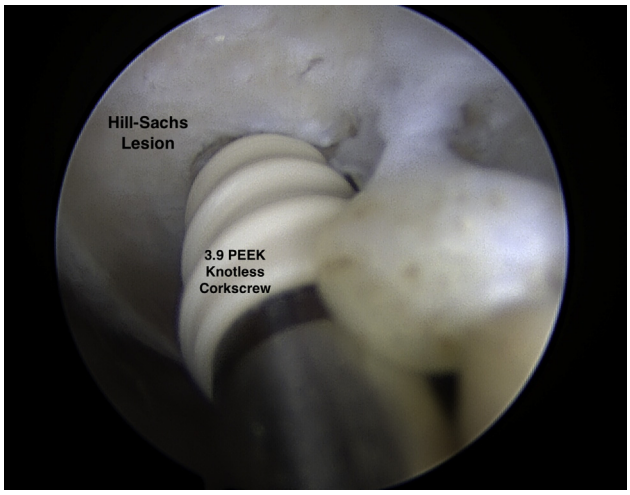

Fig 3. Transtendon placement of 3.9 × 10.2 PEEK knotless corkscrew suture anchor, through percutaneous access, viewing through the posterior portal within the subacromial space of the right shoulder.

the repair suture from anchor 1 into the locking mechanism of suture anchor 2. This is then tensioned down within the subacromial space, over the infraspinatus tendon, by pulling the excess end of the repair suture that has been pulled through anchor 2 (Fig 5). This excess suture is then cut once adequate tension has been achieved. The remaining repair suture from anchor 2 and FiberLink sutures from anchor 2 are shuttled and tensioned in the same fashion. This reduces the infraspinatus down into the Hill-Sachs lesion (Fig 6). These keys steps are demonstrated in Video 1.

Postoperative Care

The patient is placed in a shoulder immobilizer sling for 6 weeks postoperatively, during which time the patient avoids active elevation and lifting objects with the affected arm. The goal of the first 6 weeks is to maintain passive motion with pendulum exercises and scapula isokinetics. During this time, range of motion is restricted to 120° passive forward flexion and 30° passive external rotation. After 6 weeks, the sling is discontinued and goals focus on gradually regaining full range of motion and strengthening of the rotator cuff. After 18 weeks, the patient is allowed to gradually return to regular activities.

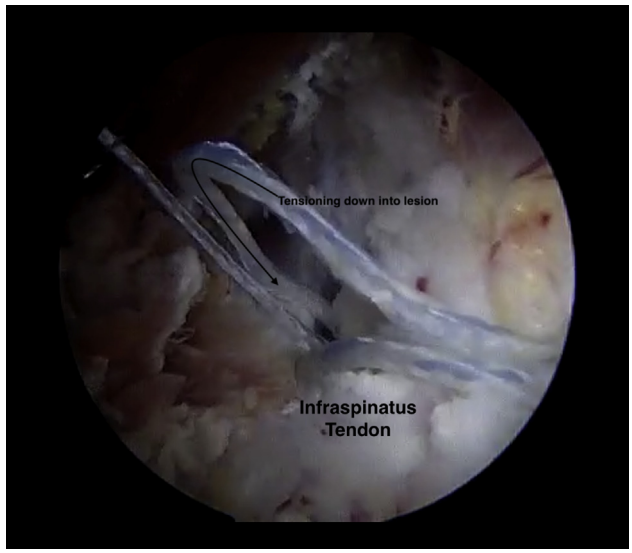

Fig 5. Tensioning down of second suture to create the double-pulley remplissage and reduce the infraspinatus tendon into the Hill-Sachs lesion, viewing from the posterior portal in the subacromial space of the right shoulder.

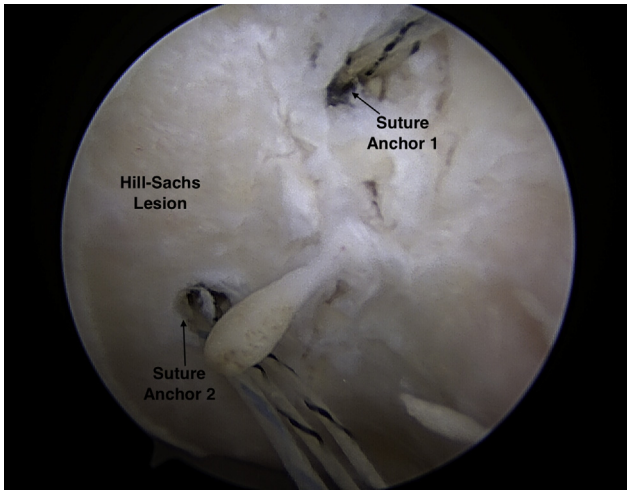

Fig 4. Two evenly spaced suture anchors placed in the inferior/superior configuration within the Hill-Sachs defect viewing from the posterior portal within the subacromial space of the right shoulder.

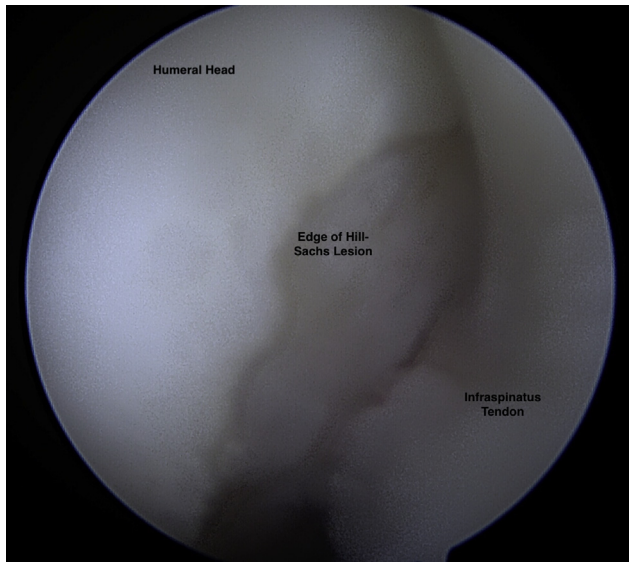

Fig 6. Viewing from the posterior portal within the glenohumeral joint, the infraspinatus tendon is filling in the Hill-Sachs defect of the right humeral head.

Table 1. Classic Versus Double-Pulley Remplissage

Classic Remplissage	Double-Pulley Remplissage
Difficult to achieve large separation between suture anchors	Large separation easily achieved with transtendon suture anchor placement
If large separation is achieved, tendon bunches in lesion.	No bunching of tendon because of suture bridge created over the tendon
Technically difficult and time consuming to bird-beak sutures through tendon	No need to pass sutures through tendon
Requires arthroscopic knot tying	Knotless suture anchor eliminates the need for knot tying

Discussion

The management of Hill-Sachs lesions is complex and involves numerous interventions. Even before the description of the lesion by Hill and Sachs in 1940, there was debate on how to treat osseous defects of the humeral head.[1-20] The goal of remplissage is to fill in the bony defect and improve stabilization by converting the intra-articular lesion to an extra-articular lesion and thus preventing engagement of the lesion with the glenoid.[1-6,14-20] Many investigators have theorized that this may result in loss of range of motion; however, a study on the anatomical and functional results after an arthroscopic Hill-Sachs remplissage by Boileau et al. concluded that the loss in range of motion was less than 10° and did not affect return to sport.[7-13]

The classic arthroscopic remplissage technique first described by Wolf et al.[3] in 2004 uses 2 suture anchors and requires a suture passer to pass sutures through the muscle belly and posterior capsule and then ties the sutures from each anchor independently in the subdeltoid space.[14] Our technique eliminates the need for a suture passer and therefore reduces operative time and technical difficulty of the procedure. In addition, the sutures from each anchor are secured to the sutures of the other anchor in the subacromial space, thereby creating a double-pulley system. Moreover, the sutures in this technique are secured around the infraspinatus tendon, therefore decreasing the risk of muscle necrosis secondary to suture strangulation. Our technique also differs from the adaptation to the original published by Koo et al. in 2009 in that we use knotless suture anchors, therefore eliminating the extra operative time taken to tie arthroscopic knots.[15]

Our proposed technique has many differences compared with the classic remplissage technique (Table 1). While this technique has advantages, there are also risks (Table 2); however, we do not anticipate an increased rate of complications. With the application of the double-pulley technique, there is a larger footprint of fixation and decreased bunching of the tendon within the lesion. Additionally, the use of 2 suture anchors allows this technique to be used in larger Hill-Sachs lesions, thus avoiding the morbidity of a possible open procedure. Using the double-pulley technique also simplifies the remplissage procedure by passing the sutures around the tendon, thus avoiding the need to pass sutures through the tendon with a suture passer and forming a more anatomic construct.

Table 2. Risks and Advantages

Advantages
Decreased operative time
Decreased technical difficulty
Larger footprint of fixation
More anatomical construct
Risks
Suture anchor pullout
Recurrent instability
Possible decrease in range of motion

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