

Remplissage Using Percutaneous Needle Navigation With Knotless Anchors in a Suture Staple Configuration



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Abstract: Remplissage is a procedure that decreases the rate of recurrent instability after arthroscopic stabilization in patients with an engaging Hill-Sachs lesion. This technique involves capsulotenodesis of the infraspinatus tendon and posterior capsule into the Hill-Sachs lesion using 2 knotless anchors with suture passage through the infraspinatus tendon guided by a percutaneous needle. Previously described techniques use knots or anchor placement through the infraspinatus, which can be challenging to control and irreversible if tendon penetration occurs in an undesirable location. Benefits of this technique include less manipulation within the subacromial space, precision with suture passage through the infraspinatus tendon and capsule to maximize spread, and decreased morbidity for the cuff tissue.

Shoulder instability is a common pathology that is multifactorial and can be addressed surgically.¹ A posterior humeral head defect, known as a Hill-Sachs lesion, was first described in 1940,² and it is the result of the anterior glenoid rim forcefully contacting the posterior humeral head. Hill-Sachs lesions occur because the inferior glenohumeral ligament and the anterior-inferior labrum fail and thus cannot statically restrain the humeral head within the glenoid fossa, causing an impaction injury.³ The prevalence of bony defects can be up to 90% in first-time instability events and up to 100% for those with multiple shoulder dislocations.^{4,3}

The “glenoid track” was first described by Di Giacomo et al. in 2016 when referring to the presence or absence of engagement of a Hill-Sachs lesion with the anterior

glenoid. An “off-track” Hill-Sachs lesion is one that is prone to engagement with the anterior glenoid due to size and/or location on the glenoid track.^{4,5} Bone loss is a significant factor in determining management for patients with shoulder instability, especially for patients with an engaging Hill-Sachs lesion. They are at higher risk for recurrence after a soft tissue arthroscopic Bankart repair alone.⁶ Surgeons may address a Hill-Sachs lesion with a remplissage, which is performed by suturing the infraspinatus and posterior capsule into the defect.⁷ The efficacy of remplissage has been well described both clinically and biomechanically. In 2016, Hartzler et al.⁸ demonstrated that remplissage prevented engagement of off-track lesions

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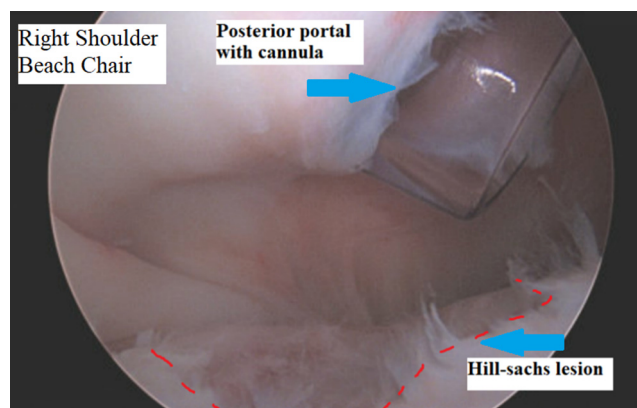


Fig 1. View from the anterior portal of the Hill-Sachs lesion on the posterior humeral head. Right shoulder in beach chair position.

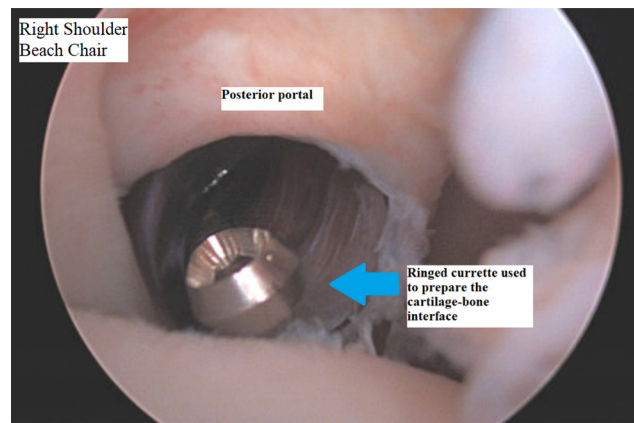


Fig 2. A ringed curette is used to prepare the bone-cartilage interface at the Hill-Sachs lesion. Right shoulder in beach chair position.

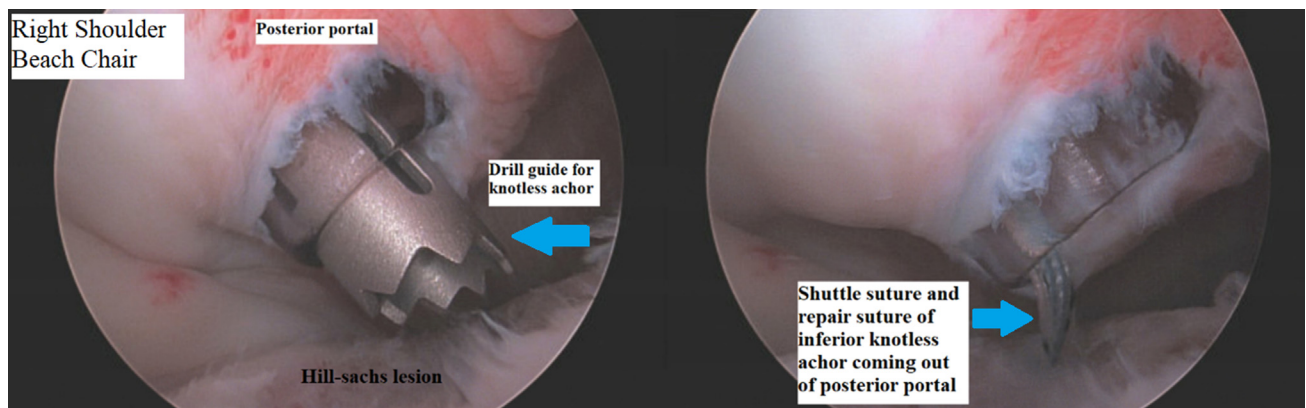


Fig 3. (Left) Introduction of the drilling guide. (Right) placement of a 2.6mm knotless fibertak anchor (Arthrex; Naples, FL) into the inferior aspect of the Hill-Sachs Lesion. Right shoulder in beach chair position.

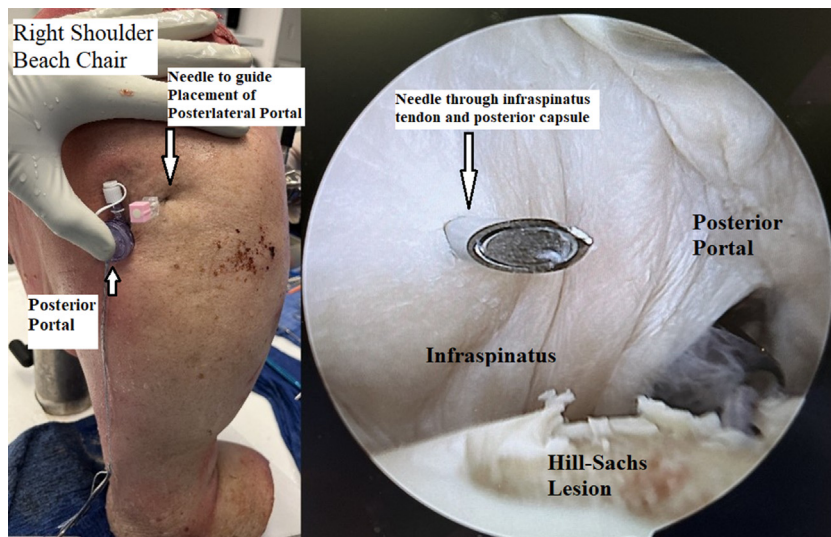


Fig 4. (Left) A spinal needle is used to percutaneously localize a posterolateral portal. (Right) Under visualization from the anterior portal, the surgeon can ensure that infraspinatus tendon can be adequately captured from the posterolateral portal prior to making incision. Right shoulder in beach chair position.

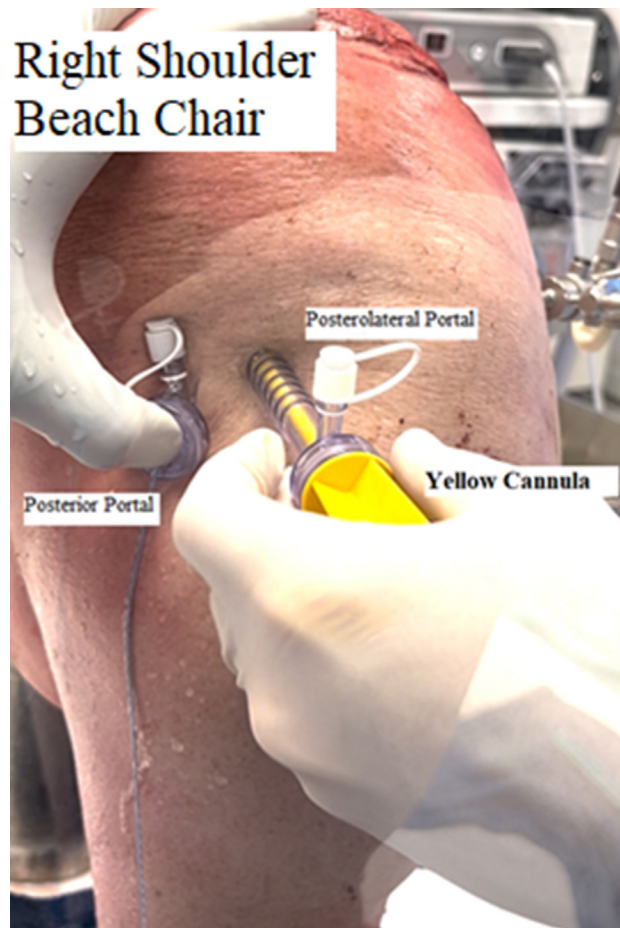


Fig 5. The yellow cannula is placed to create the posterolateral portal and sweep the bursal tissue off of the infraspinatus. Right shoulder in beach chair position.

in patients with 15% or more bone loss. Further, several studies report that patients who underwent remplissage in the setting of an off-track Hill-Sachs lesion were less likely to have recurrent instability than patients with a Bankart repair alone.^{9,10}

Previous techniques have described ways of using knotless anchors in an all-inside procedure that eliminates the need to access the subacromial space.² However, it can be difficult to predict the exact location and volume of infraspinatus that will be captured by the anchor's suture. Previous knotless techniques do not address the precision needed for infraspinatus spread to fill the Hill-Sachs defect. In the authors' experience, prior knotless techniques can lead to skiving, infraspinatus damage, and poor volume of tissue captured to fill the Hill-Sachs lesion. Additionally, when the anchor is passed through the tendon in a poor location, this creates an irreversible error as changing this location leaves a large defect in the infraspinatus tendon. This report describes a technique that uses knotless anchors in a crossed configuration with a percutaneous needle through a cannula as a guide for passing sutures in an exact location during a remplissage procedure.

The cadaver specimen used in this article was obtained via ethical sourcing with the aid of Arthrex.

Surgical Technique

Indications

Surgical intervention is an option for patients who have ongoing recurrent shoulder instability with a known off-track Hill-Sachs lesion. Along with examination, imaging of the shoulder can be useful in the workup and operative planning.

Patient Setup

The operating surgeon prefers positioning in the beach chair with the surgical limb in a limb holder. This technique can also be easily used in the lateral decubitus position.

Procedure

Landmarks should be identified, including the borders of the acromion, the clavicle, acromioclavicular joint, and the coracoid anteriorly. A standard posterior portal is established, and the arthroscope is positioned in the

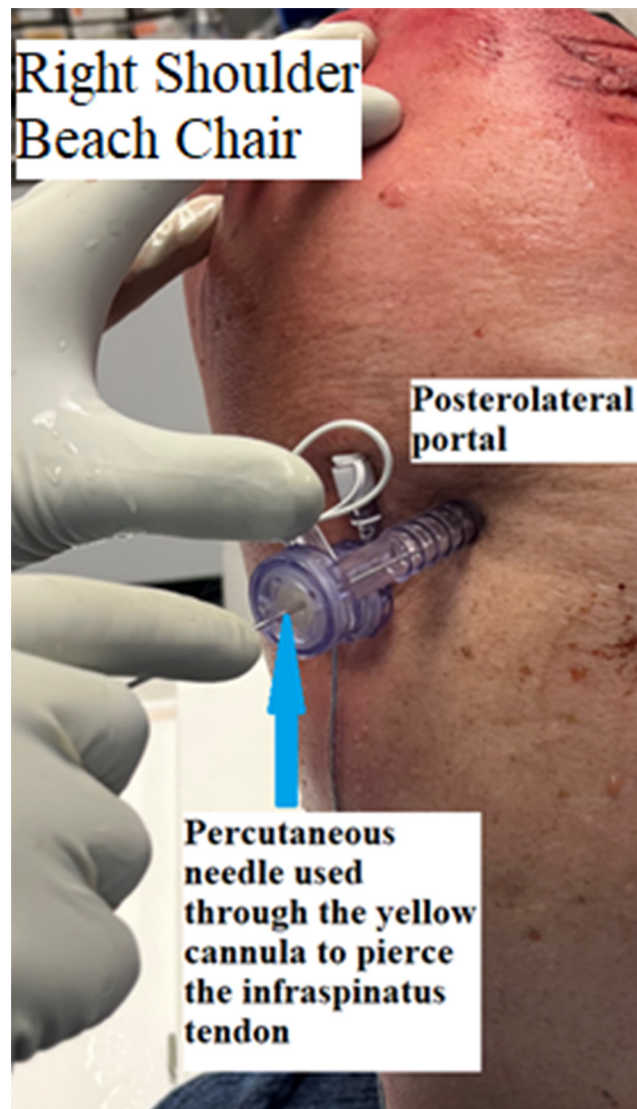


Fig 6. A percutaneous needle is placed through the yellow cannula in the posterolateral portal to pierce the infraspinatus at the desired location. Right shoulder in beach chair position.

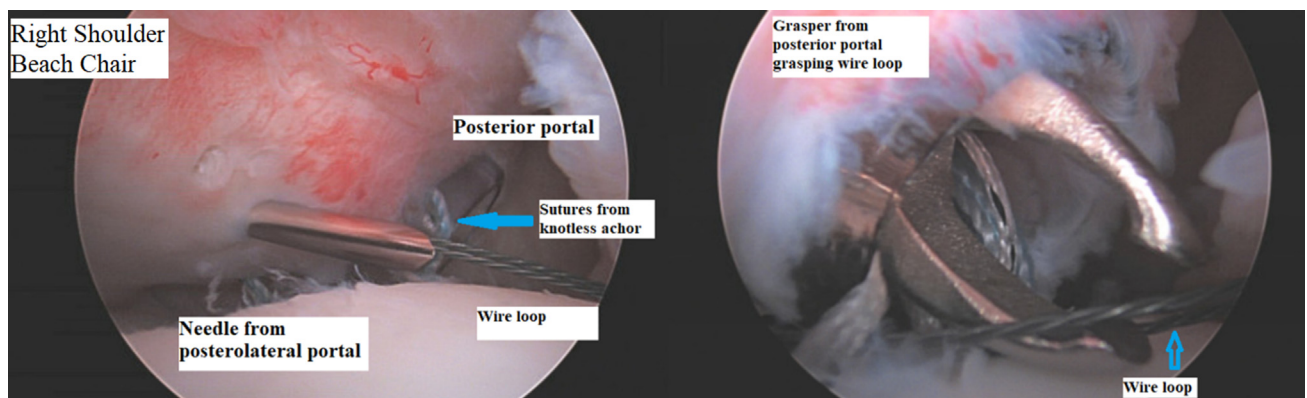
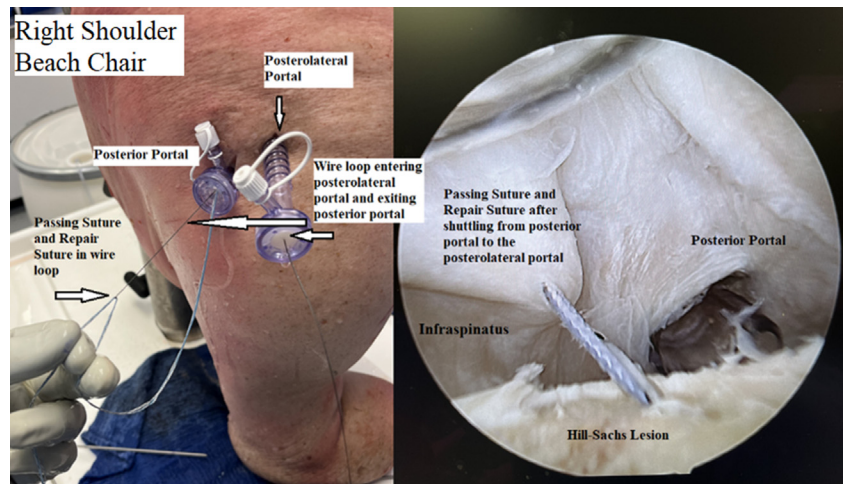


Fig 7. (Left) A wire loop can be introduced through the infraspinatus via the percutaneous needle in posterolateral portal. (Right) The wire loop is then pulled through the posterior portal using a grasper. Right shoulder in beach chair position.

Fig 8. (Left) The wire loop is used to pull the repair suture and the shuttle suture from the posterior portal through the infraspinatus tendon and out the posterolateral portal. (Right) Image demonstrating the shuttled sutures going through the infraspinatus and out of the posterolateral portal. Right shoulder in beach chair position.



glenohumeral joint. A diagnostic examination should be carried out, confirming the pathology. An anterior arthroscopic portal is created via an outside-in technique, placing a spinal needle through the rotator interval to confirm an appropriate trajectory to address any anterior labral pathology. Using the posterior viewing portal, any anterior labral pathology should be addressed using the surgeon's preferred method prior to performing remplissage, as the glenohumeral joint can become quite constricted after performing remplissage.

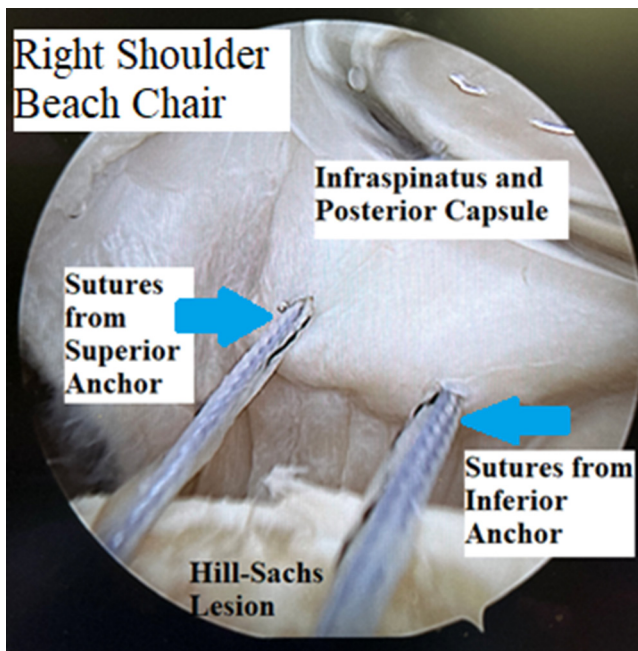


Fig 9. Once the suture shuttling process through the infraspinatus has been completed for both the superior and inferior anchors, the repair suture and the shuttling suture for both anchors should have captured a portion of the infraspinatus as they exit through the posterolateral portal. Right shoulder in beach chair position.

The scope can be placed within the anterior portal over the biceps tendon for improved visualization of the Hill-Sachs lesion on the posterior humeral head. A high and lateral placed portal is best for accessing the posterior labrum and visualizing the posterior humeral head defect. A posterior cannula is placed into the initial posterior portal site for ease of access (Fig 1). A ringed curette is used to roughen the bone-cartilage interface within the Hill-Sachs lesion to establish an area for healing (Fig 2). An anchor is placed within the inferior aspect of the lesion using the 2.6-mm knotless FiberTak anchor (Arthrex) through the posterior portal (Fig 3). Medialization or lateralization of this anchor placement is dependent on surgeon preference and patient needs. Next, localize with a spinal needle for an accessory posterolateral portal for good access to the infraspinatus tendon. During this step, ensure that an adequate volume of infraspinatus tendon is medial to the tip of the spinal needle (Fig 4). Once pleased with the location of the needle through the infraspinatus, create the accessory posterolateral portal. Place a cannula with a blunt, plastic obturator through this incision (Fig 4). With the yellow cannula, sweep superficial to the infraspinatus to clear off bursal tissue (Fig 5). Next, use the percutaneous needle through the yellow cannula to puncture through the infraspinatus tendon at the precise location desired (Fig 6). At this step, adjustments can be made without causing much damage to the tendon. Through a percutaneous needle within the yellow cannula in the posterolateral portal, a wire loop can be introduced through the infraspinatus (Fig 7) to shuttle the sutures of the inferior anchor from the posterior portal out of the posterolateral portal through the infraspinatus (Fig 8). The anchor placement and suture shuttling process is then repeated with the placement of a knotless suture anchor in the superior aspect of the Hill-Sachs lesion. The authors recommend performing inferior anchor placement

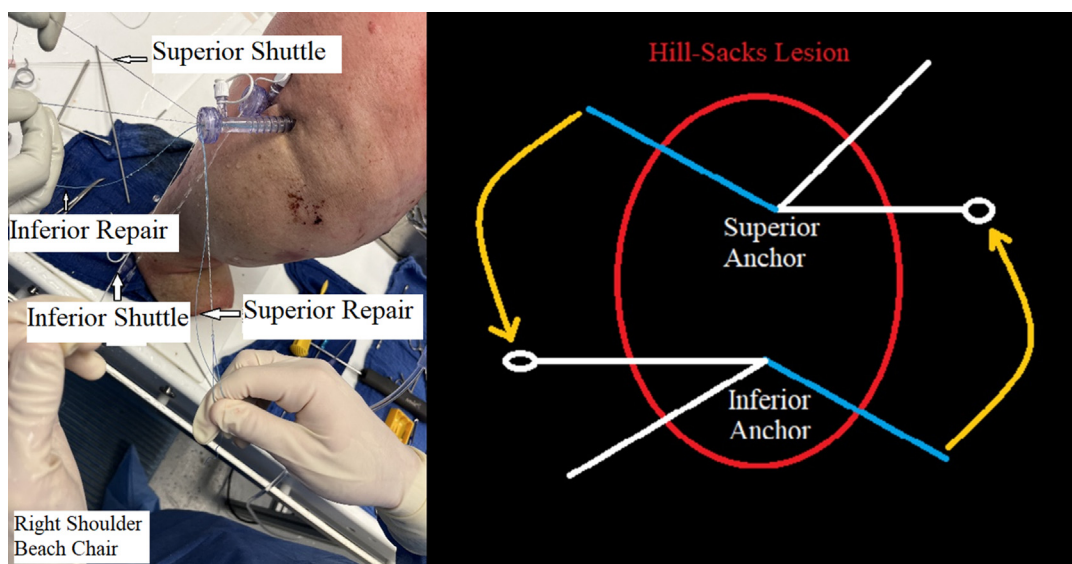


Fig 10. (Left) The blue repair suture of the inferior anchor is placed into the black and white shuttle suture loop of the superior anchor and the blue repair suture of the superior anchor is placed into the black and white shuttle suture loop of the inferior anchor. Right shoulder in beach chair position. (Right) Drawing demonstrating the shuttling technique.

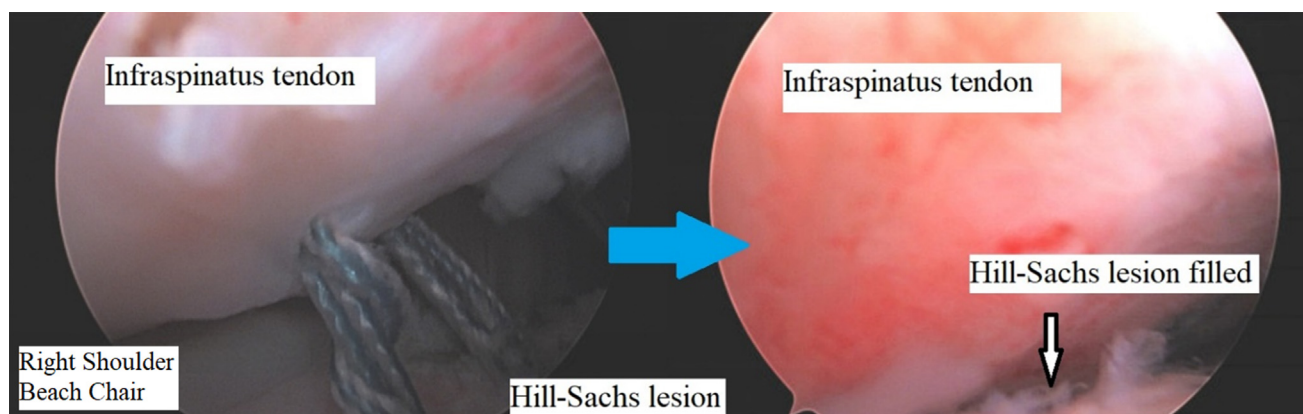


Fig 11. (Left) View from the anterior portal after the sutures have been shuttled. They can be tensioned to utilize the knotless mechanism to form a suture staple. (Right) Image demonstrating the compression of the infraspinatus tendon into the Hill-Sachs lesion to fill it. Right shoulder in beach chair position.

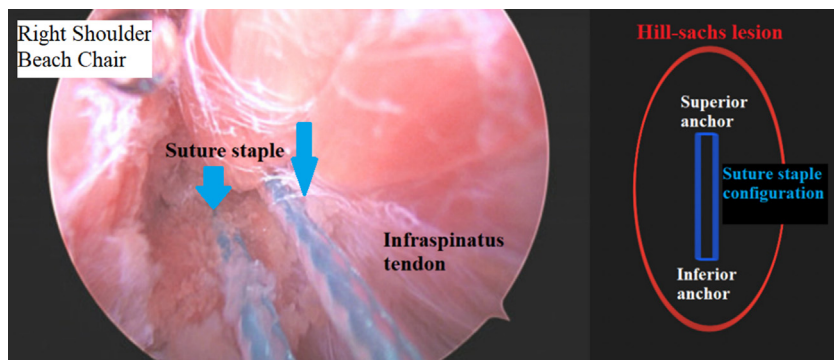


Fig 12. (Left) View from within the subacromial space via the posterolateral portal of the suture staple compressing the infraspinatus and capsule into the Hill-Sachs lesion. Right shoulder in beach chair position. (Right) A drawing demonstrating the suture staple configuration in relation to the Hill-Sachs lesion.

Table 1. Pearls and Pitfalls of Remplissage Using Percutaneous Needle Navigation With Knotless Anchors in a Suture Staple Configuration

Anterior portal should be placed inferior enough to address any inferior glenoid pathology and lateral enough to access the Hill-Sachs lesion.
The scope should be placed superior to the long head of the biceps tendon for best visualization of the Hill-Sachs lesion.
Placing the inferior anchor within the Hill-Sachs lesion allows for improved visualization during the procedure.
Any anterior glenoid procedures should be performed prior to remplissage as the glenohumeral joint space can be markedly reduced after reduction of the infraspinatus into the Hill-Sachs lesion.

prior to the superior anchor placement for improved visualization during the procedure (Fig 9).

Both sets of sutures should be out of the posterolateral accessory cannula. Next, place the repair suture of the inferior anchor into the shuttle suture loop of the superior anchor and place the repair suture of the superior anchor into the suture loop of the inferior anchor (Fig 10). After the sutures have been shuttled, the surgeon can tension both suture limbs and use the knotless mechanism of the anchors to form a suture staple that reduces the infraspinatus tendon down into the Hill-Sachs defect (Fig 11). View through the posterolateral portal to confirm that there are no loops within the suture staple (Fig 12). Each suture limb should be cut. Final arthroscopic images should be taken and all instruments removed from the glenohumeral joint. Portal incisions should be closed in a standard fashion (Table 1, Video 1).

Discussion

Anterior shoulder instability lends itself to a variety of surgical procedures and techniques when considering treatment options. Treatment plans must consider factors such as glenoid bone loss and the location and dimensions of a Hill-Sachs lesion.⁷ Special consideration should be given to whether the lesion is “on-track” or “off-track” to guide operative decision-making.^{3,4,6,7} When addressing anterior shoulder instability, it was demonstrated by Hartzler et al.⁸ that remplissage

produced favorable results in restoring stability in cases of shoulder instability with off-track bipolar lesions.

The described technique is useful when addressing Hill-Sachs lesions due to the ability to reduce the posterior capsule tissue into the defect. Because the surgeon can visualize the articular side of the remplissage while tensioning the knotless sutures, they can ensure complete reduction of the tissue within the defect. In this technique, a suture staple is created by alternating the repair suture from each anchor on the bursal side of the infraspinatus tendon. Because there are no knots involved in this technique, the surgeon does not have to perform significant manipulation within the subacromial space, which can be challenging in this region. Additionally, by using the described percutaneous needle guidance for suture retrieval, surgeons can more accurately determine the quantity and location of the infraspinatus tendon being penetrated and reduced. This decreases the risk of subsequent iatrogenic rotator cuff damage or skiving and creating too small of an infraspinatus reduction that may inadequately fill the Hill-Sachs defect. Some limitations may include difficulty with the execution of a technique that a surgeon has not previously performed, difficulty of visualizing the Hill-Sachs defect with improper anterior portal placement, and possibly an increased operative time due to the use of percutaneous needle navigation prior to suture passage through the infraspinatus (Table 2).

In conclusion, percutaneous penetration of the infraspinatus tendon through a cannula is a reversible and correctable technique that ensures that the knotless suture staple captures an adequate volume of infraspinatus to fill the Hill-Sachs defect while decreasing the risk of iatrogenic posterior cuff damage. Additionally, this knotless suture staple technique is efficient and avoids the sometimes burdensome task of accessing the posterior subacromial space.

Disclosures

All authors (C.E., C.B., J.S., J.B.G.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 2. Advantages and Limitations of Remplissage Using Percutaneous Needle Navigation With Knotless Anchors in a Suture Staple Configuration

Advantages	Limitations
Minimal manipulation within the subacromial space	Execution of an untried technique can be technically difficult
Increased accuracy in the location of the infraspinatus tendon penetration	Possible increased operative time due to percutaneous needle use prior to suture passage through the infraspinatus
Decreased risk of iatrogenic rotator cuff damage and skiving during anchor placement	Difficulty in visualizing the Hill-Sachs lesion with improper anterior portal placement

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