Technical Note

Arthroscopic All-Inside Suture Bridge for Remplissage Procedure Treating Off-Tracking Hill–Sachs Lesions in Anterior Shoulder Instability

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Abstract: Hill–Sachs lesions are significantly correlated with recurrent anterior shoulder instability. The remplissage procedure is designed to fill a posterosuperior humeral head defect with the infraspinatus tendon and posterosuperior capsule in patients with off-track Hill–Sachs lesions. This Technical Note describes an arthroscopic all-inside suture bridge to gain more footprint contact area and tissue compression to improve healing. Moreover, it does not have the necessity of going through the subacromial space to retrieve and tie the sutures. Thus, the procedure reduces the operative time and improves reproducibility.

Bone defects are increasingly recognized as a critical risk factor for recurrent anterior shoulder instability.[1-3] Posterosuperior humeral head bone defects are commonly known as Hill–Sachs lesions and were initially described by Hill and Sachs in 1940.[4] Both preoperative imaging and dynamic intraoperative assessment are used to evaluate the critical size of bone loss on the humeral side as an off-tracking[5] or engaging lesion.[6] Different surgical interventions have been described to address it, including humeral defect augmentation, such as a remplissage procedure; humeral bone augmentation[7]; rotational osteotomy[8]; humeral resurfacing[9]; humeral disimpaction procedure[10]; or even glenoid defect augmentation.[11]

The remplissage procedure, described by Wolf and Purchase in 2004,[12] effectively treats anterior shoulder instability associated with a critical humeral defect in combination with arthroscopic anterior labral repair. Biomechanical studies have shown the advantages of this combined procedure.[13] Clinical studies have reviewed excellent outcomes in long-term follow-up.[14] The French word "remplissage" means "filling" in English. Its principle is to fill the intra-articular Hill–Sachs lesion by arthroscopic posterior capsulodesis and infraspinatus tenodesis to transform it into an extra-articular lesion.

It can be challenging for surgeons who do not experience many vital points, including inadequate visualization, inaccurate anchor placement, difficulty retrieving the sutures from the subacromial space, or probable damage to the suture while clearing tissue in the subacromial area. Hence, several technical variations and adaptations have been proposed.[15] The technique described here differs from other previous methods using an all-inside suture bridge as "double-row" compression to improve capsulotenodesis approximation to the defect floor without needing arthroscopic knots.

Surgical Technique (With Video Illustration)

Surgical Positioning

After the induction of general anesthesia, a physical examination is performed comparing the affected side with the contralateral side. The examination includes a load and shift test to confirm and evaluate instability for direction, degree, or dislocated position. The patient is then placed into the standard beach chair position with the monitor positioned directly opposite the surgeon.

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The operative shoulder is prepared with preoperative skin preparation solution and subsequently draped in the usual sterile fashion (Fig 1).

Arthroscopic Portal Placement

All bony anatomical landmarks, including the acromial process, distal clavicle, coracoid process, and humeral head, are identified and marked. A standard posterior portal is established approximately 2 cm medial and 1 cm inferior to the posterolateral edge of the acromion to access intra-articular visualization and be used as the working portal for the eventual remplissage procedure. A diagnostic arthroscopic examination using 30° arthroscopy is performed.

An anterior working portal for arthroscopic Bankart repair and anterosuperior portal are then created using the outside-in technique. The anteroinferior labrum is mobilized. Then, freshening of the anterior glenoid is performed. An accessory posterior portal is formed next, approximately 1 to 2 cm inferior to the acromion's posterolateral angle, to initiate anchor placement into the Hill–Sachs lesion (Fig 2).

Remplissage Procedure

After switching the camera to the anterosuperior portal to better view the entire Hill–Sachs lesion (Fig 3), an arthroscopic 4-mm bone cutter motorized shaver and burr (DYONICS POWERMINI; Smith & Nephew, Andover, MA) is introduced through the posterior portal to debride the thin membranous scar tissue. Then, the bleeding bone for enhancing biological healing is created.

A 4.5-mm double-loaded suture anchor (CrossFT; CONMED Linvatec, Largo, FL) as a "medial-row" is first placed perpendicular to the prepared cancellous base via the accessory posterior portal (Fig 4B). The 4 strands of the sutures are passed through the posterior capsule and infraspinatus tendon by a 2-step suturing and shuttling technique using a retrograde penetrating device (Spectrum II; CONMED Linvatec (Fig 4A and C-E). After inserting the shuttled suture strands of the first anchor into the system, we insert a 4.5-mm knotless suture anchor (PopLok; CONMED Linvatec) superiorly. Tensioning is applied, and the locking mechanism trapped subcortically to provide secure fixation in the bone (Figs 5 and 6, Video 1).

Arthroscopic Bankart Repair

In this technique, there is no need to enter the subacromial space to retrieve and tie the sutures. The surgeon may now proceed with regular Bankart repair by switching the arthroscope to the posterior portal

Fig 1. Standard beach chair position for operating on a right recurrent anterior shoulder dislocation and planning for remplissage procedure.

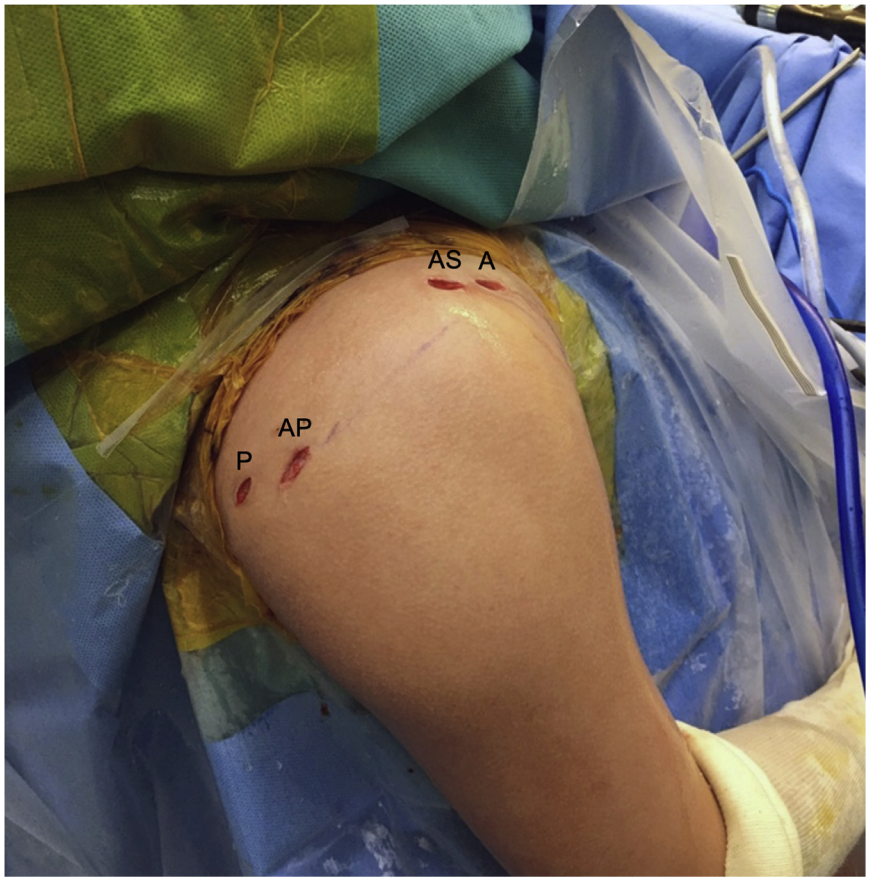

Fig 2. Arthroscopic portals for remplissage procedure of the right shoulder. (A, standard anterior; AP, accessory posterior; AS, anterosuperior; P, standard posterior.)

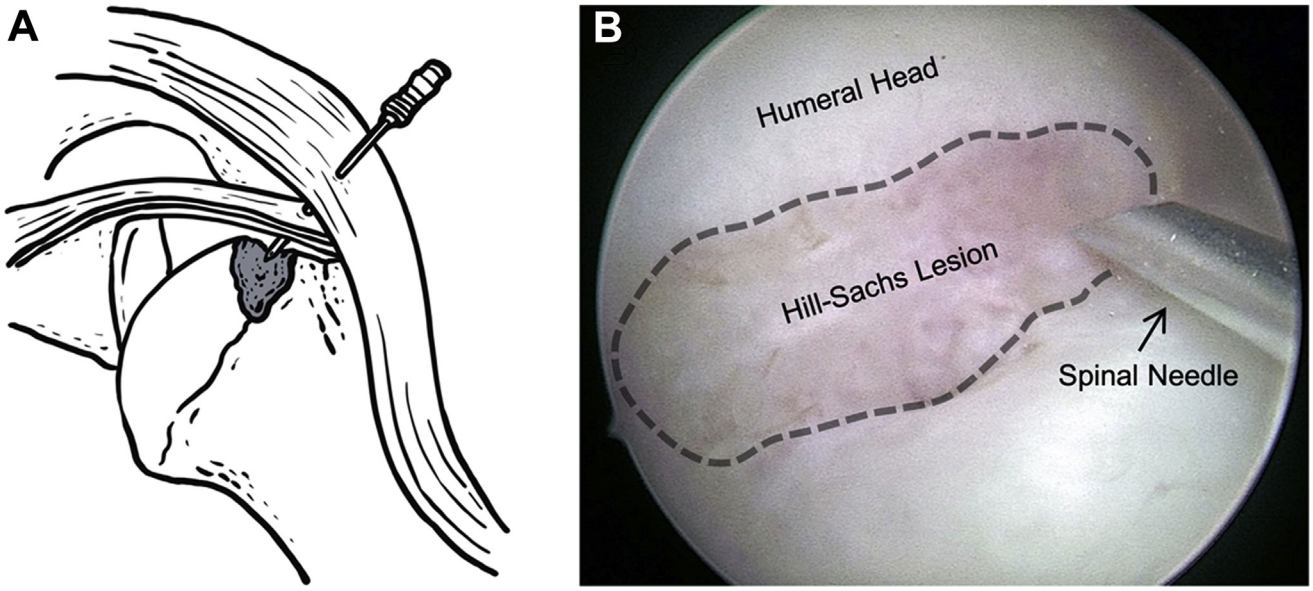

Fig 3. Drawing and arthroscopic view demonstrating the method to create an accessory portal in a patient with right recurrent anterior shoulder dislocation. (A) The accessory posterior portal is created using the outside-in technique with a spinal needle guide for suture anchor insertion. (B) Arthroscopic viewing from the standard posterior portal demonstrating the overall Hill−Sachs lesion in dashed line.

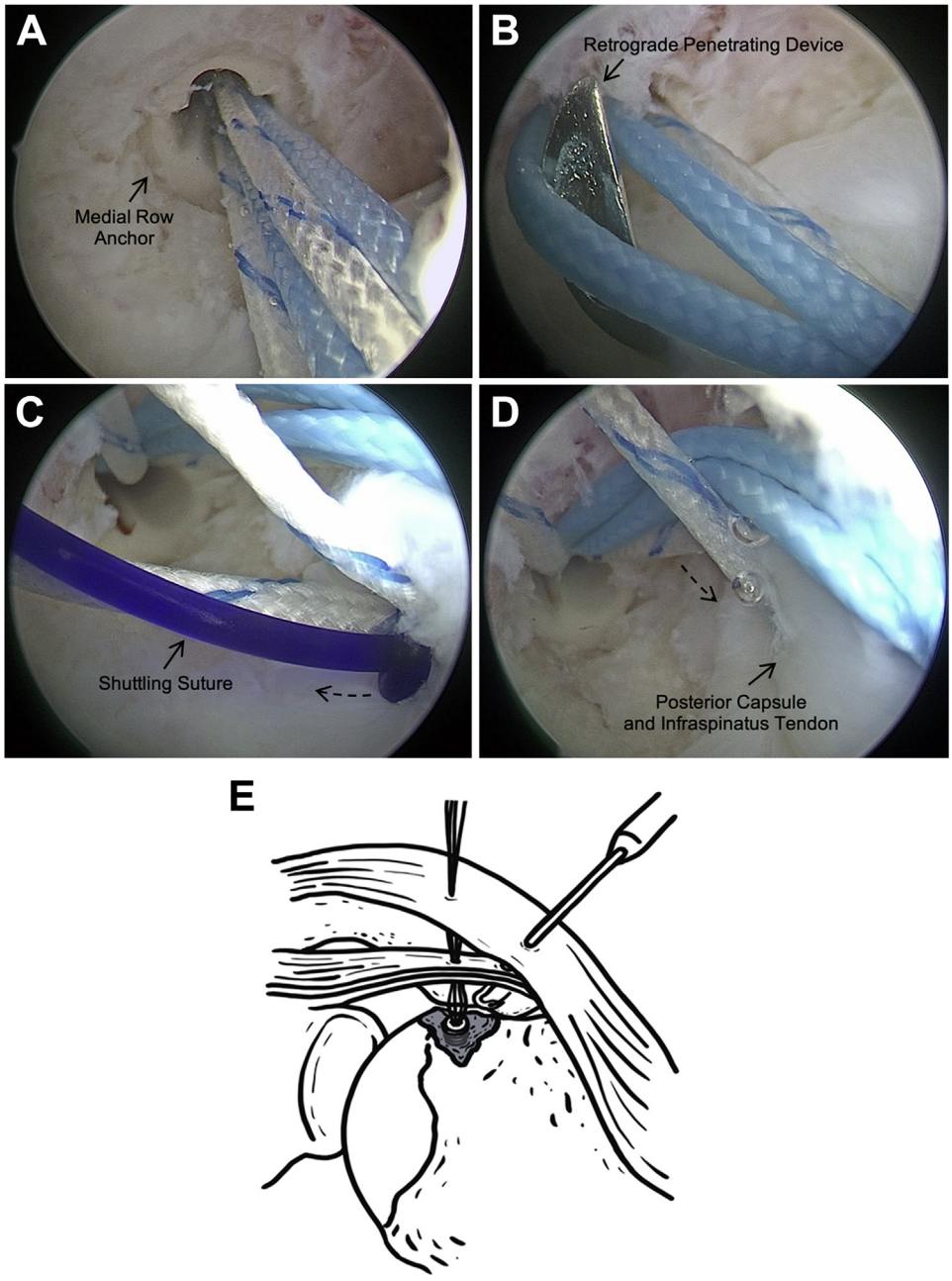

Fig 4. Demonstration of the method for doing a remplissage procedure in a patient with recurrent right anterior shoulder instability. (E) Schematic drawing of the placement of the anchor and suture. (A) Arthroscopic view from the anterosuperior portal showing the 4.5-mm double-loaded suture anchor (CrossFT; CONMED Linvatec) being inserted onto the prepared cancellous base. (B-D) The suture strand is passed through the posterior capsule and infraspinatus tendon by a 2-step suturing and shuttling technique (dashed arrows) using a retrograde penetrating device (Spectrum II; CONMED Linvatec).

and using the anterosuperior and anterior portals as working portals.

Postoperative Care

The operative shoulder is stabilized with a sling immobilizer for 3 to 4 weeks postoperatively. During this time, only passive motion with scapular isokinetic and pendulum exercises is allowed under a physical therapist's supervision. From 4 weeks postoperatively onward, sling immobilization is discontinued. Active range of motion is started at 6 weeks postoperatively, and strengthening exercises are then performed. A return to sports activities should be at 4 to 6 months postoperatively. Advantages/disadvantages and pearls/pitfalls of the procedure are further described in Tables 1 and 2.

Discussion

The critical size of Hill–Sachs lesions depends on glenoid bone loss, as Di Giacomo et al.[16] separated shoulders with anterior instability into 4 groups. If

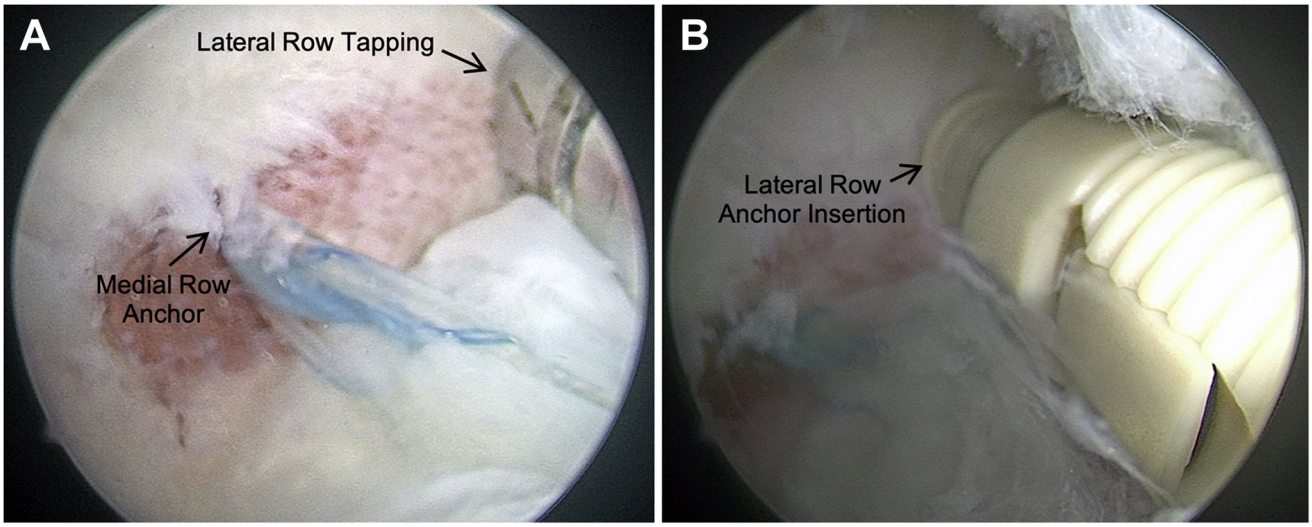

Fig 5. The arthroscopic view from the anterosuperior portal in a patient with right anterior shoulder dislocation who underwent the remplissage procedure. (A) The first placed suture anchor in the Hill–Sachs lesion. (B) The 4.5-mm knotless suture anchor (PopLok; CONMED Linvatec) is inserted superiorly.

the glenoid defect is more than 25%, glenoid bone reconstruction, such as a Latarjet procedure or iliac crest bone grafting, should be performed regardless of whether the Hill–Sachs lesion is on- or off-track. If the glenoid defect is less than 25% and the Hill–Sachs lesion is on-track, only arthroscopic Bankart repair can address the instability. In contrast, if the Hill–Sachs lesion is off-track, a humeral head procedure should be performed.

Overall outcomes of the remplissage procedure have consistently demonstrated high satisfaction and good functional scores in long-term follow-up with a minimum of 10 years.[17,18] Especially in subcritical glenoid bone loss, which is the treatment's gray zone,[19] the remplissage procedure added to the arthroscopic Bankart repair can give comparable clinical outcomes with the Latarjet procedure.[20] Fewer complications and less technical demand in primary cases of the average population who are not collision or contact athletes were noted.[21] Although there is minimal loss of external rotation after surgery due to nonanatomic reconstruction, it is not functionally deficient and does not seem to be an issue in the long term.[14,22] Another concern about the remplissage procedure is postoperative pain, which has been reported in the literature.[23-25] The contributing factors are partial healing of the infraspinatus tendon and impingement between the posterior labrum and rotator cuff footprint.[23,26] The recovery of the tendon–bone interface begins with fibrovascular tissue formation between the repaired

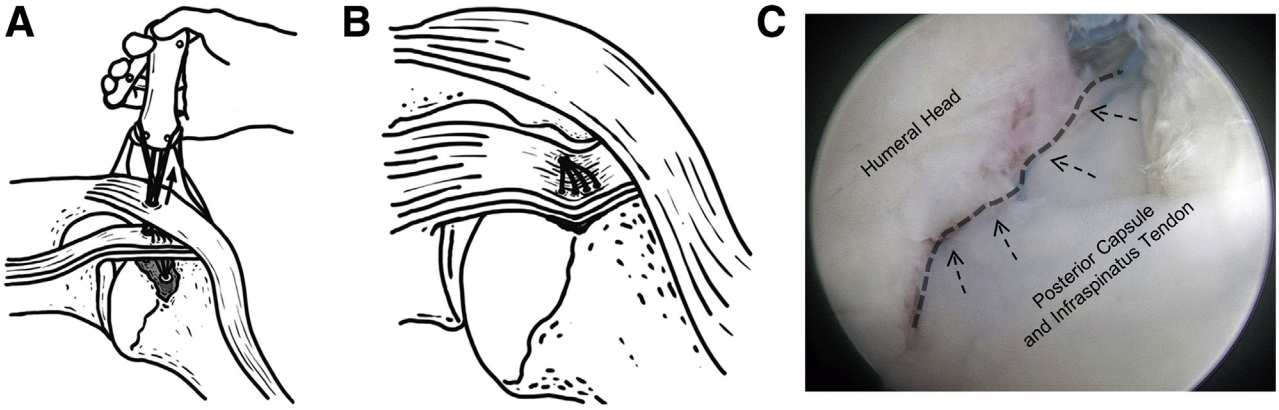

Fig 6. The schematic drawings and arthroscopic view of a patient with a right anterior shoulder dislocation who underwent the remplissage procedure. (A) Drawing of the tensioning of the suture to increase the contact pressure of the footprint of the capsulotenodesis with double-row suture bridging. (C) The arthroscopic view from the anterosuperior portal reveals the posterior capsule and infraspinatus attached to the defect (dashed line and arrows). (B) Illustration of the finished procedure.

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
No subacromial space approach; no need to perform a bursectomy to locate the sutures and possibly damage them	More technically challenging
No need to tie arthroscopic knots	The difficulty of suture management
Reduced operation time	Not being able to visualize the extra-articular side of the suture construct
Increased contact area and pressure of the capsulotenodesis footprint with double-row suture bridging configuration	Need more portals
Easier and more predictable tensioning	More costly implants

tendon and bony footprint. The healing potential relies on the footprint contact area and compression of the repaired construct.[27-30]

Even though the simple principle of the remplissage procedure is conceptually straightforward, it can be difficult for the arthroscopic surgeon to attempt it for the first time due to a combined glenohumeral and subacromial approach necessitating fussy shifting of the arthroscopic views. Moreover, subacromial bursectomy is often necessary to visualize and retrieve sutures for knot tying and add to the entire complexity of the procedure, resulting in a prolonged surgical time.

This arthroscopic all-inside suture bridge technique for remplissage procedures can be applied broadly for most Hill–Sachs lesions that need to be addressed. By eliminating the necessity to go through the subacromial space, this technique saves time and improves reproducibility. Our caution for applying this technique is flexible portal placement, which can differ in each patient due to variations in pathological anatomy. Choosing the appropriate suture passers is up to the preference of surgeons. Suture management is more technically demanding than the original procedure because of the all-inside approach. The pearls and pitfalls are shown in Table 2. However, to be strong and give more footprint contact area and compression force of the tissue into the humeral head, we believe that this technique can improve the healing of the remplissage. It can be successfully concurrent with arthroscopic Bankart repair in patients with off-tracking Hill–Sachs lesions with mild-to-moderate glenoid bone loss.

Table 2. Pitfalls and Pearls

Pitfalls	Pearls
Inadequate working space of Hill–Sachs lesion due to inappropriate portal placement	Use the spinal needle to localize the portal site by the outside-in technique, together with traction and manipulation during surgery by the assistant
Less take-down tissue	Use optimal curves and angles of retrograde suture passing devices
More complicated suture shuttling	One-by-one dealing with sutures and application of anterior accessory portal for retrieving the unused sutures

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