Technical Note

Dynamic Anterior Stabilization of the Shoulder: Onlay Biceps Transfer to the Anterior Glenoid Using the Double Double-Pulley Technique

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Abstract: The treatment of anterior glenohumeral instability includes several surgical options, ranging from soft tissue to bony procedures—open or arthroscopic. In arthroscopic dynamic anterior stabilization (DAS) of the shoulder, the long head of the biceps is transferred to the anterior glenoid through a subscapularis tendon split. The biceps may be fixed either in an inlay or in an onlay position. Inlay DAS theoretically increases anterior glenohumeral stability through 3 different effects: the hammock effect, sling effect, and the tensioning effect. Onlay DAS may additionally increase stability through a labroplasty effect, produced by the onlay positioning of the biceps on the anterior glenoid rim. The current technical note presents tips and tricks, and pearls and pitfalls, to reproducibly perform onlay DAS using all-suture anchors and the double double-pulley technique.

Introduction

The treatment algorithm of anterior glenohumeral instability with limited to subcritical glenoid bone loss (GBL) is controversial.[1] Bony transfer techniques are associated with low recurrence, but high complication rates.[2,3] Conversely, clinical studies on isolated or augmented Bankart repair have reported low complication rates,[4-6] but higher recurrence rates, or unsatisfactory outcomes, in the setting of subcritical GBL.[7,8] Dynamic anterior stabilization (DAS) with long head of the biceps tendon (LHB) transfer to the anterior glenoid is an arthroscopic soft tissue procedure that combines some advantages of bony transfers and soft tissue augmentation procedures.[9,10] Arthroscopic DAS with the biceps fixed in an inlay position in the anterior glenoid was originally described by Collin and Laddermann.[9] Several modified techniques of inlay DAS have been reported.[11-14] Arthroscopic DAS with the LHB fixed in an onlay position on the anterior glenoid rim was originally described by Milenin and Toussaint.[10] One modification of onlay DAS has been published.[15] The authors of the current technical note have used onlay DAS in their clinical practice since 2018.[16] DAS can be technically demanding, and some technical improvements have been introduced after the first report of the clinical results of onlay DAS, using the double double-pulley (DDP) technique. The purpose of the current technical note is to present the tips and tricks of onlay DAS using all-suture anchors and the DDP technique. The authors show how to reproducibly perform the technique and highlight the technical pearls and pitfalls.

Surgical Technique (With Video Illustration)

Each step of the surgical technique is illustrated in Video 1 and Figs 1-14. The pearls and pitfalls are shown in Table 1. A detailed informed consent was obtained from each patient.

Patient Setup

The patient is positioned in the beach chair position. The range of motion and the direction of instability are

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Fig 1. Anatomic landmarks and portals drawn on a right shoulder for dynamic anterior stabilization. The shoulder is placed at 70° of elevation and 10° of abduction, and in neutral rotation, using a mechanical arm holder. The position of 3 portals is drawn (blue lines). (A, anterior portal; AL, anterolateral portal; P, posterior portal.)

confirmed under general anesthesia before sterile preparation of the skin and placement of surgical drapes. The shoulder is placed at 70° of elevation and 10° of abduction, and in neutral rotation, using a mechanical arm holder (AssistArm Surgical Limb Positioner; ConMed). Anatomic landmarks are drawn with a dermographic pen (Fig 1).

Arthroscopic Approach

Three arthroscopic portals are used.

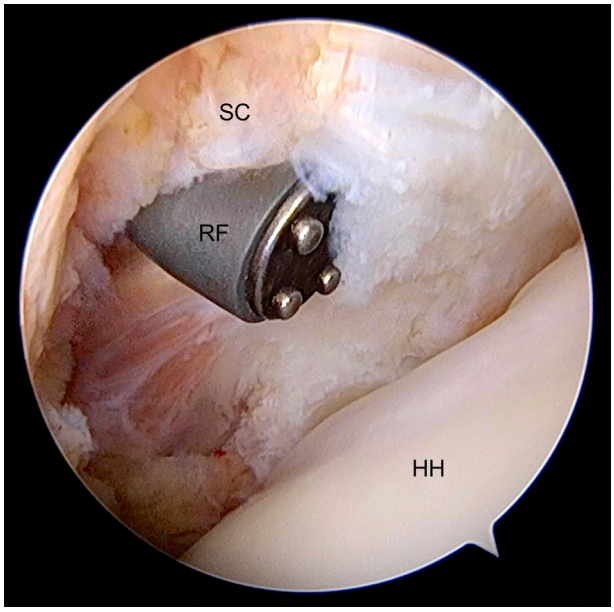

Fig 2. Subscapularis tendon split (right shoulder). Posterior portal view of the radio frequency ablator placed from the superficial to the intra-articular direction through the split, ready to continue splitting the subscapularis tendon from medial to lateral, on the articular side of the subscapularis, under direct vision. (HH, humeral head; RF, radiofrequency ablator probe; SC, subscapularis tendon.)

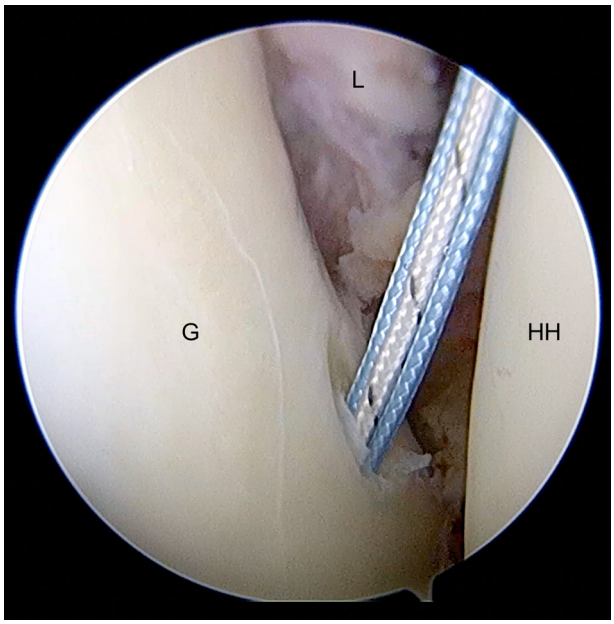

Fig 3. First anchor implanted at the 5 o'clock position (right shoulder). Posterior portal view of the first 1.8-mm, all-suture anchor implanted on the anteroinferior glenoid rim, double-loaded with the sutures seen going through the subscapularis tendon split and the anterior portal. (G, glenoid; HH, humeral head; L, labrum.)

Posterior Portal

The posterior portal is the principal viewing portal and is established in the soft spot, aiming the 4-mm and 30° arthroscope at the coracoid process. Inspection of the humeral head, glenoid, rotator cuff tendon insertions, and LHB tendon are performed. The dynamic engagement of the Hill-Sachs lesion is tested by placing the shoulder at increased degrees of abduction and external rotation.

Anterior Portal

The anterior portal is the principal working portal and is established from outside-in, under direct vision, using an 18-gauge spinal needle directed to the superior border of the subscapularis tendon, lateral to the conjoint tendon. A working cannula with an outflow connection (7 × 85-mm Hex Flex cannula; ConMed) is placed through this portal. A gauged probe is used to identify and classify a concomitant SLAP tear.

Anterolateral Portal

The anterolateral portal is used as a working and secondary viewing portal, and is established from outside in, distal to the anterolateral aspect of the acromion, using the 18-gauge spinal needle directed laterally to the transverse humeral ligament (THL), parallel and slightly distal to the superior border of the subscapularis.

The placement of the suture anchors is marked on the anterior glenoid rim, at the 4 and 5 o'clock positions on a right shoulder, using the 3.5 × 130-mm bipolar radio

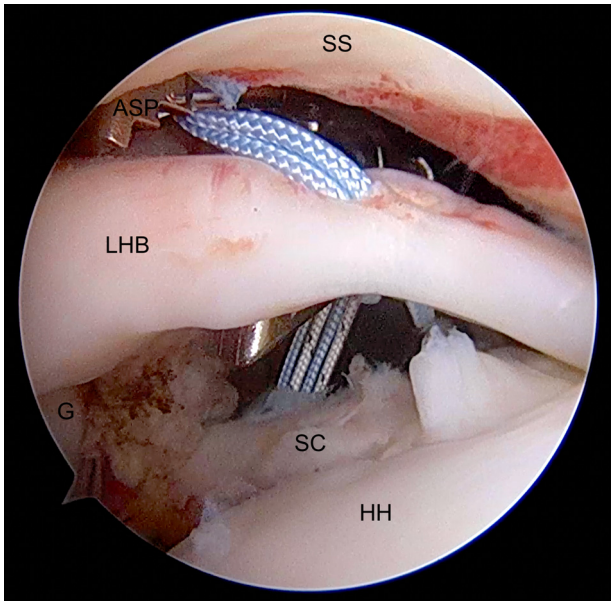

Fig 4. First suture limb from the 5 o'clock anchor passed through the LHB (right shoulder). Posterior portal view of the automatic suture passer placed through the anterior portal, retrieving the first suture limb from the 5 o'clock anchor that was passed through the LHB, just proximal to the transverse humeral ligament. (ASP, automatic suture passer; G, glenoid; HH, humeral head; LHB, long head of biceps tendon; SC, subscapularis tendon; SS, supraspinatus tendon.)

frequency ablator probe (EDGE 90°; ConMed) placed through the anterior portal. The middle glenohumeral ligament is excised until the muscle fibers of the subscapularis are visualized. The bony bed of the Bankart lesion is debrided using the 4 × 125-mm automated shaver (Formula Aggressive Plus Cutter; Stryker).

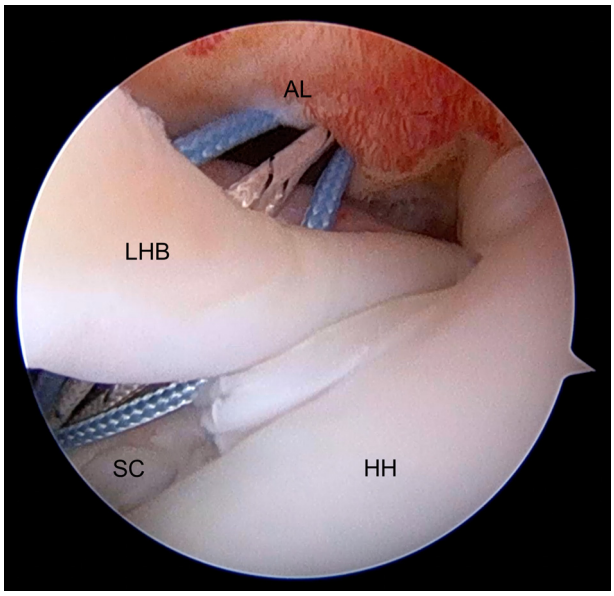

Fig 5. Four suture limbs of the 5 o'clock anchor passed through the LHB (right shoulder). Posterior portal view of the 4 suture limbs of the 5 o'clock anchor passed through the LHB and parked in the anterolateral portal. (AL, anterolateral portal; HH, humeral head; LHB, long head of biceps; SC, subscapularis tendon.)

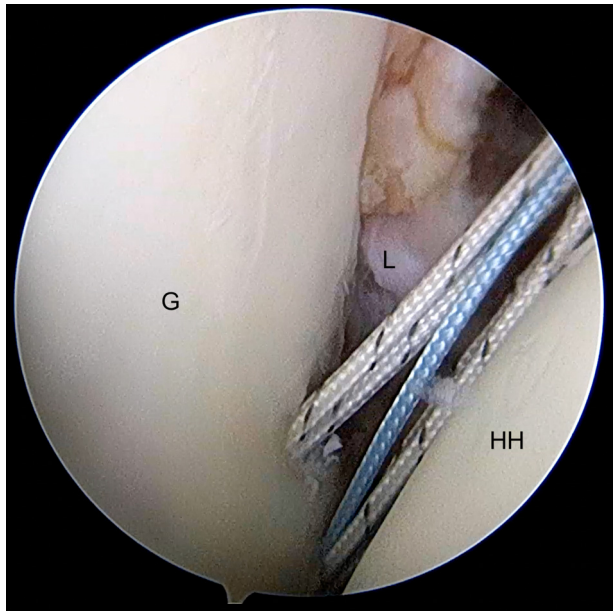

Fig 6. Second anchor implanted at the 4 o'clock position (right shoulder). Posterior portal view of the second 1.8-mm all-suture anchor implanted on the anteroinferior glenoid rim, double-loaded with the sutures seen going through the subscapularis tendon split and the anterior portal. (G, glenoid; HH, humeral head; L, labrum.)

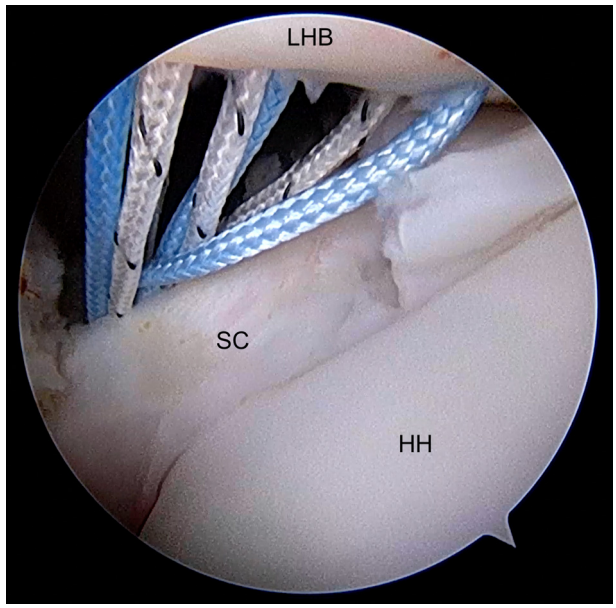

Fig 7. Eight suture limbs from the 2 anchors passed through the LHB (right shoulder). Posterior portal view of each of the suture limbs from the 2 anchors passed through the LHB. (HH, humeral head; LHB, long head of biceps; SC, subscapularis tendon.)

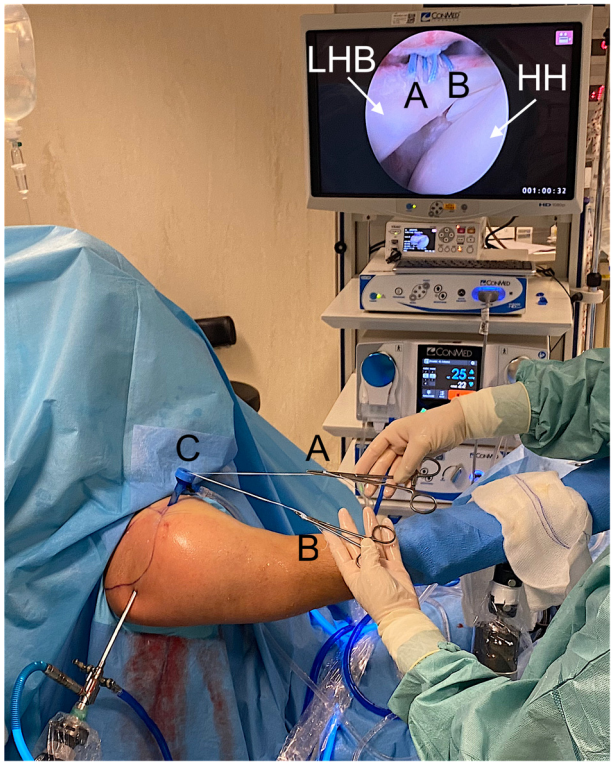

Fig 8. Eight suture limbs of the 2 anchors parked in the anterior portal and referenced with different clamps. Patient in the beach chair position with the right shoulder positioned using a mechanical arm holder. The arthroscope is introduced through the posterior portal. The monitor shows the posterior portal view of the 8 suture limbs of the 2 anchors passing through the LHB. The outside view shows the 4 suture limbs of the 4 o'clock anchor and the 4 suture limbs of the 5 o'clock anchor that passed through the LHB parked in the anterior portal and referenced with a straight and a curved hemostat clamp, respectively. (A, 4 suture limbs of the 4 o'clock anchor passed through the LHB and referenced with a straight hemostat clamp; B, 4 suture limbs of the 5 o'clock anchor passed through the LHB and referenced with a curved hemostat clamp; C, working cannula in the anterior portal; HH, humeral head; LHB, long head of biceps.)

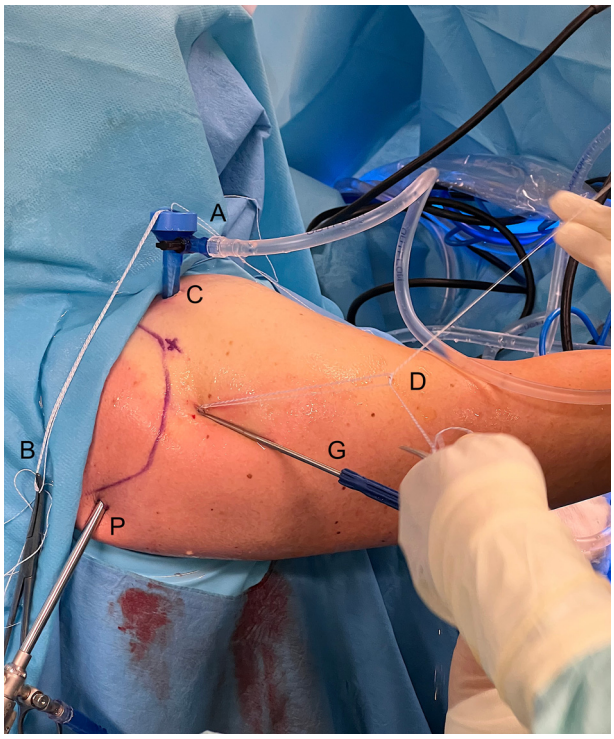

Fig 9. Double double-pulley (DDP) knot tying. Outside view of the right shoulder positioned using a mechanical arm holder. The arthroscope is introduced through the posterior portal. The 4 limbs of the sutures of the 5 o'clock anchor and the 2 opposing suture limbs of the 4 o'clock anchor that have been passed through the long head of biceps are parked in the anterior portal and referenced with a curved and a straight hemostat clamp, respectively. The double-pulley knot of the 4 o'clock anchor is being tied through the anterolateral portal. A gauged probe has been introduced through the anterolateral portal and is being used to help retract the supraspinatus tendon, improving arthroscopic visualization while knot tying. (A, the 2 opposing suture limbs of the 4 o'clock anchor referenced with a straight hemostat clamp; B, the 4 suture limbs of the 5 o'clock anchor referenced with a curved hemostat clamp; C, working cannula in the anterior portal; D, the double-pulley knot of the 4 o'clock anchor being tied; G, gauge probe; P, arthroscope introduced through the posterior portal.)

Subscapularis Tendon Split

The subscapularis tendon is split using the radio frequency ablator introduced through the anterior portal, cutting from medial to lateral at the middle third of articular side of the subscapularis tendon, and lateral to the conjoint tendon. Once the superficial fibers of the subscapularis are visible, the arthroscope, which is introduced through the posterior portal, is advanced toward the split. The radio frequency ablator is introduced from superficial to intra-articular, through the split, and is used to continue splitting the subscapularis tendon from medial to lateral, on the articular side of the subscapularis, under direct vision (Fig 2). The split is complete when the radio frequency ablator can easily go through the split, unobstructed.

5 o'Clock and 4 o'Clock Anchors

First, one 1.8-mm all-suture anchor double-loaded with sutures (Y-Knot Flex, ConMed) is introduced through the anterior portal and the subscapularis tendon split and is implanted on the anteroinferior glenoid rim at the 5 o'clock position (right shoulder) (Fig 3). Each of the 4 suture limbs is passed through the LHB sequentially using an automatic suture passer (first pass mini-straight; Smith & Nephew) introduced through the anterior portal: the first suture limb is passed through the LHB just proximal to the THL (Fig 4) and is retrieved through the anterolateral portal, where it is parked; the second suture limb is passed

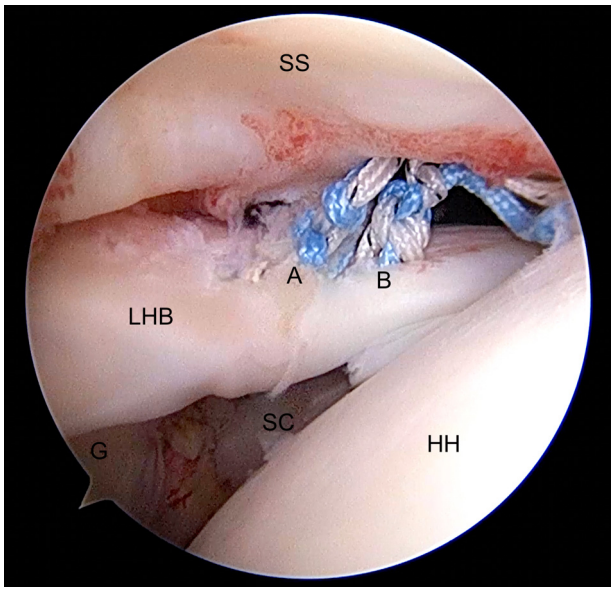

Fig 10. Double double-pulley (DDP) knots tied on the LHB (right shoulder). Posterior portal view of 2 knots that were tied, one using 2 different colored suture limbs from the 4 o'clock anchor, the other using 2 different suture limbs from the 5 o'clock anchor: this is the DDP knot. (A, double-pulley knot of the 4 o'clock anchor; B, double-pulley knot of the 5 o'clock anchor; G, glenoid; HH, humeral head; LHB, long head of biceps; SC, subscapularis tendon; SS, supraspinatus tendon.)

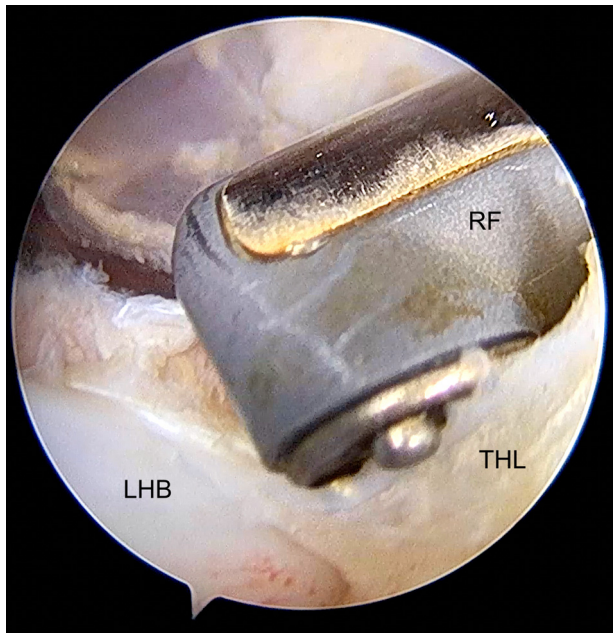

Fig 11. Cutting the THL (right shoulder). Posterior portal view with the arthroscope pushed anteriorly along the bicipital groove, and the radio frequency ablator probe introduced through the anterolateral portal and cutting the THL laterally to the LHB tendon. (LHB, long head of biceps; RF, radiofrequency ablator probe; THL, transverse humeral ligament.)

posterior to the first and is retrieved through the anterolateral portal, where it is parked as well; the third and fourth suture limbs are passed ~2 mm more proximal to the first and second suture limbs, following the same sequential steps as the first 2 suture limbs. After each of the 4 suture limbs from the 5 o'clock anchor have been passed through the LHB, they are referenced with a straight hemostat and left parked in the anterolateral portal (Fig 5).

Another 1.8-mm, all-suture double-loaded anchor (Y-Knot Flex, ConMed) is placed through the anterior portal and subscapularis tendon split and is implanted on the anteroinferior glenoid rim at the 4 o'clock position (right shoulder) (Fig 6). Each of the 4 suture limbs is passed through the LHB sequentially, medially to the previous suture limbs and closer to the LHB anchor and superior labrum, repeating the same steps used for the 5 o'clock anchor. After each of the 4 suture limbs from the 4 o'clock anchor has been passed through the LHB, they are retrieved to the anterior portal, referenced with a straight hemostat, and left parked in the anterior portal (Fig 7). Next, the suture limbs of the 5 o'clock anchor that had been passed through the LHB are retrieved from the anterolateral portal to the anterior portal as well, referenced with a curved hemostat, and parked in the anterior portal (Fig 8).

DDP Knots

First, a surgeon's knot and 2 half-stitches are tied using 2 different-colored suture limbs from the 5 o'clock anchor: This is the first double-pulley knot. Second, a surgeon's knot and 2 half-stitches are tied using 2 different suture limbs from the 4 o'clock anchor: This is the second double-pulley knot (Figs 9 and 10). The 4 suture limbs of the 2 DDP knots are cut, whereas the remaining 4 opposing limbs of each of the 2 anchors are left parked in the anterior portal.

Cutting the THL

The radio frequency ablator probe is introduced through the anterolateral portal and is used to cut the THL laterally to the LHB tendon, until the LHB tendon is completely released from the bicipital groove (Fig 11). At this point the LHB dislocates medially.

LHB Tenotomy

Using the ablator, the surgeon tenotomizes the LHB proximally to the most proximal limbs of the sutures and distally to the bicipital anchor on the superior labrum (Fig 12).

Shuttling of the LHB Through the Subscapularis Tendon Split

The 4 opposing limbs that are parked in the anterior portal are pulled while the 2 double-pulley knots push

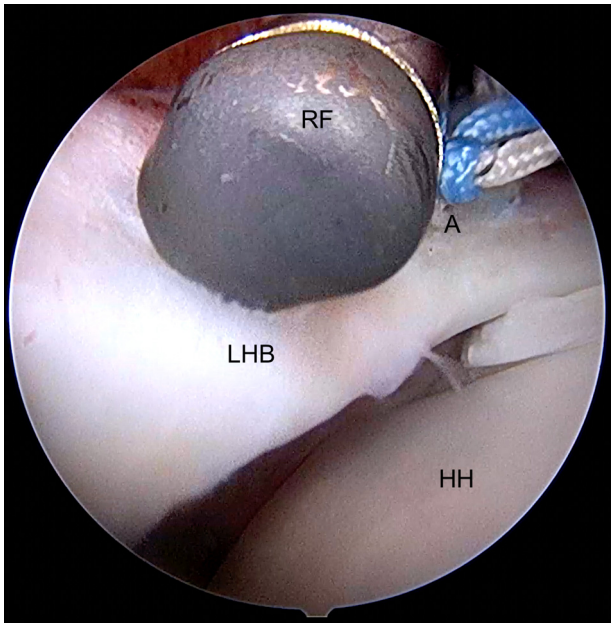

Fig 12. LHB tenotomy (right shoulder). Posterior portal view showing the radio frequency ablator introduced through the anterior portal, ready to tenotomize the LHB proximally to the most proximal suture limbs and distally to the bicipital anchor on the superior labrum. (A, double-pulley knot of the 4 o'clock anchor; HH, humeral head; L, labrum; LHB, long head of biceps.)

the tenotomized LHB intra-articularly through the subscapularis tendon split (Fig 13). The remaining

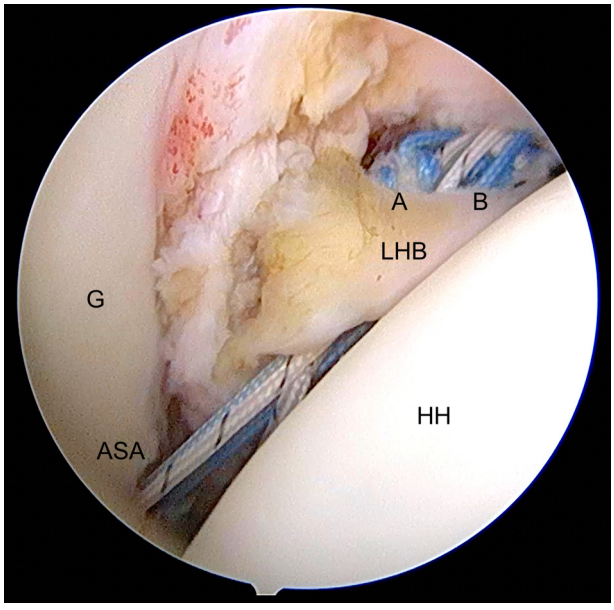

Fig 13. Shuttling of the LHB through the subscapularis tendon (right shoulder). Posterior portal view of the tenotomized LHB being shuttled intra-articularly through the subscapularis tendon split toward the anterior glenoid rim. (A, double-pulley knot of the 4 o'clock anchor; ASA, 4 o'clock all-suture anchor; B, double-pulley knot of the 5 o'clock anchor; G, glenoid; HH, humeral head; LHB, long head of biceps.)

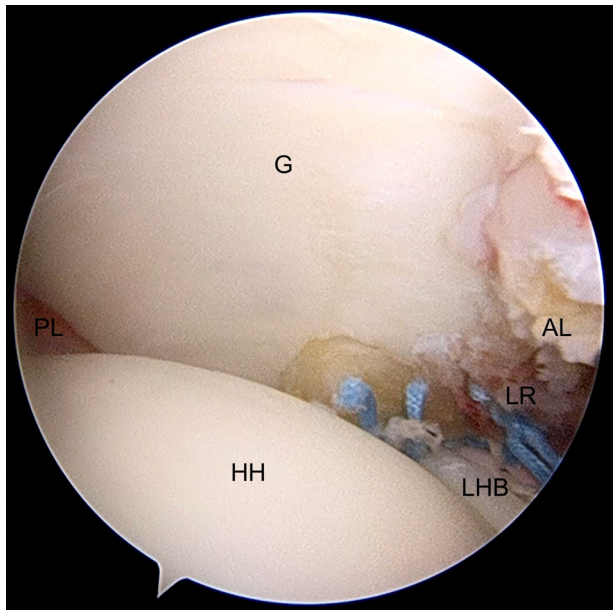

Fig 14. Anterior labrum plication (right shoulder). Anterolateral portal view of the anterior labrum repair. One simple suture of one all-suture single-loaded anchor was implanted on the anterior glenoid rim, adjacent to the superior half of the transferred LHB tendon. (AL, anterior labrum; G, glenoid; HH, humeral head; LHB, long head of biceps; LR, labral repair; PL, posterior labrum.)

suture limbs are tied once the LHB reaches the anteroinferior glenoid rim.

Anterior Labrum Plication

One 1.3-mm all-suture single-loaded anchor (Y-Knot Flex; ConMed) is implanted adjacent to the superior half of the transposed LHB tendon on the glenoid rim, and a simple knot is tied to plicate the remaining anterior labrum and/or capsular tissue onto the glenoid rim (Fig 14).

Postoperative Rehabilitation Protocol

For the first 3 weeks, patients wear a sling and may remove it several times a day to perform passive shoulder and elbow exercises. Shoulder exercises are limited to elevation up to 90°, and external-internal rotation exercises with the arm at the side from internal rotation to the neutral position. From weeks 3 to 6, shoulder and elbow exercises progress from passive to active assisted exercises and the use of the sling is diminished. Until 6 weeks, active resistant elbow exercises are not allowed. From weeks 6 to 8, active resistant elbow exercises progress from 1 kg to 2 kg. After week 8, active resistant elbow exercises progress, according to pain tolerance. Active shoulder abduction in external rotation is avoided until 3 months. After 6 months, a full return to the previous level of sports activity is allowed.

Table 1. Pearls and Pitfalls of Arthroscopic Onlay DAS Utilizing the DDP Technique

Pearl	Pitfall
Use of a mechanical arm holder maintains the ideal positioning in flexion/extension and external/internal rotation of the shoulder during each step.	Using nonadjustable nonsterile arm traction limits the choices of shoulder positioning and the visualization of lesions and structures in specific steps.
The radiofrequency ablator is used to meticulously clean the rotator interval until there is no soft tissue interposed between the conjoint tendon medially, the subscapularis tendon anteriorly, and the transverse humeral ligament (THL) laterally.	Imperfect cleaning of the rotator interval risks suture limbs entangling and soft tissue interposition during the LHB shuttling step.
After cleaning the rotator interval, the working cannula is placed through the anterior portal; the canula should be at least 7 mm in diameter to accommodate the automatic suture passer.	$<$ 7-mm or $\geq$ 8-mm cannulas: the smaller cannulas cannot accommodate the automatic suture passer, and the larger ones occupy space and conflict with maneuvering the suture passer inside the joint.
Place the anterior cannula in the direction of the superior third of the subscapularis tendon; this improves the attack angle of the radiofrequency ablator used to perform the subscapularis split intra-articularly, and of the automatic suture passer during the LHB suture-passing step, when these instruments are placed through the anterior cannula.	Low placement of the anterior cannula makes it difficult to use the radio frequency ablator through this portal to perform the split starting from the articular surface of the subscapularis tendon, or to use the automatic suture passer during LHB suture-passing because the subscapularis tendon blocks the instruments.
For improved suture management, first implant the 5 o'clock anchor; the automatic suture passer goes through the anterior canula to pass each suture distally on the LHB, and each suture limb is parked in the anterolateral portal after suture passing and will not be in the way of the next suture to be passed. Second, the surgeon implants the 4 o'clock anchor, whose suture limbs will pass more proximally on the LHB, and will not be blocked by the suture limbs coming from the 5 o'clock anchor because those will be parked in the anterolateral portal at this point.	Implanting the 4 o'clock anchor first means that the respective 4 suture limbs, which are passed more proximally in the LHB, will be in the way of the automatic suture passer that goes through the anterior cannula after it is armed with each of the suture limbs of the 5 o'clock anchor that are to be passed more distally in the LHB.
Test anchor pull-out after implanting each all-suture anchor, and before LHB suture-passing; pull on the sutures with a continuous movement and stable force until the anchor locks under the cortical bone.	Not testing each all-suture anchor pull-out strength risks pulling out during the LHB shuttling step.
Use different clamps to reference the suture limbs from each of the 2 anchors to distinguish which limbs to pull from each pulley; knot tying must be done between different suture limbs belonging to the same anchor.	Failing to reference the suture limbs from each anchor with different clamps increases the risks misidentification of suture limb origin and failure of the DDP knot technique.
Use a low-profile automatic suture passer placed through the anterior cannula to pass the sutures through the LHB; the assistant can further increase the working space between the supraspinatus tendon and the LHB by placing a gauged probe or switching stick through the anterolateral portal to push the supraspinatus upward and away from the LHB.	Bulky automatic suture passers conflict with reduced space between the anterior cannula and the LHB that block opening the jaw of the instrument, and conflict between the LHB and both the supraspinatus tendon superiorly and the anterior portal and cannula anteriorly.
Tie each of the DDP knots through the anterolateral portal to avoid entangling the limbs of sutures of the knot with the other 6 suture limbs; while tying each knot, leave the other 6 limbs parked in the anterior portal.	Tying knots while the 8 suture limbs are placed through the same portal risks entangling suture limbs.
Cutting the THL only after the 8 suture limbs are passed through the in situ LHB facilitates LHB suture-passing; parking the suture limbs in the anterior cannula while cutting the THL protects the suture limbs from inadvertently cutting them.	Cutting the THL before LHB suture-passing dislocates the LHB medially and makes LHB suture-passing more challenging.
Progressive shoulder flexion is paramount to visualize and adequately cut the whole length of the THL with the arthroscope placed through the posterior portal.	Performing the THL cutting step looking from the posterior portal without progressively flexing the shoulder and without progressively advancing the scope through the bicipital groove risks inadvertent lesions to the LHB, subscapularis, or supraspinatus tendon insertions.
Place the elbow in flexion before the tenotomy of the LHB and the LHB shuttling step.	The elbow placed in extension places excessive stress on the LHB shuttling step.

DAS, dynamic anterior stabilization; DDP, double double-pulley; LHB, long head of the biceps tendon; THL, transverse humeral ligament.

Discussion

DAS with biceps transfer fixed either in an inlay position,[17,18] or an onlay position,[15,16] has shown promising short-term results. As shown in Table 2, both techniques offer several theoretical advantages over other surgical treatment options for the treatment of anterior glenohumeral instability with limited to subcritical glenoid bone loss, and onlay DAS may offer

Table 2. Advantages and Disadvantages of Onlay DAS Using the Double Double-Pulley Technique

Advantages	Disadvantages
All-arthroscopic, minimally invasive procedure that does not require extrusion of the LHB and utilizes only 3 portals	Technically demanding procedure that involves increased operative time compared to Bankart repair alone
Transfers the biceps instead of the conjoint tendon and avoids traction injury to the musculocutaneous nerve and the neurological complications related to the coracoid transfer	Does not use bone graft to address glenoid bone loss structurally
Transfers the biceps through a small subscapularis tendon split, lateral to the conjoint tendon, reducing the risk of damage to the subscapularis tendon or to the axillary nerve	Theoretical risk of biceps complications
Utilizes an in situ local autograft that avoids donor site morbidity related to harvesting the iliac crest or distal clavicle, and combines the increased biologic healing potential and the decreased immunologic reaction potential of an autograft in comparison with either soft or bony allografts or xenografts	Clinical studies with long-term follow-up are lacking
LHB tenodesis to the anterior glenoid simultaneously treats a concomitant superior labrum anterior to posterior (SLAP) tear[15,19]	Comparative studies between inlay and onlay DAS, or other surgical options, are lacking
Small-diameter (1.3- and 1.8-mm) drill holes avoid the risk of glenoid tunnel fracture-related complications	Return to play is delayed because of the need to protect biceps healing; limited indication in competitive athletes
All-suture anchor instead of metallic hardware avoids hardware-related complications (avoids metallic screws, or buttons, in the glenohumeral joint, and glenoid tunnel fractures) and allows more accurate MRI control of the procedure because metallic artifacts are absent.	More expensive than open coracoid transfer and fixation with malleolar screws
Onlay fixation theoretically increases stability through the labroplasty effect and is useful in patients who have anterior capsulolabral insufficiency and in whom a Bankart repair to augment DAS may be impossible to perform	Impossible to perform in patients who do not have the LHB because of previous surgery or trauma; must be prepared for the risk of absent LHB in revision cases where artifacts may decrease preoperative imaging accuracy
Standard arthroscopic instrumentation is the same used for a typical Bankart repair; avoids bulky instrumentation sets, or the need to preoperatively order complex specific instrumentation	LHB is a dynamic scapular stabilizer and the long-term effects on scapular kinesis of changing the LHB insertion from the superior labrum to the anterior glenoid are unknown.
Biomechanical studies showed increased glenohumeral stability in subcritical GBL and humeral head bone loss models in comparison with either an isolated Bankart repair,[20] or conjoint tendon transfer procedures.[21]	
Technique avoids the risk of scapular dyskinesis, and respective potential nefarious long-term consequences, because the LHB tendon is transposed instead of the coracoid and conjoint tendon, and the pectoralis minor is not detached and the vector and the working length of the coracobrachialis and the short head of the biceps are not changed.[22]	

DAS, dynamic anterior stabilization; LHB, long head of biceps.

additional advantages over inlay DAS as well. DAS, either inlay or onlay, theoretically increases anterior glenohumeral stability through 3 different effects. First, the hammock effect is produced by the downward force of the biceps on the inferior subscapularis tendon. Second, the sling effect is produced by the posteriorly directed force of biceps on the humeral head. Third, the tensioning effect, which is produced by the repaired anterior capsulolabral tissue, which is sutured to the anterior glenoid. In addition, onlay DAS may increase stability through a fourth effect: the labroplasty effect, which is produced by the onlay positioning of the biceps on the anterior glenoid rim. Theoretically, the labroplasty effect produced by the onlay DAS may increase anterior glenohumeral stability by increasing the contact surface area of the humeral head and glenoid. Long-term follow-up and comparative clinical studies are lacking to establish whether onlay and inlay DAS produces significantly different outcomes. Nevertheless, biomechanical studies have shown that inlay DAS alone, without concomitant Bankart repair, does not significantly differ from Bankart repair alone in resisting anterior glenohumeral translation in cadaveric models with 15% of GBL.[23] This means that in patients in whom it is impossible to augment DAS with the Bankart repair because they have anterior capsulolabral insufficiency secondary to multiple dislocation episodes, the additional labroplasty effect of onlay DAS may provide an advantage over inlay DAS. Furthermore, most of the complications of bony procedures avoided by soft tissue procedures are hardware related. In onlay DAS, the LHB is fixed on the anterior glenoid rim utilizing suture anchors and avoids hardware-related complications, whereas in inlay DAS the LHB is fixed

Table 3. Indications and Contraindications of Onlay Dynamic Anterior Stabilization

Indications	Contraindications
AGHI and GBL ≤20%	AGHI and GBL >20%
AGHI and anterior capsulolabral insufficiency	MDI*
	Absent LHB
AGHI and SLAP type I-III	AGHI and SLAP type IV
	Beighton score >6*

AGHI, anterior glenohumeral instability; MDI, multidirectional glenohumeral instability.

*Relative contraindication when performed as an isolated procedure.

in the anterior glenoid utilizing an interference screw in a drilled hole, or metallic buttons in a tunnel, risking tunnel fractures and hardware-related complications. Therefore, onlay DAS avoids some of the risks of complications of inlay DAS, either related to tunnel fracture, or to the presence of metallic hardware in the glenohumeral joint.

Table 3 shows the authors' current indications and contraindications for the technique.

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