

# Technical Guide and Tips to Posterior Arthroscopic Latissimus Dorsi Transfer for Irreparable Posterosuperior Rotator Cuff Tears



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**Abstract:** Latissimus dorsi (LD) transfer is a reliable treatment option for irreparable posterosuperior (PS) rotator cuff tears in young and active patients that need to recover the range of motion for their daily living activities. The technique starts with an arthroscopic assessment of the tear. The next step is the mini-open stage for muscle release from the subcutaneous layer of the skin, the teres major (TM), the triceps, and the lateral border and inferior angle of the scapula. Later, the scope is used to prepare the footprint (arthroscopy) and for the release and the harvest of the tendon (endoscopy), taking care not to detach the TM and not to damage the radial nerve. A grasper is used to push the LD to its correct path medial to the triceps. After that the same instrument is placed from the anterolateral and the anterior arthroscopic portals toward the mini-open incision to catch the sutures previously loaded on the LD tendon with Krackow stitches. The LD is transferred to the greater tuberosity and is attached with one medial and one lateral knotless anchors. A third point of fixation enables a partial RC repair and ensures a surface of bone to tendon healing.

## Introduction

Tendon transfers (TT) have been used for decades to treat impaired shoulder in brachial plexus birth palsy.<sup>1</sup> In 1988, Gerber<sup>2</sup> expanded the indications to irreparable posterior superior (PS) rotator cuff (RC) tears, and since then, many authors described arthroscopic and open techniques.<sup>2-12</sup>

Through our experience performing the latissimus dorsi (LD) transfer, we have developed our specific TT technique that uses the LD to address PS RC deficiency. It mixes arthroscopy, endoscopy, and mini-open

surgery. Technical tips, pearls, and pitfalls will be outlined to provide a guide for surgeons to safely perform the procedure (Table 1).

## Surgical Technique (Video 1)

After the administration of preoperative prophylactic antibiotic, the operation is performed under general anesthesia with interscalene regional block.

The patient is in a beach chair position with a head support and the arm and hemithorax draped free. A robotic arm or two assistants will maintain the arm in the required position during the mini-open phase (Fig 1).

Tip: The robotic arm helps to manage the positioning of the arm, but it could also limit the range of motion (ROM) during the arthroscopic harvesting of the LD tendon.

### Stage 1. Arthroscopic Assessment of the RC tear

Quick arthroscopic assessment of the irreparability of the RC tear and confirmation of the LD TT indication.

### Stage 2. Mini-Open Dissection of the LD

The skin incision is made posterior and distal to the axilla to prevent the risk of infection.

We tag the LD muscle and separate it from the surrounding structures (skin, teres major [TM] muscle,

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**Table 1.** Pitfalls and Pearls of the Surgical Technique

Stage	Procedure	Pitfalls	Pearls
1.	Arthroscopic assessment of the rotator cuff tear	Irreparable cuff tear	Fatty infiltration Poor quality tendon Tendon retraction No arthropathy
2.	Posterior mini-open LD dissection	Correct skin incision location Skin maceration and infection in postoperative period Lengthen LD tendon excursion LD pedicle injury	Posterior and distal to the axilla Level of the lateral edge of the scapula Cut adhesions between LD and TM, triceps, skin, and tip of the scapula. Pedicle is located anteriorly toward the axillary fossa and penetrates the muscle between 5 and 10 cm proximal to the musculotendinous junction
3.	Arthroscopic subacromial and GH preparation	Landmarks for visualization	Expose spine of acromion and coracoid Perform biceps tenodesis or tenotomy (if stiff shoulder) Dissection between deltoid and infraspinatus muscles
4.	Anterior preparation, dissection, and harvesting of the LD tendon	Working space between deltoid, PM, and SSC  Locate the 3 sisters (anterior humeral circumflex artery and veins) Axillary and radial nerve injury  Long head of triceps motor branch injury LD tendon exposition  LD tendon detachment (risk of LD tendon shortening)  LD posterior dissection (risk of TM insertion damage)  LD transfer course shortening Impingement with radial or axillary nerves	Dissect the rotator interval and clavicular fascia to expose pectoralis minor, PM, and SSC. Apply slight flexion and traction to the arm, to get a better exposition of the retropectoralis space Expose progressively SSC up to its lower border.  Identify posterior cord and axillary and radial nerves in retro-coracoid area Axillary nerve is anterior and perpendicular to the SSC and then goes posterior under the SSC and enters the quadrangular space under the teres minor. Radial nerve in anterior and perpendicular to SSC, LD, and TM and enters humero-tricipital triangle (triangular interval) under TM It runs parallel and medially to the radial nerve Apply forward elevation, adduction, and internal rotation to decrease tension on deltoid and PM Use switching stick to retract deltoid If needed, flex the elbow to decrease tension on conjoint tendon. The switching stick might be also used to retract the conjoint tendon. Release upper third of PM Locate LHB in its groove and retract it Dissect upper and lower borders of the LD Detach LD from lateral to medial Hold the upper border of LD with a grasper to help you during the dissection. LD tendon is really thin TM tendon is shorter, wider, and thicker than LD tendon TM tendon is just posterior to LD tendon TM muscle belly seen immediately beneath LD tendon LD posterior dissection done as medial as possible following TM muscle Do not take TM tendon with LD tendon
5.	LD tendon preparation	LD tendon twisting when passing sutures	Prepare tendon with 2 running locking sutures Use 2 different colors sutures, use a marker, or tie a knot in one of them.

(continued)

**Table 1.** Continued

Stage	Procedure	Pitfalls	Pearls
6.	LD Tendon transfer	Difficulties with posterior gliding space Avoid axillary nerve compression and injury	Slight abduction and external rotation for better identification of the working space Pass a grasper or a foley catheter from the anterolateral and the anterior arthroscopic portals to the axillary incision LD tendon transfer must arrive to the PS footprint from a space medial to the triceps Identify long head of the triceps, which is the medial border of the quadrangular space
7.	Arthroscopic LD tendon fixation	Poor LD healing on tuberosity  Anchors position	Fix sutures with knotless anchors Use medial and lateral anchors to maintain the tendon flat to the bone Use a third anchor to fix LD tendon and avoid a “windshield-wiper effect” of the transfer in rotation Use a biodegradable subacromial spacer to maintain the humeral head centered (optional) Depending on patient’s clinical deficit: Superiorly on GT in case of main deficit in forward elevation Inferiorly on GT in case of deficit only in external rotation

GH, glenohumeral; GT, greater tuberosity; LD, latissimus dorsi; LHB, long head of the biceps; PM: pectoralis major; PS, posterosuperior; SSC, subscapularis; TM, teres major.

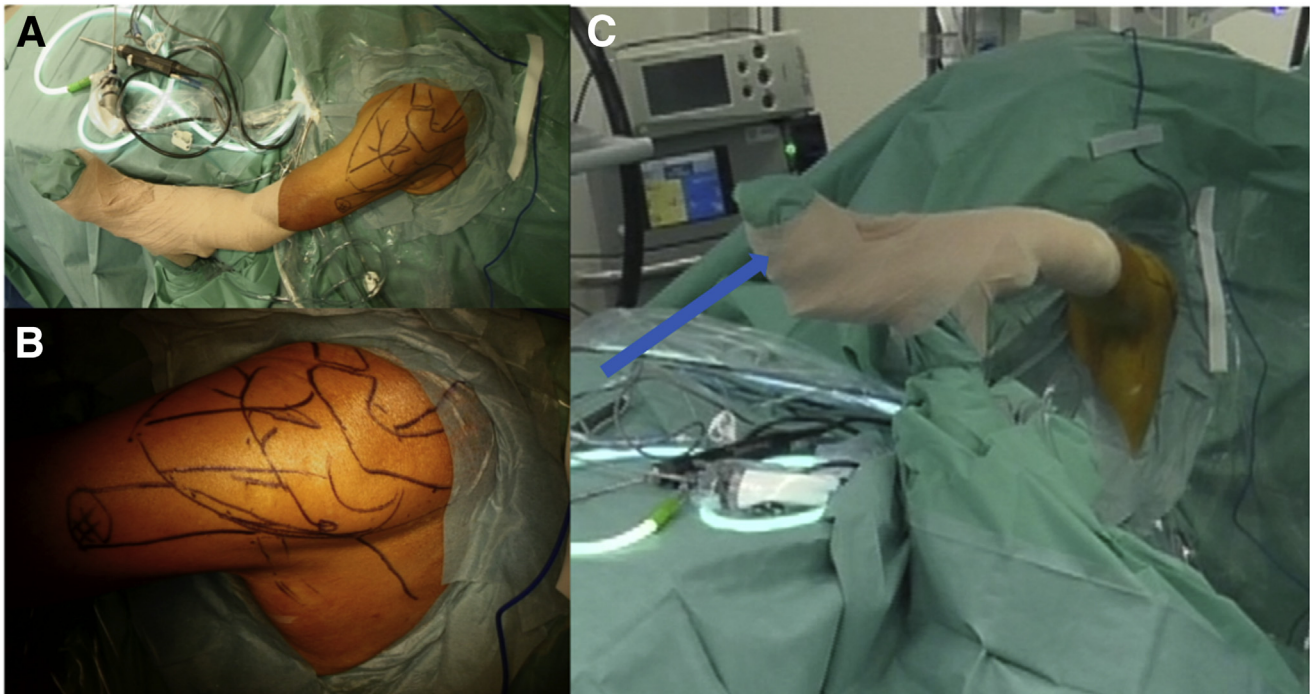
scapula, and an aponeurotic band between the inferior border of the LD and the triceps). These adhesions, if not cut, may limit the course of the LD TT (Fig 2). The dissection must be done as close as possible to the tendon attachment but without detaching it (this will be done during the arthroscopic stage).

Tip: Dissecting the LD muscle before the arthroscopic bursectomy and the RC partial repair enables to release it easier than if done afterward because it would be swollen.

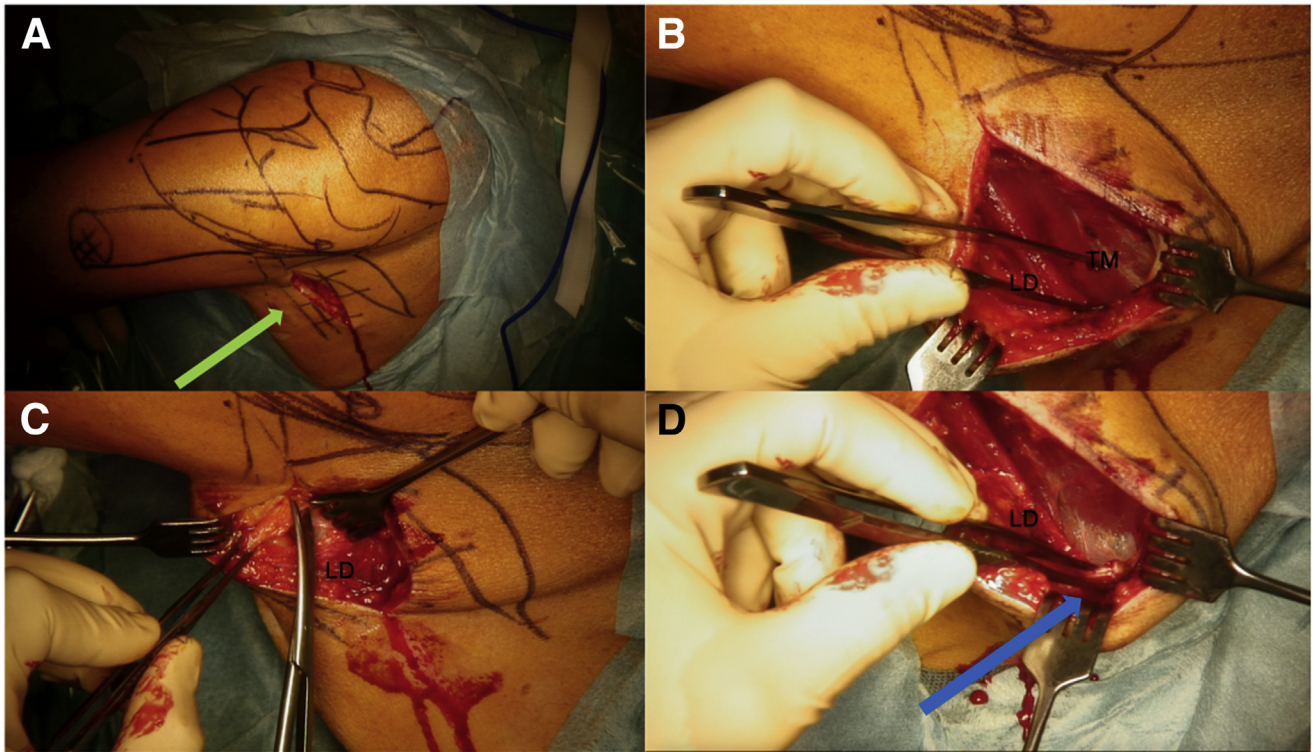
Tip: It is not mandatory to perform a close dissection of the pedicle, which is located anteriorly toward the axillary fossa and penetrates the muscle between 5 and 10 cm proximal to the musculotendinous junction.

**Stage 3. Glenohumeral and Subacromial Arthroscopic Preparation**

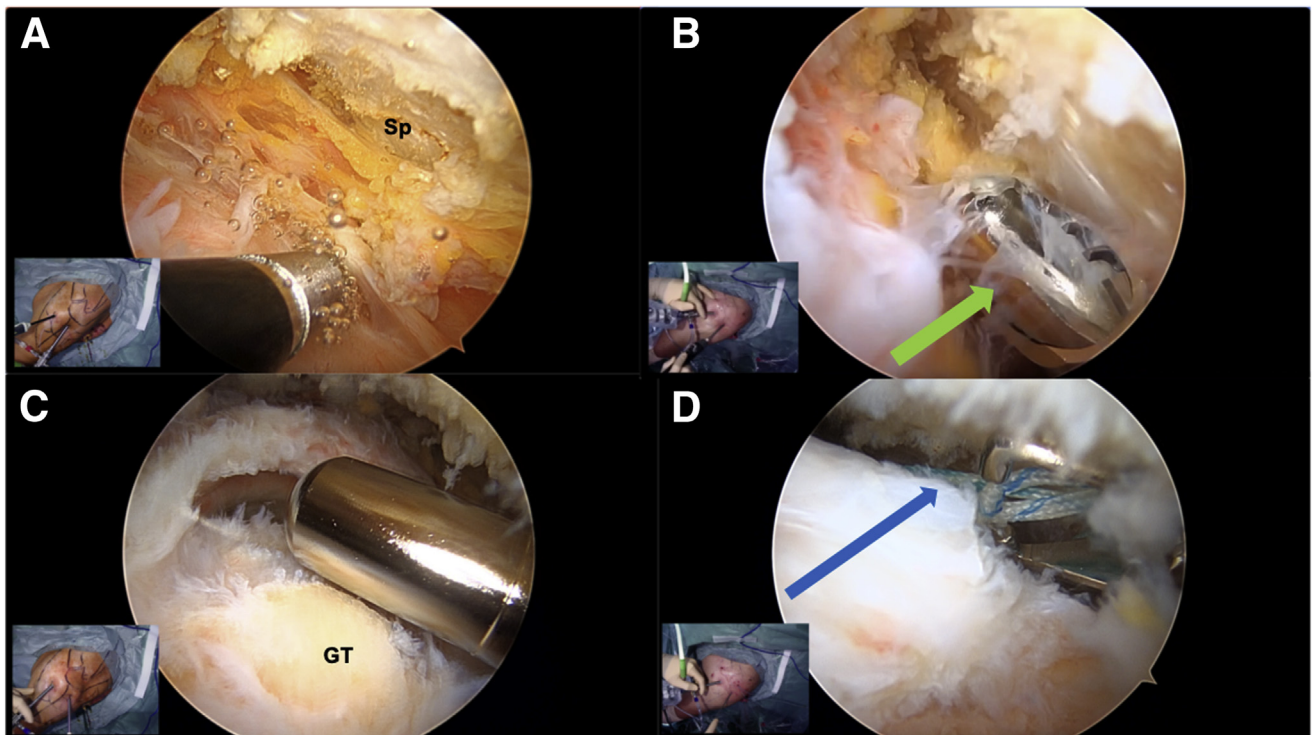
With the camera through the lateral portal, the subacromial bursa is removed using the anterolateral



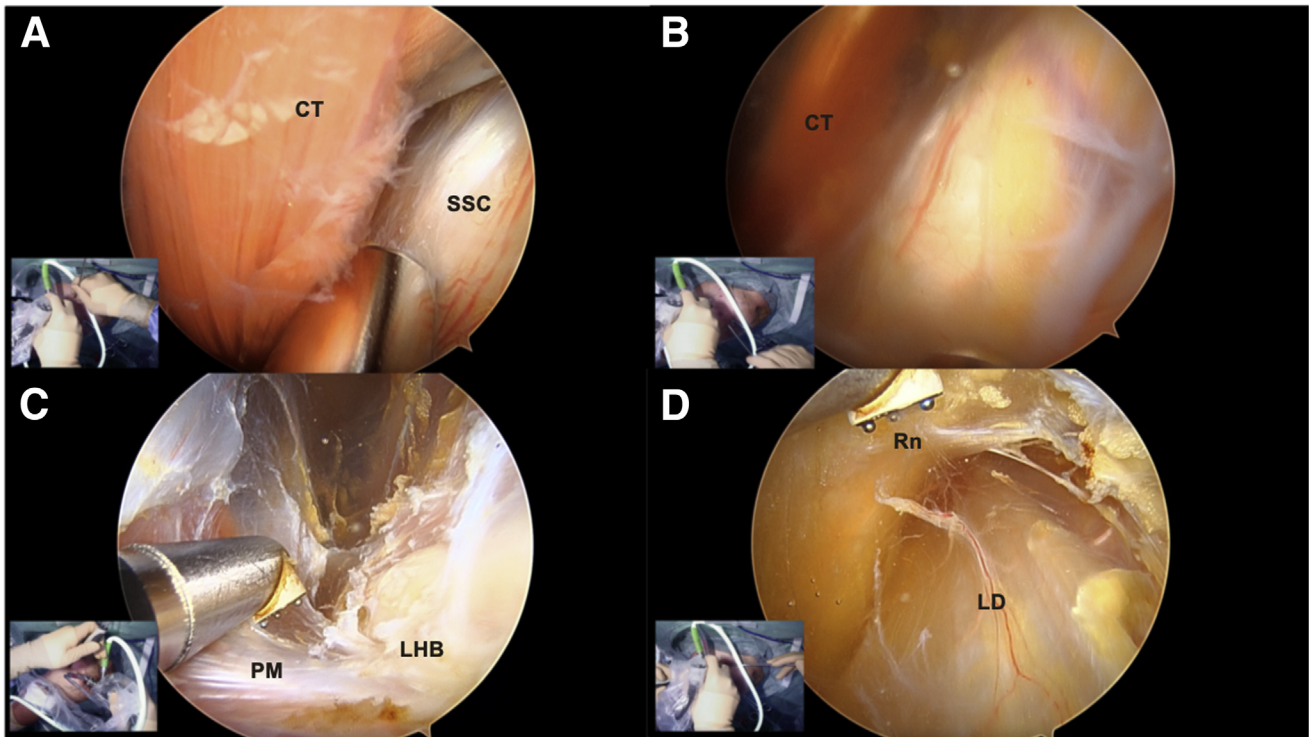
**Fig. 1.** Patient in beach chair position. (A) Skin landmarks in left shoulder with arm and hemithorax draped free. (B) Skin landmarks. (C) Arm elevation with a robotic arm (blue arrow) for mini-open latissimus dorsi tendon preparation.



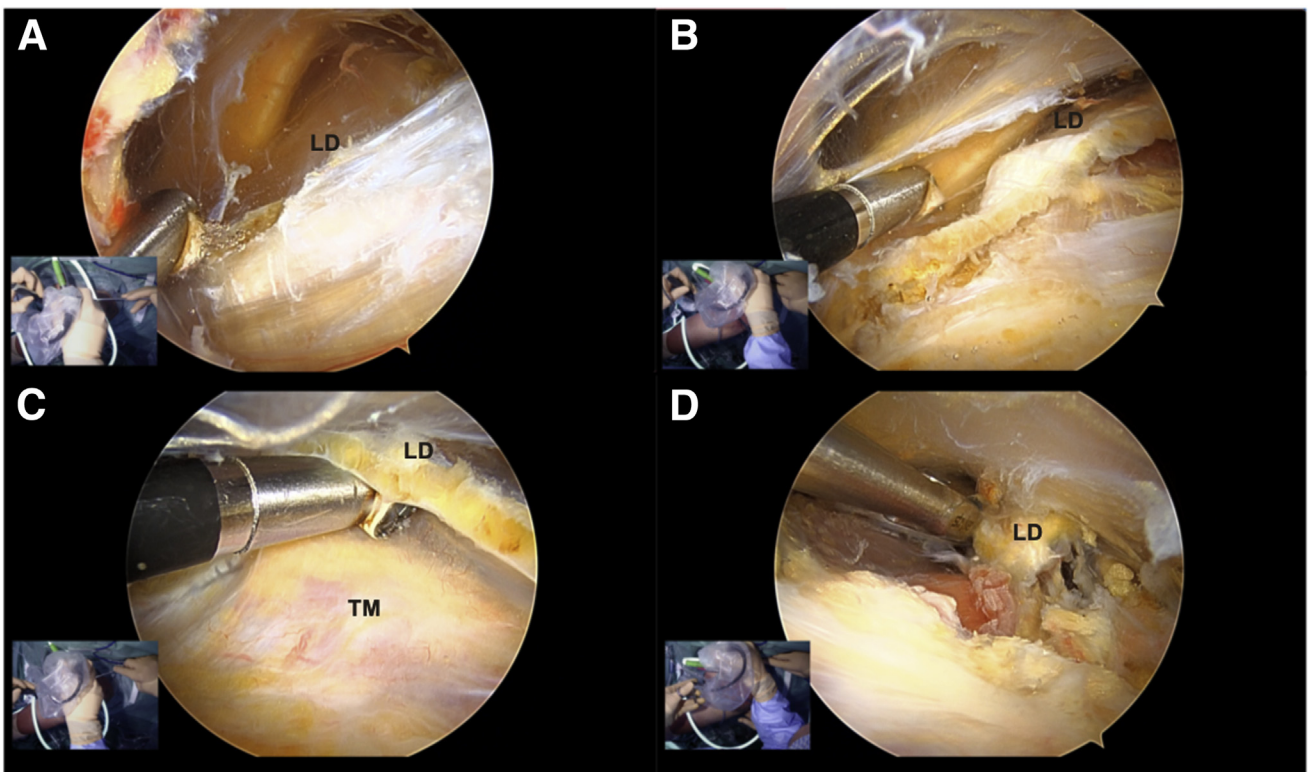
**Fig. 2.** Mini-open latissimus dorsi (LD) dissection (left shoulder with patient in the beach chair position; arm maintained in abduction). (A). Skin incision posterior and inferior to the axilla, to prevent maceration and infection (green arrow). (B) Split between LD and teres major (TM). (C and D) Release of LD tendon from skin and the tip of scapula (blue arrow).



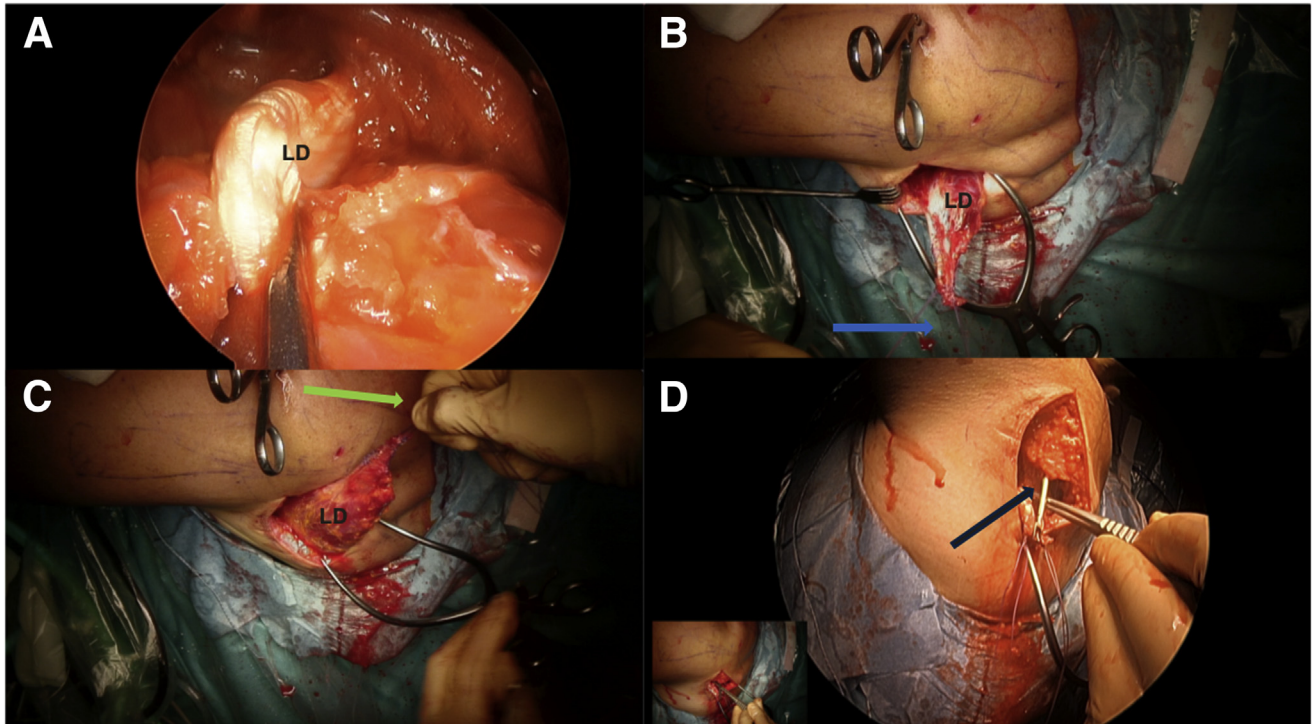
**Fig. 3.** Posterosuperior dissection and partial repair of the rotator cuff (RC) tear (left shoulder with patient in beach-chair position). (A) Subacromial bursectomy exposing the spine of the acromion (Sp) with the scope in the lateral portal and the shaver or the radiofrequency (RF) device through the anterolateral portal. (B) Preparation of the posterior workspace with the shaver (green arrow). (C) Preparation of the posterosuperior footprint on the greater tuberosity (GT) with the burr. (D) Partial repair of the RC tear (blue arrow). (B-D) Scope in the anterolateral portal, RF and shaver in the lateral portal, and specific instrument for RC repair in the posterior portal.



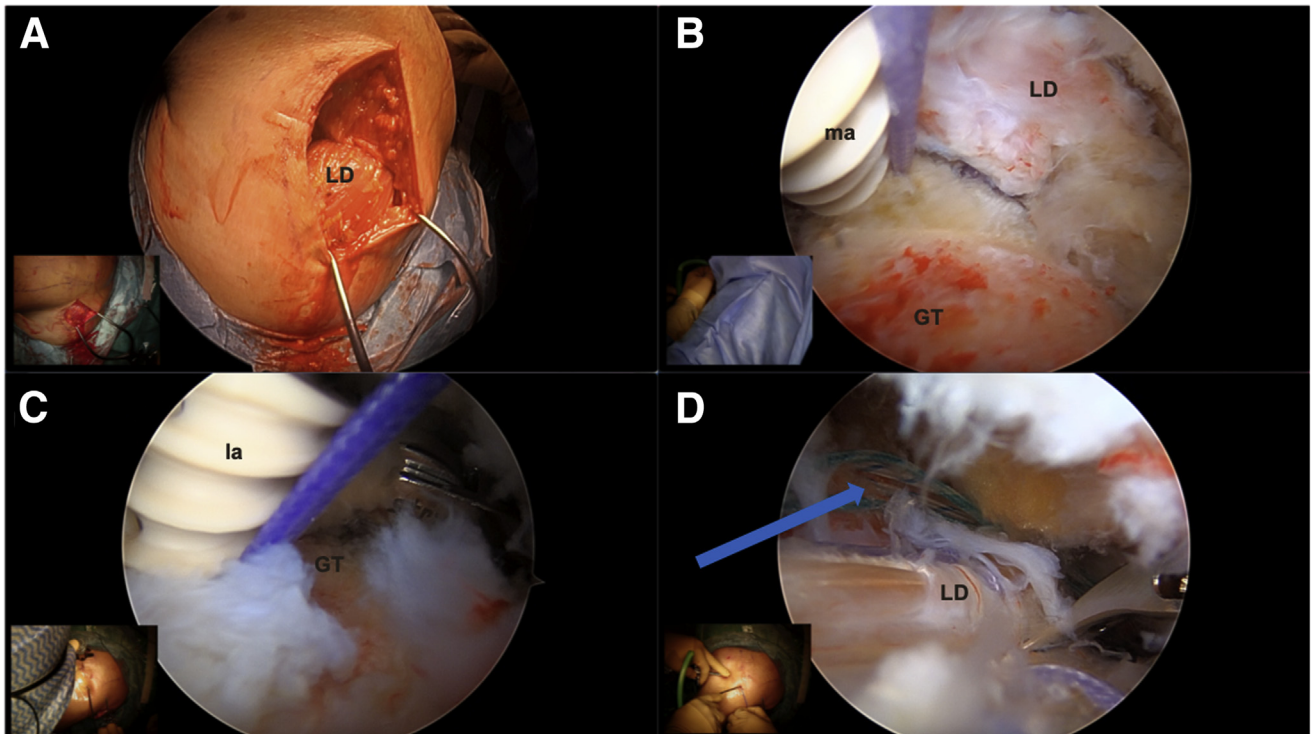
**Fig. 4.** Latissimus dorsi (LD) dissection (left shoulder with patient in beach-chair position; visualization from anterolateral portal and shaver and radiofrequency device from anterior, anteroinferior, and, if necessary, inferior portals. (A) Switching stick pushing the conjoint tendon (CT) anteriorly to make room for the LD tendon dissection. (B) Anterior dissection of the LD posterior to CT and inferior to the three sisters (anterior humeral circumflex artery and veins). (C) LD tendon medial to long head of the biceps (LHB) and behind the pectoralis major (PM) insertion. (D) radial nerve (Rn) medial to the LD tendon and TM tendon behind the LD tendon. (SSC, subscapularis)



**Fig. 5.** Latissimus dorsi (LD) detachment (left shoulder with patient in the beach chair position; visualization from anterolateral portal). (A and B) LD detachment from lateral to medial. (C) Teres major (TM) visualization and preservation of its insertion (between LD and TM tendons there is not risk of damaging any nerve). (D) A grasper is used to push the LD tendon toward the mini-open approach to its correct position.



**Fig. 6.** Mini-open latissimus dorsi (LD) dissection and retrieval (left shoulder with patient in beach-chair position). (A) Obtention of the LD tendon through the mini-open approach. (B) 2 Krackow sutures (blue arrow), one on each side of the LD tendon. (C) Verification of the good excursion of the tendon (green arrow). (D) The LD tendon is retrieved with a grasper (black arrow) taking care not to twist the tendon.



**Fig. 7.** Latissimus dorsi (LD) tendon transfer and fixation (left shoulder with patient in the beach chair position). (A) Transferred tendon (medial to the triceps, protecting the axillary nerve). Medial knotless anchor (ma) (B) and Lateral knotless anchor (la) (C). (D) The sutures used for the partial rotator cuff repair (blue arrow) will make the third point of fixation of the LD tendon on the footprint of the greater tuberosity (GT).

portal. Exposure of the spine of the acromion and the coracoid is needed to release the cuff and assess its excursion for a potential partial repair. The footprint is prepared with the burr.

Tip: Preparation of the posterior workspace is mandatory. Infraspinatus fascia must be widely open particularly in cases of bulky LD muscle body. If not, the muscle body may limit the course of the tendon when transferred to the PS footprint.

Partial cuff repair using a 5.5-mm PEEK Zip anchor (Stryker, Portage, MI) can be performed (Fig 3).

Tip: The RC partial repair may restore external rotation (ER) strength.

Tenodesis or tenotomy (in a stiff shoulder) of the long head of the biceps (LHB) might also be done.

#### Stage 4. Endoscopic Anterior Preparation and Harvest of the LD

Anterior "anteroinferior, and, if necessary, inferior portals are used for the radiofrequency probe and the shaver. As described in our previous article,<sup>13</sup> progressive debridement is done to expose the LD tendon (Fig 4), which is detached from lateral to medial (Fig 5).

Important landmarks:

- The three sisters are inferior to the subscapularis (SSC).
- The LHB is located laterally to the SSC tendon.
- Axillary and radial nerves are at risk. The posterior cord divides in the retrocoracoid area. The axillary nerve runs superior to inferior, and anterior to posterior. On its way to the posterior compartment, it goes under the inferior border of the SSC and enters the quadrangular space under the teres minor. The radial nerve passes inferior and anterior in relation to the axillary nerve. It lies on top of the SSC, the LD, and the TM and enters the triangular interval under the TM on its way to the posterior compartment. Both the quadrangular space and the triangular interval are lateral to the long head of the triceps.

After detaching the LD, we need to release it from the TM, that lies posterior to the LD and is inserted on the groove just medially to the LD.

Tip: TM should not be harvested with the LD, as its course is shorter and would decrease the excursion of the transfer.

The LD tendon is pushed inferiorly toward the axillary area with the grasper. It must reach the previously dissected space and be medial to the long head of the triceps, avoiding the branches of the axillary nerve.

Tip: The long head of the triceps marks the medial border of the quadrangular space and is the key to identify the axillary nerve. Its fibers are orientated in a vertical direction in contrast to the teres minor whose fibers are orientated horizontally.

#### Stage 5. Preparation of the LD Using the Posterior Mini-Open Approach

The LD tendon is prepared along both borders with the Krackow technique using two braided sutures (Fig 6).

Tip: Using two different colored sutures or a surgical marker on one of them will distinguish one from the other and help prevent tendon twisting.

#### Stage 6. LD Tendon Transfer

A grasper is used as a shuttle relay for the LD with a direction that starts in the axillary fossa and will enter the space between the deltoid and the posterior cuff, medial and superior to the quadrangular space, preventing any compression on the axillary pedicle (Fig 6).

Tip: With the scope through the lateral portal, the sutures might be retrieved through 2 different portals, to limit the risk of mistakes between the two loaded sutures. The superior one, attached to the grasper, will be passed through the tendon's new path and then through the anterolateral portal. The second suture, from the lower border of the LD, would follow naturally and would be retrieved through the anterior portal.

#### Stage 7. Arthroscopic LD Tendon Fixation in PS Footprint

The tendon and sutures are fixed to the bone with two 4.75-mm knotless anchors (Omega anchor; Stryker, Portage, MI) on the greater tuberosity. One anchor is usually placed at the level of the supraspinatus footprint to fix the upper border of the transfer. Another anchor will be placed at the level of a second row in RC repair to fix the lower border of the TT (Fig 7).

Tip: The anchors and the LD TT should be positioned depending on the patient's clinical deficit. They will be positioned superiorly on the greater tuberosity in case of a deficit in forward elevation, but inferiorly on the greater tuberosity in case of a deficit in ER.

Tip: Three anchor sites are needed to avoid a "windshield-wiper effect" of the TT when the patient moves the arm, so the sutures previously used for partial RC repair may be used as the third attachment site.

The humerus is taken through its ROM to assess the fixation and excursion of the TT.

Postoperatively, the upper limb is immobilized in an abduction pillow for 6 weeks.

### Discussion

With recent discoveries in the understanding of RC biomechanics, as well as kinematics, and developments in arthroscopic techniques, treatment of massive and irreparable RC tears have become one of the most studied topics.<sup>14-19</sup>

The LD TT has good clinical outcomes in the treatment of these tears; however, proper patient selection

is very important in order to achieve good results.<sup>20</sup> It is important to remember that the function of the deltoid and SSC muscles can affect the clinical results.<sup>2,21</sup>

Many different techniques regarding LD TT have been described: open surgery, arthroscopy-assisted, mini-open, and all-arthroscopic techniques.

This study aims to describe our preferred surgical technique when transferring the LD tendon for the treatment of massive and irreparable RC tears. It has the advantages of being arthroscopy-assisted but with a mini-open stage. The arthroscopy step minimizes the risk of the injury of the deltoid. It also allows the surgeon to detach the tendon far distally more easily than with open surgery (the open technique needs an axillary approach to properly detach the tendon from the humerus). At the same time, with the mini-open stage of this procedure, the proximal part of the LD muscle is dissected and released from its adhesions, such as on the tip of the scapula. So, on the basis of our experience, we believe that this approach leads to a better mobilization for the patient and gives the surgeon better control over the transferred tendon compared to all-arthroscopic techniques.

The main limitation of the presented technique is the steep learning curve associated with the procedure. There is always a risk of injury to the major anatomical structures, such as the radial nerve, axillary nerve, or vascular structures during all of the phases of the surgery but, from our perspective, this procedure can be performed safely by respecting the meticulously described technique.

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