Technical Note

Arthroscopic-Assisted Anterior Latissimus Dorsi Transfer for Irreparable Anterior Rotator Cuff Tear: A Technical Note

Karl Wieser, M.D., and Julian Hasler, M.D.

Abstract: Several reconstruction techniques for irreparable tears of the subscapularis tendon have been described with variable results regarding pain relief, functional recovery, and dynamic stabilization of the glenohumeral joint. Because of a more advantageous direction of movement compared with previously described transfer techniques such as transfer of the pectoralis major and pectoralis minor tendons, the anterior latissimus dorsi (LD) transfer has been proposed as a potentially beneficial treatment method. This Technical Note aims to introduce an alternative technique for the anterior LD transfer that combines the advantages of a proper muscle release and tendon reinforcement through an axillary incision with the arthroscopic intra-articular and periarticular work, including detachment of the LD tendon from its humeral insertion and reattachment at the lesser tuberosity.

Massive irreparable tears of the subscapularis (SSC) tendon remain a challenging problem, especially in young and active patients. Treatment depends on the condition of the glenohumeral joint and the patient's age, activity level, and symptoms. Although reverse shoulder arthroplasty is a valuable treatment option in the presence of combined irreparable rotator cuff (RC) tear and osteoarthritis,[1] it should be avoided in young patients with intact cartilage in the glenohumeral joint. Various reconstruction techniques for the treatment of irreparable SSC tears have been described, including transfer of the pectoralis minor tendon,[2] upper trapezius transfer,[3] and pectoralis major (PM) transfer,[4] of which the latter is the most frequently performed procedure. However, although some authors showed good long-term outcomes after transfer of the PM tendon,[4] others reported unsatisfactory clinical results with weakness returning to the preoperative level and diminishing range of motion during long-term follow-up,[5] as well as persistent pain and a high failure rate.[6] Therefore, Elhassan et al.[7] proposed the anterior latissimus dorsi transfer (ALDT) as an alternative treatment option for irreparable anterior RC tears. The working vector of the latissimus dorsi (LD) muscle is in the line of pull of the SSC muscle, which is at least a strong theoretical advantage. Usually, the ALDT is performed through an open deltopectoral approach,[8] thereby entailing the disadvantage of increased soft-tissue damage and difficulties in repairing concomitant posterior-superior RC lesions.

This article aims to describe a technique for an arthroscopic-assisted ALDT, combining the advantages of the arthroscopic intra-articular and periarticular work, including detachment of the LD tendon from its humeral insertion and subsequent reattachment to the lesser tubercle, with a proper muscle release and tendon reinforcement through an axillary incision, which might be helpful for shoulder surgeons encountering the problem of irreparable SSC tendon tears.

Surgical Technique

The operative technique is shown in Video 1. Pearls and pitfalls of the procedure are listed in Table 1.

From the Department of Orthopaedics, Balgrist University Hospital, University of Zurich, Zurich, Switzerland.

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received July 28, 2020; accepted October 4, 2020.

Address correspondence to Julian Hasler, M.D., Department of Orthopaedics, Balgrist University Hospital, Forchstrasse 340, CH-8008, Zurich, Switzerland. E-mail: julian.hasler@balgrist.ch

2212-6287/201336

https://doi.org/10.1016/j.eats.2020.10.002

Table 1. Pearls and Pitfalls

Pearls
A hydraulic arm holder is used to support the arm during the surgical procedure.
Diagnostic arthroscopy prior to tendon harvesting allows one to assess for additional posterosuperior rotator cuff tears and to verify irreparability of the anterior rotator cuff.
Arthroscopic detachment of the LD tendon at its humeral insertion with subsequent PDS insertion into the tendon prior to the open dissection of the LD muscle allows for safe transfer and reinsertion of the tendon into the joint.
Posterosuperior rotator cuff tears are easier to address compared with open techniques using a deltopectoral approach.
Pitfalls
Inaccurate portal placement makes access to the insertion of the LD tendon difficult.
Insufficient visualization during arthroscopic release of the LD tendon from its humeral insertion endangers the axillary nerve and radial nerve.
Care should be taken to detach the LD tendon exactly at its humeral insertion and to perform a proper muscle release to avoid over-tensioning and facilitate refixation to the lesser tubercle.
Twisting of the LD tendon during reattachment to the lesser tubercle can be prevented by tagging the superior and inferior borders of the tendon with differently colored sutures.

LD, latissimus dorsi; PDS, polydioxanone.

Patient Positioning and Preparation

Routinely, an interscalene nerve block and general anesthesia are administered. The patient is placed in the supine beach-chair position, and a hydraulic arm holder (Trimano Fortis Support Arm; Arthrex, Naples, FL) is applied ipsilateral to the operative limb, allowing for free range of motion of the operated shoulder. Widespread draping of the arm is performed to enable access to the shoulder as well as the axilla.

Diagnostic Arthroscopy and Management of Concomitant Shoulder Pathologies

In total, 5 arthroscopic portals are used (Fig 1). First, a standard posterior soft-point portal 2 cm medial and 2 cm inferior to the posterolateral corner of the acromion is established. Thereafter, standard anterior, anterolateral, and lateral portals are placed under direct view from the first portal. A general arthroscopic examination is performed to assess additional pathologies of the labrum, cartilage, long head of the biceps, and posterosuperior RC. After subacromial bursectomy and resection of the remaining rotator interval using an aggressive shaver blade (Aggressive Pro Line Shaver Blade; Karl Storz, Tuttlingen, Germany), the retracted tendons of the torn RC are debrided and mobilized (Fig 2).

Arthroscopic Tendon Release

After confirmation of the irreparability of the SSC tendon, the coracoid process and the posterior surface of the conjoint tendon are exposed. With the camera in the anterolateral portal, an additional, straight, anteroinferior portal superior to or within the PM tendon is established under direct view, enabling good access to the LD tendon at its humeral insertion beneath the PM tendon (Fig 1). Now, the LD tendon is released from its humeral insertion and separated from the underlying teres major tendon using a 90° tipped radiofrequency device (Werewolf Coblation System; Smith & Nephew, London, England) (Fig 3A). Care must be taken during the release to damage neither the axillary nerve, which passes just above the superior border of the LD tendon around the humerus, nor the radial nerve, as it passes obliquely over the inferior border of the LD tendon. Both nerves can be arthroscopically visualized if needed. Once the tendon is completely detached from the humerus and sufficiently mobilized, a monofilament suture (e.g. No. 2 polydioxanone) is passed through the tendon using a suture passer (Spectrum; ConMed, Utica, NY) and retrieved through the lateral or anterior portal (Fig 3B).

LD Muscle Dissection

For the purpose of further LD muscle release and proper tendon reinforcement, the shoulder is placed in maximal abduction and internal rotation. A 5- to 8-cm incision (depending on the patient's anatomy) is made along the anterior border of the LD muscle. Thorough

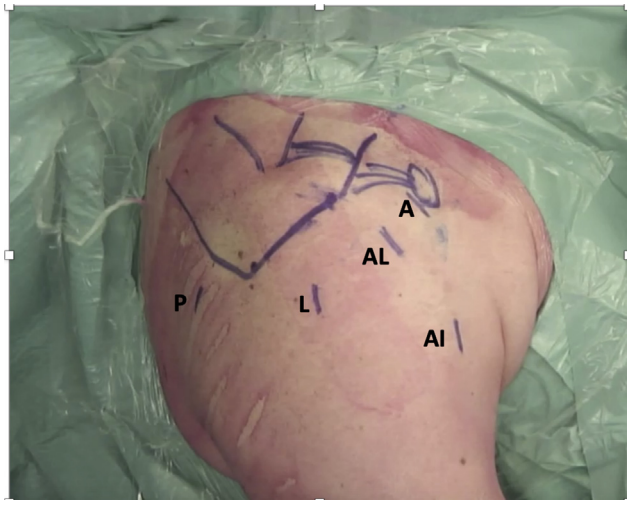

Fig 1. Right shoulder in a 49-year-old male patient in the beach-chair position. Five arthroscopic portals are used for the performed procedure: posterior portal (P), lateral portal (L), anterolateral portal (AL), anterior portal (A), and anteroinferior portal (AI).

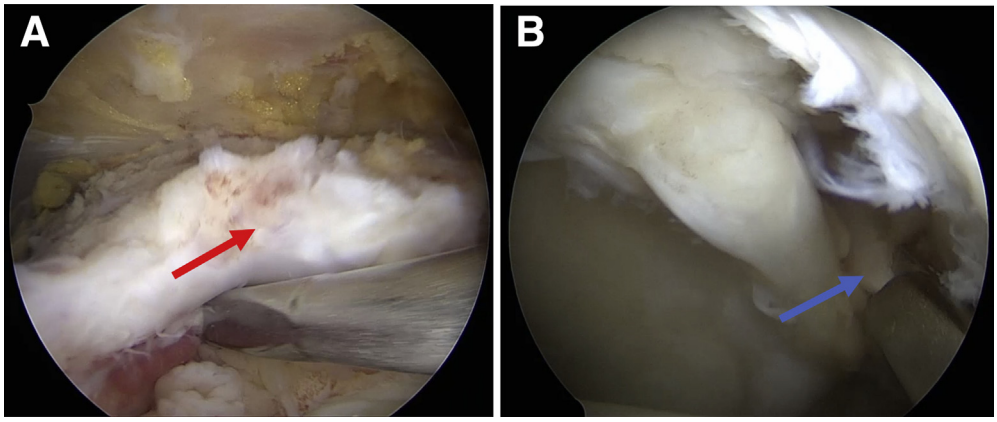

Fig 2. Right shoulder in a 49-year-old male patient in the beach-chair position. Intra-articular arthroscopic view from the lateral portal revealing a torn posterosuperior rotator cuff (red arrow) (A) and a torn and irreparable subscapularis tendon (blue arrow), which is retracted medially to the glenoid (B).

mobilization of the LD muscle is performed by excessive subcutaneous dissection and separation of fascial connections to the teres major muscle to increase excursion for the transfer (Fig 4A). Care must be taken not to injure the thoracodorsal pedicle, which penetrates the LD muscle from its medial surface at an average distance of 13 cm caudal to its humeral insertion. Once the muscle is sufficiently mobilized, the tendon is pulled out through the axillary incision (Fig 4B) and tagged twice with crisscross stitches using a No. 2 FiberWire (Arthrex) and a No. 2 TigerWire suture (Arthrex) (Fig 4C). The use of differently colored sutures for tendon preparation is strongly recommended to avoid twisting during subsequent fixation of the tendon to the lesser tubercle. For the transfer of the LD tendon through the axillary incision back into the glenohumeral joint, the polydioxanone suture is used to shuttle a ribbon of an abdominal bandage from the axillary incision through the lateral portal. By attaching the FiberWire and TigerWire to the ribbon, the tendon can safely be pulled back into the glenohumeral joint (Fig 4D).

Tendon Fixation

For tendon-to-bone fixation, the shoulder is adducted and placed in neutral rotation. The arthroscope is placed in the lateral portal, and the footprint of the SSC tendon at the lesser tubercle is freed from scar tissue. After examination of the LD excursion to avoid over-tensioning, the TigerWire and FiberWire are separated and pulled through the anterior and anterolateral portals, respectively. By use of 2 knotless anchors (ReelX STT Knotless Anchor; Stryker, Kalamazoo, MI), the transferred LD tendon is reinserted into the lesser tubercle at the level of the SSC tendon insertion (Fig 5). Additional lesions of the posterosuperior RC can now be fixed to the footprint at the greater tubercle as customary.

Discussion

Several operative techniques have been described for irreparable tears of the SSC tendon, of which the PM tendon transfer is the most frequently used.[4,6] However, the PM muscle originates from the anterior chest wall; thus, the line of pull of the PM muscle forms a

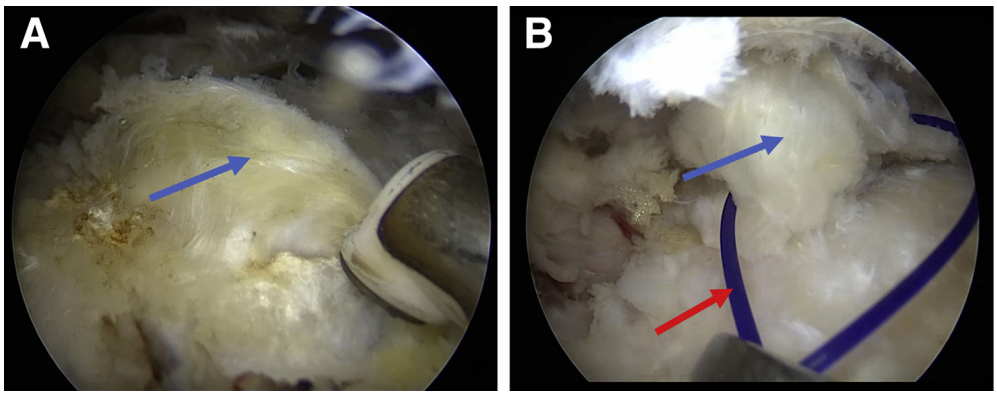

Fig 3. Right shoulder in a 49-year-old male patient in the beach-chair position. Intra-articular arthroscopic view from the anterolateral viewing portal. (A) By use of a 90° tipped radiofrequency device inserted through the anteroinferior portal, the latissimus dorsi tendon (blue arrow) is released from its humeral insertion and separated from the underlying teres major tendon. (B) After release of the tendon, a polydioxanone suture (red arrow) is passed through the latissimus dorsi tendon (blue arrow) using a Spectrum suture retriever (ConMed) inserted through the anteroinferior portal.

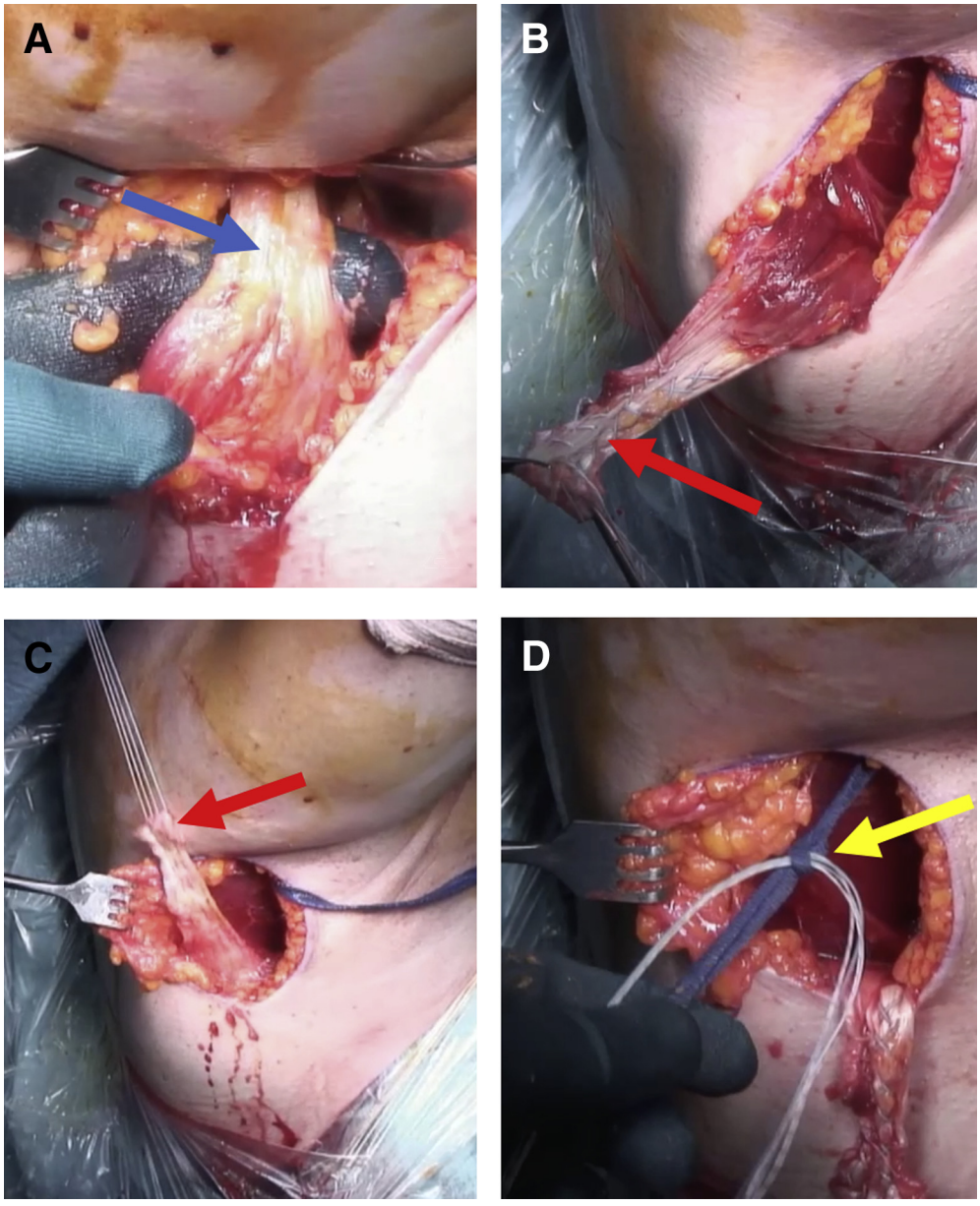

Fig 4. Right shoulder in a 49-year-old male patient in the beach-chair position with the arm placed in maximal abduction and internal rotation. (A) The latissimus dorsi muscle (blue arrow) is mobilized through an axillary incision by excessive subcutaneous dissection and separation of the fascial connection to the teres major muscle. (B) Once the muscle is mobilized, the tendon (red arrow) is pulled out through the axillary incision. (C) The tendon is tagged twice with crisscross stitches, using 2 differently colored FiberWire and TigerWire sutures (red arrow). Thereafter, the previously placed polydioxanone suture is used to shuttle a ribbon of an abdominal bandage from the axillary incision through the lateral portal. (D) By attaching the FiberWire and TigerWire to the ribbon (yellow arrow), the tendon can now safely be retrieved back into the glenohumeral joint.

nearly 90° angle to the direction of movement of the SSC muscle fibers and tendon, which might explain unfavorable results in some patients after such procedures.[6] In contrast, the LD muscle originates from the posterior chest wall, thereby showing an almost similar direction of movement to that of the SSC muscle.[7] Furthermore, the LD muscle acts as an internal rotator on the humerus and is therefore synergistic with the SSC muscle.[9] Therefore, the ALDT might be an advantageous treatment option for patients with an SSC deficiency compared with previously described transfer techniques such as the PM tendon or pectoralis minor tendon transfer. Elhassan et al.[7] were the first authors to investigate the ALDT in a cadaveric study and showed its feasibility with a very low risk of nerve compression. Subsequently, Mun et al.[8] reported on 24 consecutive patients undergoing ALDT through a deltopectoral approach and found good clinical results and no neurovascular complications. However, although tagging of the tendon with sutures is usually not a problem through this kind of approach, a partial detachment of the proximal PM tendon was necessary to obtain appropriate access to the insertion of the LD tendon. Furthermore, repair of concomitant tears of the posterosuperior RC and thorough release of the LD muscle belly might be difficult to achieve, leading to potentially increased tension of the reinserted tendon at the lesser tuberosity.

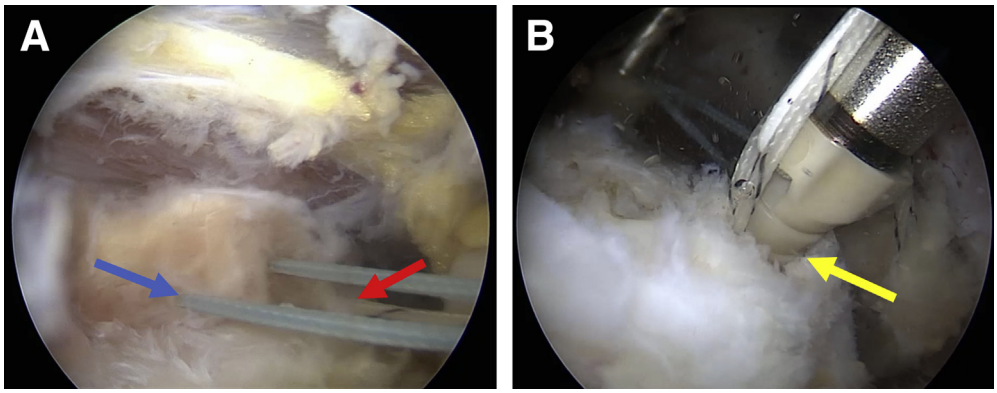

Fig 5. Right shoulder in a 49-year-old male patient in the beach-chair position. Intra-articular arthroscopic view from the lateral portal, showing the tagged latissimus dorsi tendon. (A) To avoid twisting of the tendon during reattachment, differently colored sutures at the superior border (blue arrow) and inferior border (red arrow) of the latissimus dorsi tendon are used. (B) The tendon is reattached at the footprint of the lesser tubercle with knotless anchors (yellow arrow) inserted through the anterior and anterolateral portals.

Other authors reported on an arthroscopically assisted technique for ALDT, which contains the advantages of decreased soft-tissue damage, increased visibility of concomitant intra-articular pathologies, and easier repair of posterosuperior RC tears. However, although they used an arthroscopic approach for reattachment of the LD tendon, release of the tendon from its humeral insertion was performed through an axillary incision. Thus, reinsertion of the LD tendon into the glenohumeral joint was performed blindly, using a grasping instrument or suture manipulator introduced through a proximal or distal anterolateral portal, which might endanger neurovascular structures.[9,10]

The technique presented in this report combines the advantages of a proper muscle release and tendon reinforcement through a short open axillary approach but taking full advantage of an arthroscopic detachment of the LD tendon from its humeral insertion, as well as a more guided transfer back into the glenohumeral joint and reinsertion of the tagged LD tendon at the lesser tuberosity, thereby protecting neurovascular structures such as the axillary and radial nerves. It might therefore be helpful for shoulder surgeons encountering the problem of irreparable SSC tendon tears.

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