Technical Note

Arthroscopic-Assisted Lower Trapezius Tendon Transfer Using a Fasciae Lata Autograft in Treatment of Posterior Superior Irreparable Rotator Cuff Tears in Lateral Decubitus Position

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Abstract: The optimal treatment for patients with posterior superior irreparable rotator cuff tears (PSIRCTs) is still a topic of ongoing debate. Lower trapezius tendon transfer is one of the effective surgical treatments for PSIRCTs in younger patients and elderly patients with high activity levels without arthritis. In this report, we describe an arthroscopic-assisted technique for lower trapezius transfer using a fascia lata autograft for patient with PSIRCTs in lateral decubitus position.

The best surgical treatment option for posterior superior irreparable rotator cuff tears (PSIRCTs) still remains a controversial topic, especially in young individuals and high-demand elderly patients without arthritis. Lower trapezius tendon (LTT) transfer has gained attention as a potential joint-preserving surgical option in patients with PSIRCTs with or without external rotation deficiency.[1-10]

LTT transfer helps re-centering the humeral head by restoring the balance between the anterior and posterior force couples that may be disrupted in cases of a massive rotator cuff tear.[11] LTT shares similar excursion and "line of pull" with infraspinatus.[12,13] Because of these biomechanical advantages, LTT transfer has shown promising clinical results.[1,4-6] Both autologous and allograft hamstring tendon and Achilles tendon allograft have been mentioned in the literature as possible options for interpositional grafts to bridge the gap between the LTT and the greater tuberosity of the humerus.[2,14] In addition, various techniques have been developed to attach the LTT graft to the greater tuberosity, such as suture anchor fixation or tubularizing the tendon into a humerus bone tunnel.[2,15-17] In this surgical technique, we describe an arthroscopic-assisted LTT to treat PSIRCTs using fascia lata autograft with a double-row suture-bridge technique with the patient in the lateral decubitus (LD) position.

Surgical Technique

The indications and contraindications of arthroscopic-assisted LTT transfer with fascia lata autograft for PSIRCTs are listed in Table 1. The whole procedure of the surgical technique is shown in Video 1, and the pearls and pitfalls for each surgical steps are described in Table 2.

Patient Preparation

Before surgery, the patient is given a combination of general anesthesia and interscalene brachial plexus block. The patient is positioned in the standard LD position with the arm suspended in a traction arm holder (Fig 1A). The shoulder and ipsilateral thigh are draped and prepared in standard fashion (Fig 1B).

Arthroscopic Portals

A standard posterior portal is created, followed by a diagnostic arthroscopy using a 30° arthroscope. An 18-gauge spinal needle is used to create an anterior portal in the rotator interval using the outside-in technique. Standard lateral and posterolateral portals are created to access and work within the subacromial space

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Table 1. Indications and Contraindications

Indications
Massive irreparable posterior superior rotator cuff tears
Advanced high-grade fatty infiltration of cuff muscles (Goutallier[27] classification grades 3 and 4)
Nonarthritic shoulder (Hamada[28] stage $\leq$ 2)
Shortening and medial retraction of the tendons to the level of the glenoid
Glenohumeral arthritis (Hamada[28] stage $>$ 3)
Contraindications
Chronic subscapularis deficiency
Shoulder stiffness
Deltoid or trapezius muscle paralysis
Active soft tissue infection

(Fig 1C). The borders of the acromion, clavicle, medial border of the scapula, the scapula spine, and the tendon insertion of the LTT are marked on the skin (Fig 1D).

Arthroscopic Examination, Soft-Tissue Releases, and Greater Tuberosity Preparation

First, an extensive release of the rotator interval and capsule is performed in the glenohumeral joint space (Fig 2), and the glenohumeral joint is thoroughly examined to check for any significant arthritis. If necessary, the subscapularis tear is repaired using the double-row suture-bridge technique. After the removal of the subacromial bursa, mobilization and reparability of the remaining supraspinatus and infraspinatus tendons are checked to confirm PSIRCTs (Fig 3A). Tendon remnants are debrided using a shaver, and the footprint of the supraspinatus is prepared. Two medial-row anchors (Healix Advance BR 3 Suture Anchor w/ Permacord; DePuy Mitek, Raynham, MA) are implanted on the supraspinatus footprint approximately 1.5 cm apart (Fig 3B). Using the 45°Curved Suture Lasso SD (Arthrex, Naples, FL), 2 suture limbs from the posterior medial-row anchor are passed through the anterior portion of the remaining infraspinatus muscle or teres minor, one medially and one laterally (Fig 3 C and D). These sutures will later be used for side-to-side sutures of the fascia lata autograft. One of the sutures from the anterior medial-row anchor is removed to be used as a free-strand suture later in the procedure.

Table 2. Surgical Steps, Pearls, and Pitfalls

Steps	Procedure	Pitfall	Pearls
1	Patient preparation	Difficult anatomic orientation and difficult positioning in Lateral-Decubitus position than Beach-Chair position.	Lateral Decubitus Better access of posterior and inferior part of joint Lesser risk of stroke with hypotensive anesthesia. The ipsilateral lower leg can be prepared simultaneously.
2	Arthroscopic portals		Four main arthroscopic portals: anterior, lateral, posterolateral, and posterior. An additional anterior portal is needed for subscapularis repair.
3	Arthroscopic examination, soft-tissue releases and greater tuberosity preparation	Tight glenohumeral joint space and subacromial space.	Maintain shoulder in slight abduction and external rotation to obtain work space Extensive release of rotator interval and capsule.
4	Harvesting fascia lata autograft	If the patient is small and lightweight, it may be challenging to obtain enough fascia lata autograft. Additional operation time being required to harvest autograft. Donor site morbidity.	Augmentation with acellular allodermal matrix graft can increase graft's thickness, create spacer effect, and maintain good suture retention. Compared to allograft, fascia lata autograft can reduce the risk of inflammatory response and promote the healing.
5	Preparation of lower trapezius tendon	Difficult identifying and harvesting the lower trapezius tendon. Be cautious when working near medial border of scapular because spinal accessory nerve runs 3 to 4 cm medially to the medial border of scapula.	Removal of triangular fat area helps to identify the lateral border of lower trapezius tendon
6	Arthroscopic graft passage and fixation	Graft twisting and folding during graft passage Difficult suture management	Proper tensioning of graft. Usage of a long curved clamp. Usage of suture-bridge technique can create higher bone to tendon contact area and higher load to failure.
7	Graft attachment and tensioning of lower trapezius tendon	Inadequate tensioning of the graft can result in insufficient external rotation.	Graft is attached and wrapped along inferior margin of lower trapezius muscle to increase the contact area.
8	Wound closure	Failure to adequately close the fascia lata defect may result in hematoma formation.	Before closing the fascia lata defect, perform extensive coagulation to prevent bleeding.

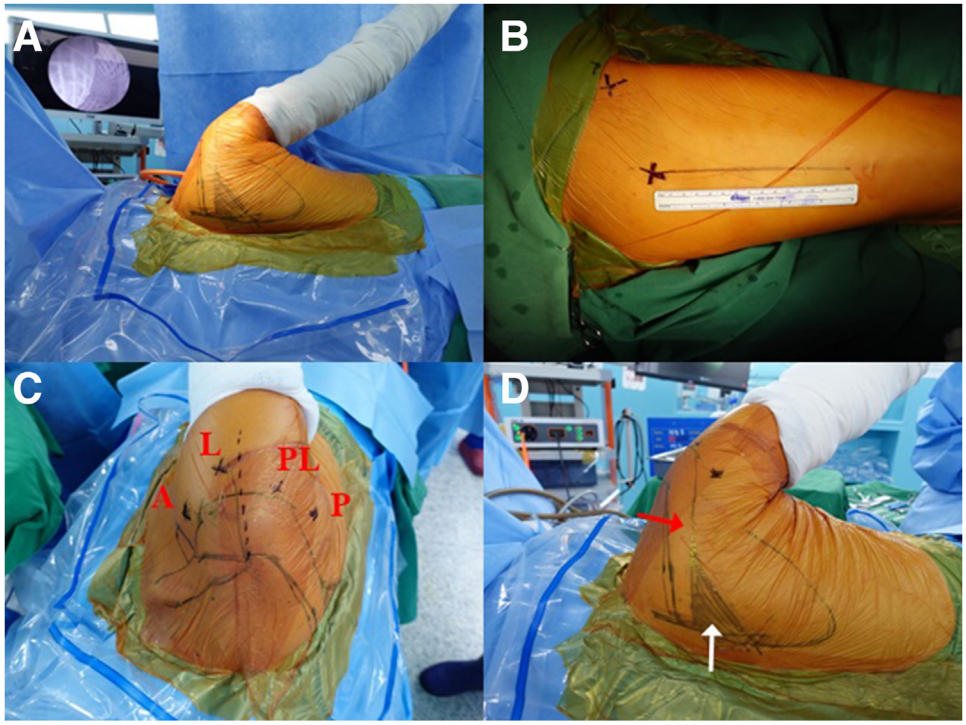

Fig 1. Patient's positions and portals. (A) Patient is position in the right lateral decubitus with the right arm in traction. (B) Ipsilateral thigh is prepared and draped in sterile fashion. (C) Arthroscopic portals are marked on skin: posterior portal (*P*) anterior portal (*A*) lateral portal (*L*), and posterolateral portal (*PL*). (D) The bony landmarks of the posterior scapular are marked in the right shoulder: lower trapezius tendon (white arrow) and scapular spine (red arrow).

Harvesting Fascia Lata Autograft

A straight 15-cm incision is made at the center of the greater trochanter of the femur along the lateral side of the hip. After exposing the fascia lata through dissection of the overlying soft tissue and fat, 15 cm × 4 cm of fascia lata autograft is harvested (Fig 4A). After remaining fatty tissue is removed, the graft is folded in half (Fig 4B), and its edges are stitched together using no. 2 Ethibond sutures (Ethicon, Somerville, NJ). The graft is then augmented with an acellular dermal matrix (ADM) graft (Surederm; Hans Biomed Co., Daejeon, Republic of Korea) on 1 side, with each lateral edge using different-colored no. 2 nonabsorbable sutures in the Krackow configuration (Fig 4 C and D). The use of sutures in different colors helps with the orientation of the graft during graft delivery. To ensure proper tensioning of the graft, a traction stitch is applied on the opposite side using a no. 2 nonabsorbable suture (Fig 4D).

Preparation of LTT

To access LTT, a 5-cm horizontal skin incision is made laterally from the medial edge along the scapular spine. The lateral border of the LTT is located above a triangular fat area (Fig 5A), and dissection is carried out to free it from the deep fascial tissues. LTT is identified and

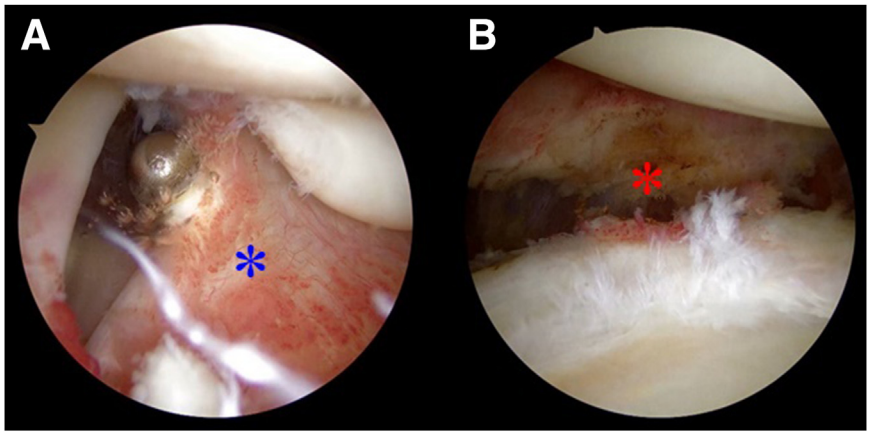

Fig 2. Arthroscopic soft-tissue release. Arthroscopic image from posterior portal showing (A) rotator cuff interval (blue asterisk) and (B) capsular being released (red asterisk).

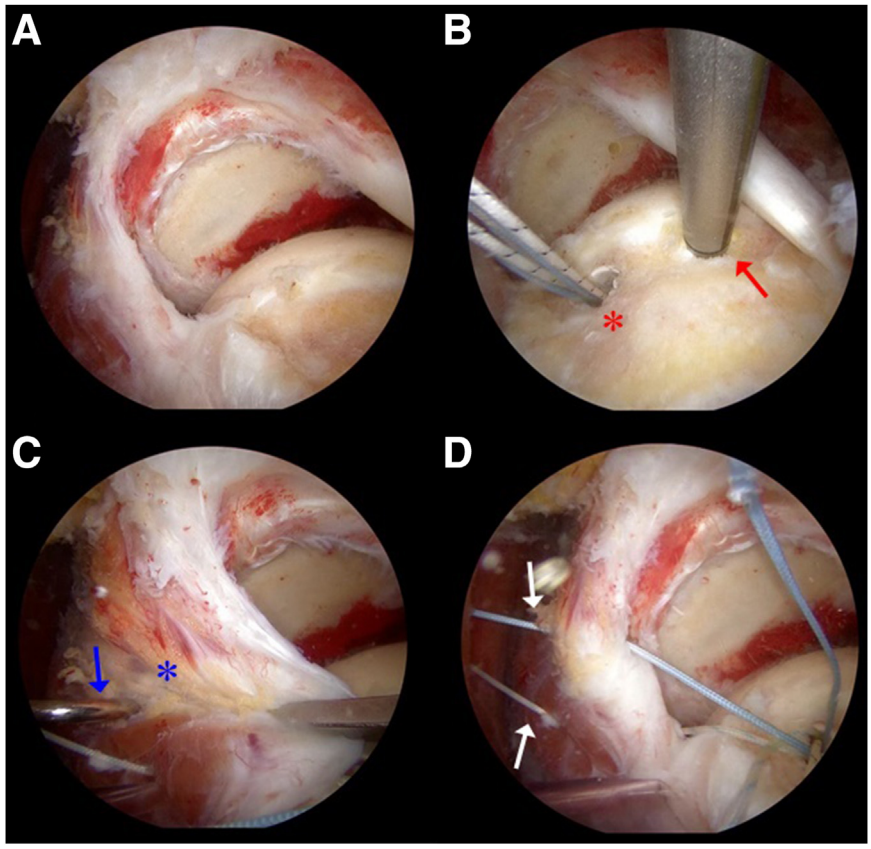

Fig 3. Arthroscopic greater tuberosity preparation and medial-row anchors placement. (A) Arthroscopic image from lateral portal showing massive posterior superior irreparable rotator cuff tears. (B) Anchor punch (red arrow) for anterior medial-row anchor is being placed in anterior part of supraspinatus footprint and posterior medial-row anchor has been inserted (red asterisk). (C) A 45° curved Arthrex SutureLasso (Arthrex) (blue arrow) is piercing the anterior portion of the remnant infraspinatus muscle (blue asterisk) while keeping traction with the grasper. (D) Two suture limbs (white arrows) are being placed in anterior portion of the remnant infraspinatus muscle.

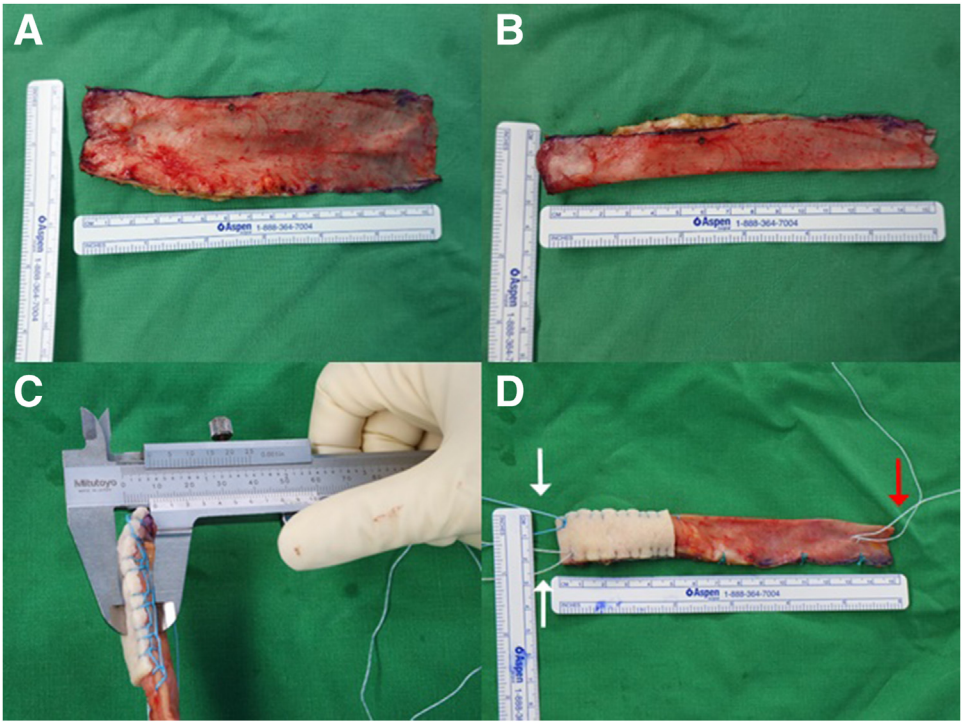

Fig 4. Fascia lata autograft harvesting and acellular dermal matrix graft augmentation. (A) Fascia lata autograft, measuring 15 cm by 4 cm, is harvested and (B) folded in half. (C) Graft is augmented with ADM graft. (D) Two no. 2 nonabsorbable sutures (white arrow) are used to augment ADM graft in the Krackow configuration. One nonabsorbable suture is used for traction stitch (red arrow).

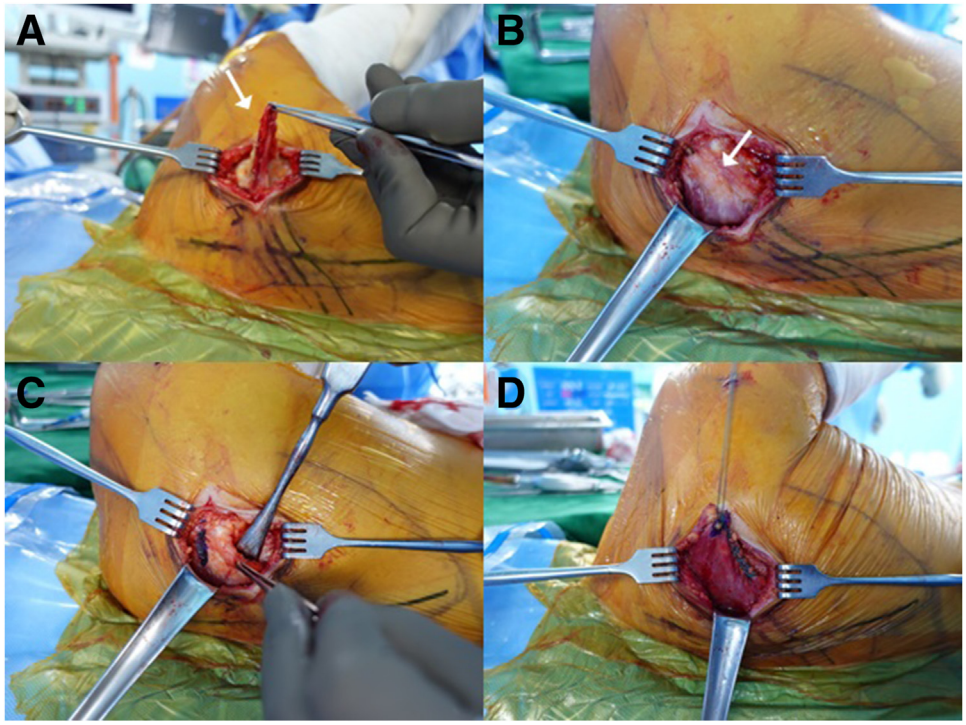

Fig 5. Harvesting lower trapezius tendon (LTT). (A) After 5-cm horizontal incision is made just below the spine of the scapula, triangular fat [white arrow] area is identified. (B) Obliquely and horizontally oriented fiber of LTT (white arrow) is identified. (C) Periosteal elevator is being used to dissect and elevate LTT. (D) Dissected and released LTT is stitched with no. 2 Ethibond (Ethicon) sutures along the musculotendinous portion of LTT.

detached from the scapular spine (Fig 5 B and C). To avoid potential injury to the spinal accessory, it is crucial not to advance medially to the medial border of the scapula when dissecting, because the spinal accessory nerve is located approximately 2 to 3 cm medial to the medial border of the scapula. Once adequate release and mobilization of the LTT are achieved, a no. 2 Ethibond suture is placed along inferior margin of the lower trapezius muscle in the Krackow configuration (Fig 5D).

Arthroscopic Graft Passage and Fixation

The arthroscope is reinserted through the posterolateral portal. Next, the customized PassPort Button Cannula (Arthrex), a soft and flexible 8.00 mm cannula, is inserted into the lateral portal (Fig 6). All suture limbs from the medial-row anchors are pull out through the lateral portal (Fig 7A). Then, a 5.75 mm Crystal Cannula (Arthrex) is placed into the customized PassPort Button Cannula (Fig 7B). To create the passing plane for the graft, the infraspinatus fascia is incised and opened to allow adequate graft passage (Fig 8-1A). A long-curved clamp (Solco-Rochester Pean Forceps 18.0 cm; Solco Biomedical Co., Seoul, Republic of Korea), is introduced into the subacromial space through the opening of infraspinatus fascia (Fig 8-1B). The distal end of a long-curved clamp pushes out the Crystal Cannula and grasps the traction stitch of the graft (Figs 8-1C and 8-2A). The traction stitch is then pulled out through the opening in the infraspinatus fascia (Fig 8-1D and 8-2B). Afterward, the customized PassPort Cannula (Arthrex) of the lateral portal is removed, and an opening of lateral portal is extended to allow graft delivery. While maintaining proper tensioning with traction stitch, the graft is delivered into the subacromial space until the augmented side of the graft is

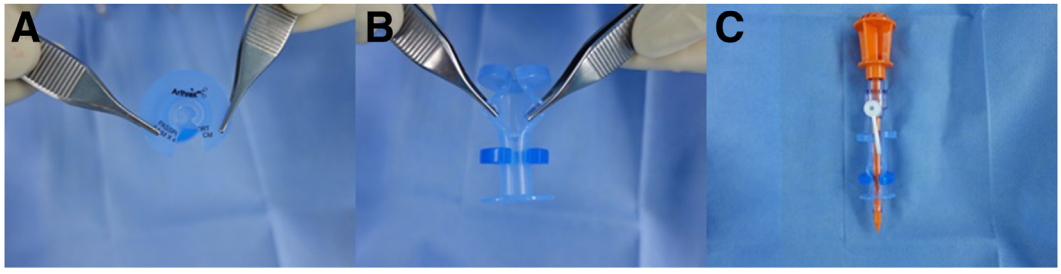

Fig 6. Preparing cannula for lateral portal. (A, B) PassPort Button Cannula (Arthrex) has been cut in half on one side. (C) A 5.75 mm Crystal Cannula (Arthrex) has been inserted inside the customized Passport Button Cannula (Arthrex).

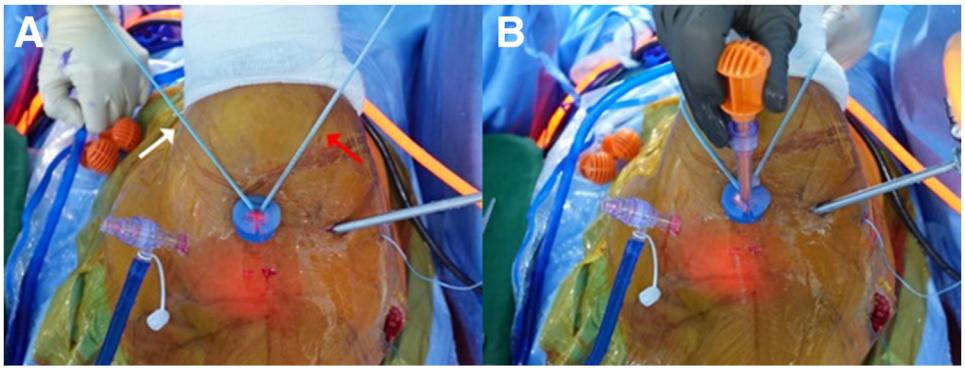

Fig 7. Cannula placement in lateral portal before the graft insertion. (A) For suture management, suture limbs from medial-row anchors are retrieved out through the PassPort Button Cannula (Arthrex) of lateral portal: sutures of anterior medial-row anchor (white arrow) and sutures of posterior medial-row anchor (red arrow). (B) A 5.75-mm Crystal Cannula (Arthrex) is then inserted into PassPort Button Cannula (Arthrex) of lateral portal.

positioned just outside the shoulder. Using 18-gauge spinal needle, the previously retrieved medial-row anchor sutures are passed through the predetermined sites on the graft (Figs 9-1 and 10A). Afterward, the graft is gently entered into the subacromial space and same-colored suture limbs from the same medial-row anchor are tied together (Fig 9-2). After knot tying, a suture-bridge construct is created using three 5.5-mm SwiveLock anchors (Arthrex) (Fig 10B). Three SwiveLock anchors (Arthrex), preloaded with corresponding suture limbs, are placed in an anterolateral, middle lateral, and posterolateral position on the greater tuberosity (Fig 11 A-C). To further compress the graft onto the greater tuberosity, an additional 5.5-mm SwiveLock anchor (Arthrex) preloaded with the side-to-side suture can be placed just posterior to the long head of the biceps tendon in greater tuberosity (Fig 11D). Arthroscopic final appearance of graft fixation is shown (Fig 12).

Graft Attachment and Tensioning of Lower Trapezius Tendon

When attaching the graft to LTT, the arm is placed in maximal external rotation at 60° to 90° of abduction

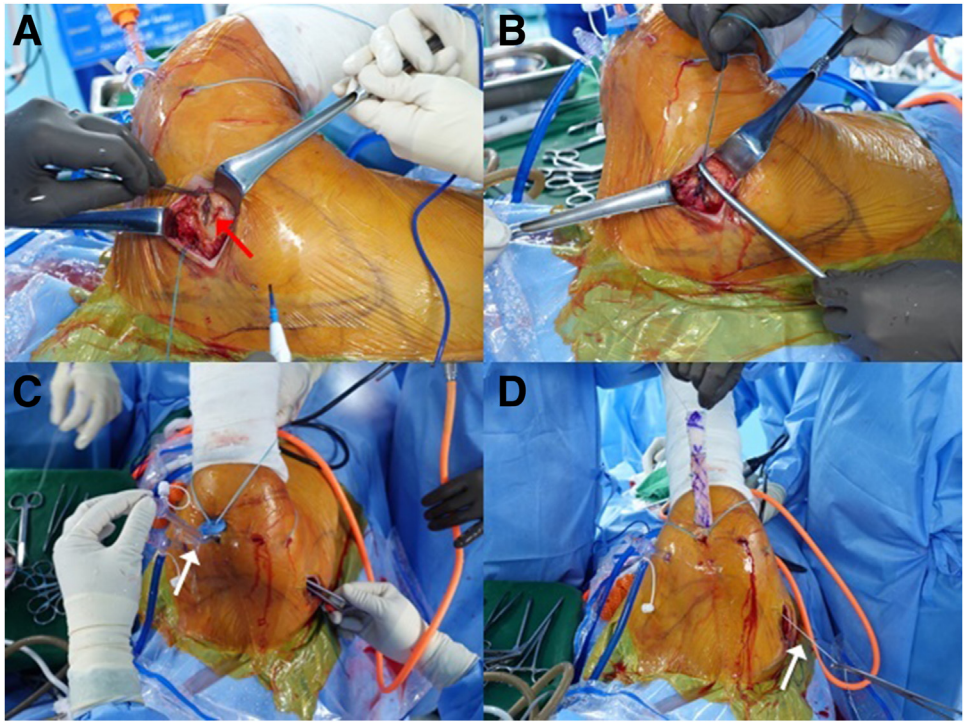

Fig 8-1. Graft passage. (A) Infraspinatus fascia [red arrow] is incised and opened to create the passing plane for the graft. (B) A long-curved clamp, the Solco-Rochester Pean 18.0 cm (Solco Biomedical Co.), is inserted into the joint through the opening in the infraspinatus fascia. (C) The distal end of a long-curved clamp is used to push out the 5.75 mm Crystal Cannula (Arthrex) (white arrow) and (D) grasp and pull the traction stitch (white arrow) of the graft.

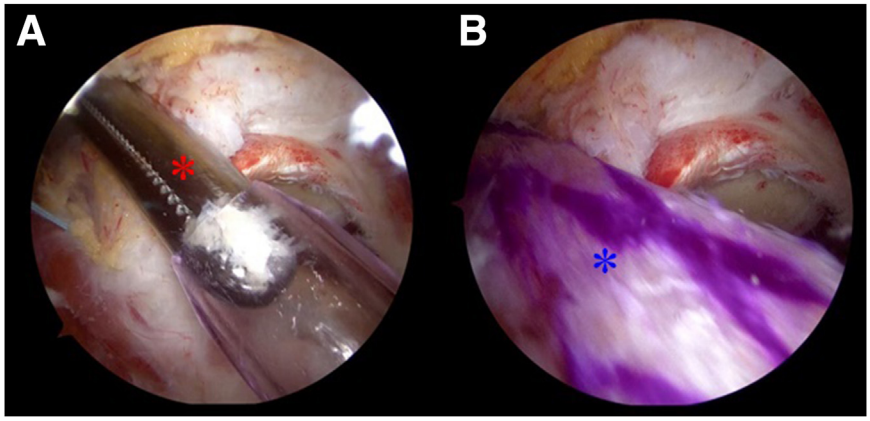

Fig 8-2. Graft passage. (A) Arthroscopic image from posterolateral portal showing distal end of a long-curved clamp (Solco Biomedical Co.) (red asterisk) pushing out the 5.75-mm Crystal Cannula (Arthrex) and (B) graft (blue asterisk) is being delivered into the joint.

(Fig 13 A and B). Graft is placed and wrapped anteriorly and posteriorly along the inferior margin of lower trapezius muscle using one no. 2 nonabsorbable suture in Krackow configuration (Fig 13 C and D). Once completed, LTT transfer moves as one unit as the shoulder externally rotates.

Wound Closure

The defect of harvested fascia lata is closed with a no. 2-Polysorb (Covidien, Mansfield, MA), followed by subcutaneous closure with 0-Polysorb (Covidien) and skin closure. The arthroscopy portals are closed in a standard fashion, and the LTT incision is closed with 0-Polysorb (Covidien) and staples for the skin. Standard dressings are applied.

Postoperative Protocol for Shoulder

The patient remains in a brace with the shoulder maintained at 0° external rotation for 4 weeks. During this period, patient is allowed to move their elbows, wrists, and fingers and to do tolerable living activities like eating and writing. After 4 weeks of wearing a brace, the patient begins active-assisted range-of-motion exercises, physical therapy, and external rotation strengthening exercises with elastic bands. The patient is advised to avoid heavy work or sports until 3 months after surgery.

Postoperative Protocol for Donor Site

Postoperatively, a compressive bandage is applied to donor site for 24 hours. The patient is encouraged to wear compression stockings for 4 weeks, but no specific physical therapy is recommended. The patient is advised to avoid high-activity sports involving the lower limbs until 2 months after surgery.

Discussion

In 2016, Elhassan et al.[1,17] first described the technique of arthroscopic-assisted LTT transfer for PSIRCTs and showed promising clinical results. Baek et al.[4,6] demonstrated superior outcomes for arthroscopic-assisted LTT transfer compared to other procedures such as superior capsular reconstruction and latissimus dorsi transfer. Both authors have used Achilles allograft as an interpositional graft. The use of an Achilles allograft offers several advantages, including its availability from tissue banks, reduced surgical time, and avoidance of donor site mobility. However, concerns still exist regarding the low viability,

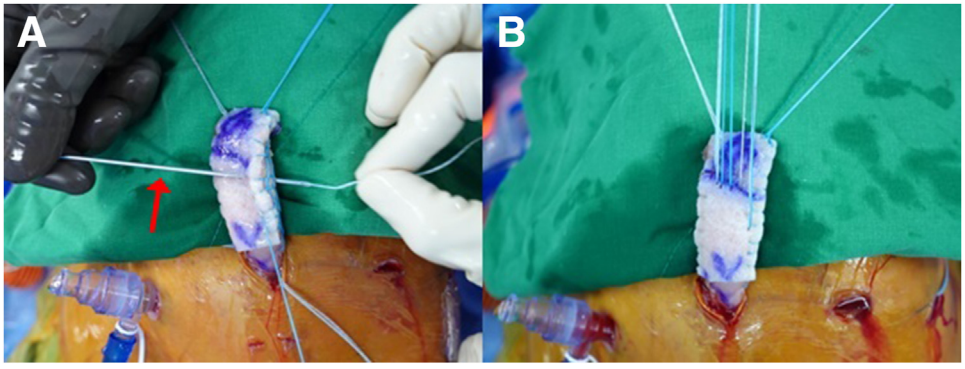

Fig 9-1. Graft fixation. (A) Spinal needle (red arrow) is being used to pass sutures through predetermined sites on the graft, in order from medial to lateral and from posterior to anterior. (B) Final appearance of sutures being passed through the predetermined sites on the graft.

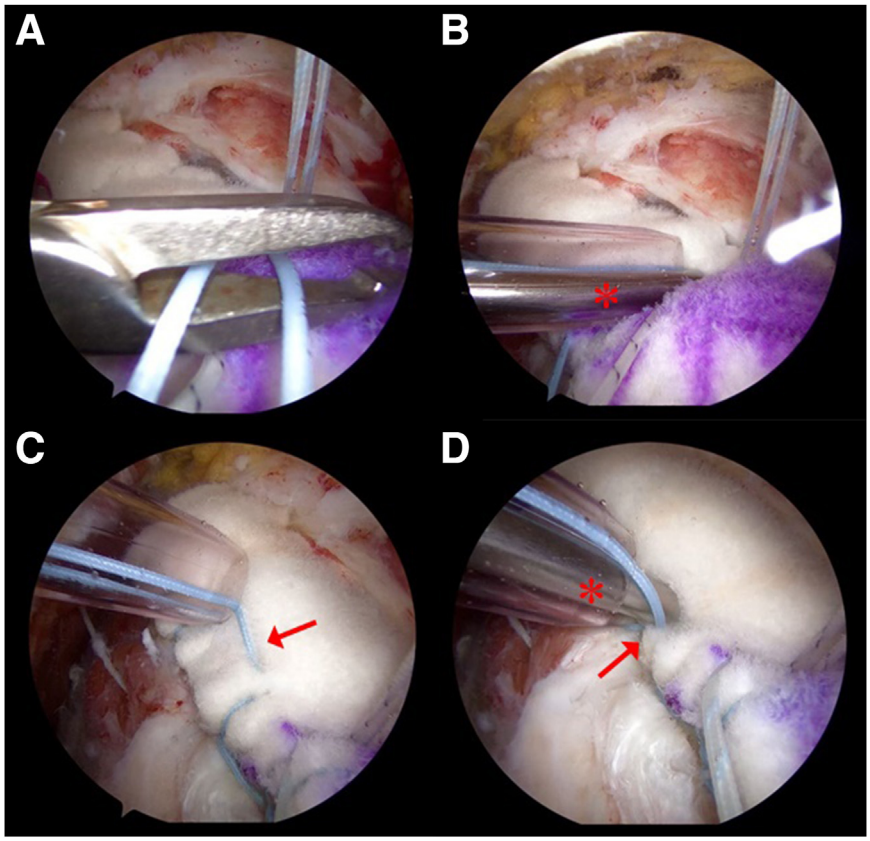

Fig 9-2. Graft fixation. (A, B) Arthroscopic image from the posterolateral portal showing medial-row sutures being tied using knot pusher (red asterisk) through the posterior portal. (C, D) Side-to-side suture (red arrow) between infraspinatus remnant muscle and the graft being tied using knot pusher (red asterisk) through the posterior portal.

potential graft rejection, and susceptibility to infections. To address these concerns, we use a fascia lata autograft in this surgical technique to reduce the risk of inflammatory response and to promote the healing process, aiming to minimize potential complications associated with allograft.

To increase its thickness, the fascia lata autograft is augmented with an ADM graft. The thick graft, positioned specifically in the footprint of the supraspinatus, is believed to replicate the effect of biologic tuberoplasty by reducing bone-to-bone contact between the greater tuberosity and acromion. Promising clinical outcomes

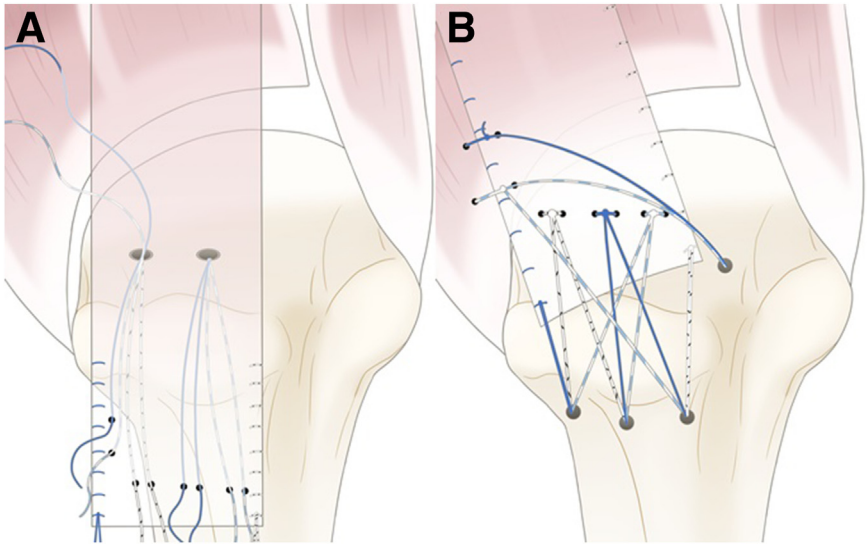

Fig 10. Roadmap of graft fixation. (A) Roadmap of placement of suture in the graft. (B) Final appearance of graft fixation with double-row suture-bridge technique.

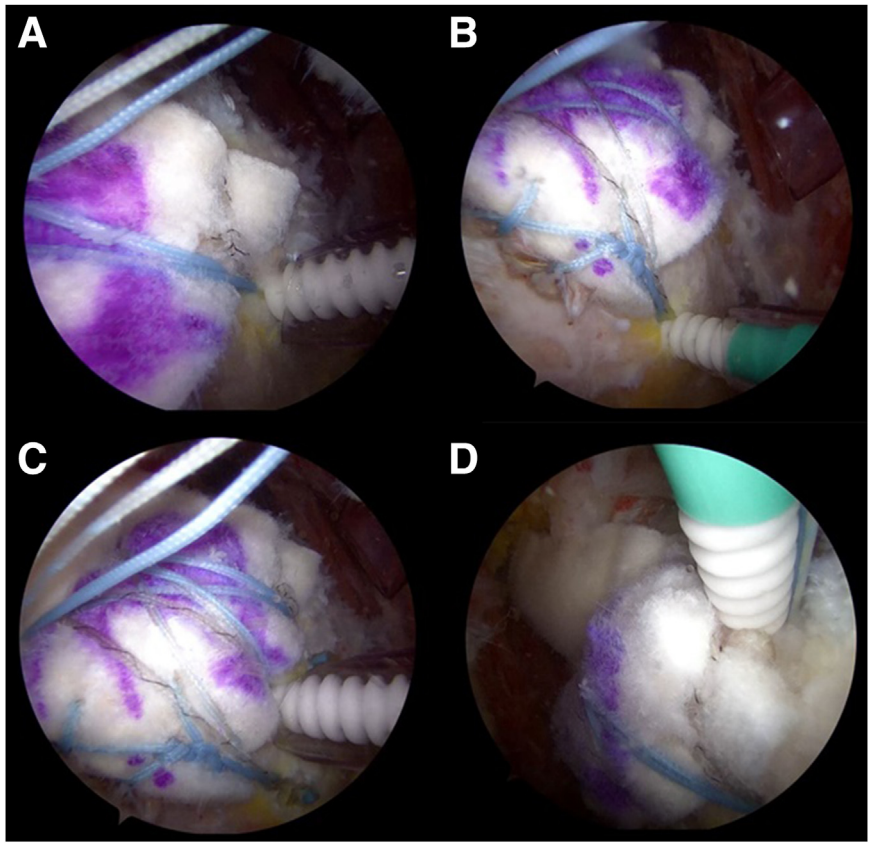

Fig 11. Lateral-row anchor placement. Arthroscopic image from posterolateral portal showing 5.5-mm SwiveLock anchors (Arthrex), preloaded with corresponding suture limbs, are placed in (A) anterolateral, (B) posterolateral, and (C) midlateral of the greater tuberosity. (D) Additional SwiveLock anchor (Arthrex), preloaded with side-to-side suture limbs, is used to compress the graft at the front of the graft and just behind the long head of the biceps tendon.

of biologic tuberoplasty with an ADM graft have already been reported in patients with massive rotator cuff tears.[18-20] Last, as supported by a biomechanical study,[21] ADM graft augmentation offers additional advantages such as providing biocompatible scaffold, exhibiting the excellent suture retention properties,[22] and obtaining high-strength against high-tensile loads.[21]

Different methods are available when securing the interpositional graft into the humerus, such as suture anchor fixation or tubularizing the tendon into a humerus bone tunnel.[1,15,17] In this surgical technique, we use a double-row suture bridge technique for its biomechanically advantage in the higher bone-tendon contact area, a higher bone-tendon contact pressure, and a higher load to failure.[23,24] However, well-

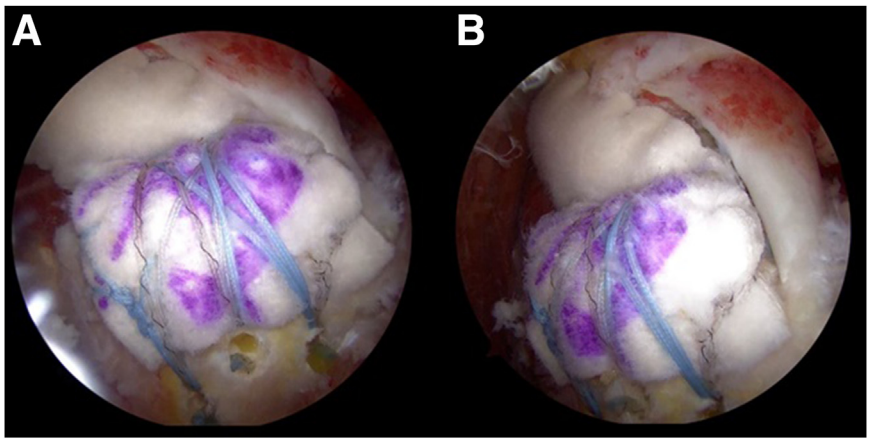

Fig 12. Final appearance of graft fixation. (A, B) Arthroscopic image from lateral portal showing final appearance of graft fixation with double-row suture-bridge technique.

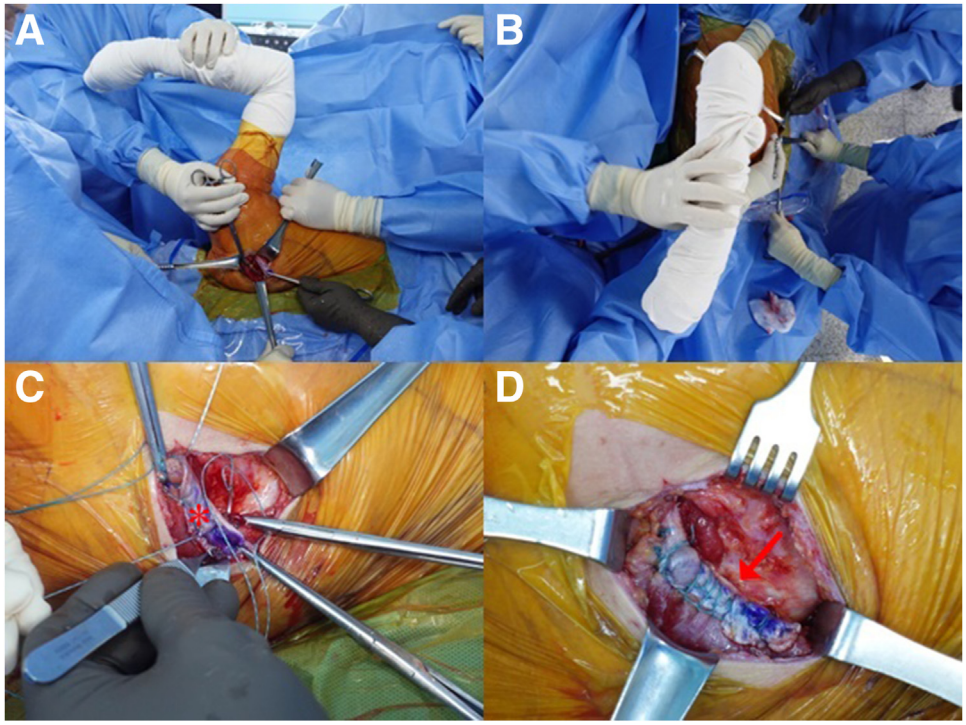

Fig 13. Graft attachment to lower trapezius tendon (LTT). During the fixation of graft to LTT, the patient's arm is placed in maximal external rotation at 60° to 90° of abduction, shown in (A) posterior view and (B) high-angle view. (C) Graft is wrapped along the inferior margin of LTT (red asterisk), covering anteriorly and posteriorly. (D) Using no 2. nonabsorbable suture, graft is attached to LTT in Krackow configuration (red arrow).

structured research is necessary to investigate the effectiveness of various surgical fixation methods.

The LD position offers several advantages compared to the beach-chair position. Not only does the LD position with arm traction increase the working space, it can reduce visibility issues because of fogging and cautery bubbles, improve cerebral perfusion, and decrease the risk of hypotension or bradycardia.[25,26] These advantages are particularly crucial in time-consuming surgeries like LTT transfer, which involve a combination of both open and arthroscopic procedures. This surgery requires longer anesthesia and involves technically demanding techniques, further highlighting the significance of the aforementioned advantages.

Despite the limitations outlined in the Table 3, this surgical technique presents a new method for arthroscopic-assisted LTT transfer using a fascia lata autograft in the lateral decubitus position, with the graft secured to the humerus through a double-row suture bridge technique.

Table 3. Strengths and Limitations

Strengths
Compared to allograft, fascia lata autograft incorporates more quickly and reduces the risk of inflammatory response.
Faster short-term recovery and earlier rehabilitation because of usage of autograft
Suture bridge construct provides strong fixation and greater bone to tendon contact area.
Natural physiological advantage of lateral decubitus position.
Provide a spacer effect and strong suture retention by augmentation of acellular dermal matrix graft.
Limitations
Not suitable for usage of fascia lata autograft if patient is small and light weighted.
Donor site morbidity
Extensive arthroscopic techniques.
Further clinical and radiological follow-up should be done.

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