Technical Note

Supraspinatus Tendon Reconstruction Using Fascia Lata Autograft for Irreparable Posterosuperior Massive Rotator Cuff Tears

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Abstract: Superior capsule reconstruction has shown good long-term clinical efficacy in treating irreparable posterosuperior massive rotator cuff tears. However, conventional superior capsule reconstruction did not treat the medial supraspinatus tendons. Therefore, dynamic function of the posterosuperior rotator cuff does not restore effectively, especially the function of active abduction and external rotation. We describe a supraspinatus tendon reconstruction technique that presents a stepwise approach to accomplish the dual goals of stable anatomic reconstruction and restoring the dynamic function of the supraspinatus tendon.

Irreparable posterosuperior massive rotator cuff tears (MRCTs) result in severe shoulder dysfunction due to shoulder superior instability. Superior capsule reconstruction (SCR) and bridging patches have been used increasingly to treat irreparable posterosuperior MRCT.[1,2] SCR was first reported by Mihata et al.[3] and has shown good mid- and long-term clinical efficacy in the treatment of irreparable MRCT.[4,5] The SCR technique fixes the patch graft on the glenoid and footprint of the rotator cuff. SCR restores superior glenohumeral joint stability and improves shoulder joint function.[1,6] However, the anatomic supraspinatus (SSP) tendon not only dynamically stabilize the shoulder but also assist the deltoid muscle in abducting the shoulder joint. Therefore, SCR does not restore the anatomy or dynamic function of the SSP tendon.

Bridging techniques with different patches, which mimic the anatomy of the SSP tendon, have been reported.[2,7,8] However, this technique should be used carefully because of the high retear rate in the patch graft–tendon interface.[9] In addition, there are always concerns regarding the poor mechanical properties of allogenic grafts compared with autogenic grafts and the possibility of inflammation[10] (Table 1). The supraspinatus tendon reconstruction (STR) technique using the autogenous fascia lata (FL) is introduced in this study. The technique accomplishes our goals of stable anatomic and dynamic reconstruction of the SSP tendon with strong fascia–muscle healing. A schematic of graft placement is demonstrated in Fig 1.

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Statement on Ethics and Consent

The clinical research was approved by ethics committee of the First Affiliated Hospital of Army Medical University (No. AKY2022126).

Surgical Technique (With Video Illustration)

Anesthesia and Patient Positioning

All patients are placed under general anesthesia in the contralateral decubitus position. Under cuff protection, the upper limb on the affected side is abducted by 30° and flexed at 20°. The vertical traction weight is 3 kg, and the lateral traction weight is 2 kg. The scope of

Table 1. Advantages and Disadvantages of STR

Advantages	Disadvantages
• Autologous fascia lata patch could fused well with SSP muscle. • STR restored the dynamic stability of SSP, compared with SCR. • STR minimized the risk of retear at the interface between the graft and remnant of SSP tendon. • The learning curve of STR technique is short.	• Rare continuous pain at donor site. • A relatively long time of abduction sling for 6 weeks to ensure fascia–muscle fusion.

SCR, superior capsule reconstruction; SSP, supraspinatus; STR, supraspinatus tendon reconstruction.

disinfection ranges from the upper limbs on the affected side, neck, and shoulders to the midline on the back side, nipple on the affected side of the ventral side, and FL on the affected thigh.

Diagnostic Arthroscopy, Subacromial Decompression, and Harvesting the FL

The surgical technique used is shown in Video 1. The conventional posterior, anterior, and anterolateral portals are selected and used. First, a 30° arthroscope (Smith & Nephew, Andover, MA) is placed into the glenohumeral joint from the posterior portal (Fig 2, A and B). The conditions of the subscapularis, labrum, articular cartilage, and long head of the biceps are evaluated and repaired through the anterolateral portal. Then, the arthroscope is transferred into the subacromial space from the posterior approach to explore the degree of rotator cuff injury and the shape of the acromion. The subacromial debridement and decompression are performed through the lateral channel. The anterior, posterior, and medial rotator cuff stumps are fully released, and tissue-grasping forceps are used to assess the tension for rotator cuff repair. STR is performed with autogenous FL if the rotator cuff stump cannot be restored to the footprint area under the appropriate tension (Fig 2, C and D). The FL patch width is measured from the anterior to the posterior edge of the rotator cuff tendon lesion. The length of the FL patch is based on the distance from the lateral edge of the acromial to the most medial spine of the scapula (Fig 3A).

Harvesting FL Graft

Starting from 2 cm proximal to the greater trochanter, the skin and subcutaneous tissue is longitudinally incised along the lateral side of the femur to expose the FL. The tensor FL is cut to the measured length and width, with an average of 3 × 15 cm, and the residual muscle and adipose tissue on the FL are removed (Fig 3B).

Implanted Graft

Two absorbable anchors with a diameter of 4.5 mm are placed on the medial line of the footprint. The sutures of the anchors are sutured through the lateral FL patch, which is 2 cm away from the lateral end, and the traction wire is sutured at the medial end of the FL patch. The guide pin passes through the subacromial from the lateral portal, runs along the SSP muscle to the most medial part of the spine of the scapula, and penetrates the dorsal skin (Fig 4A). The traction wire is pulled medially to pull out the FL patch under the acromion (Fig 4B), and then the wire of the anchor is knotted to fix the FL graft to the footprint of rotator cuff with a double-row style (GRYPHON for medial row and VERSALOK for lateral row; DePuy Mitek Synthes, Raynham, MA). A transverse incision of approximately 3 cm in length is made at the most medial side of the scapular spine to expose the medial end of the patch and the spine of the scapula (Fig 5A). An absorbable lupine anchor (DePuy Mitek Synthes) is implanted at the most medial side of the scapular spine, and the FL graft is sutured and fixed under the appropriate tension (Fig 5B). The incision is sutured layer by layer, and the operation is completed (Table 2).

Postoperative Rehabilitation

Postsurgery, patients are placed in a brace in a neutral position with a small abduction pillow to protect the reconstruction. Full active range of motion of the elbow, wrist, and hand is allowed immediately. Patients

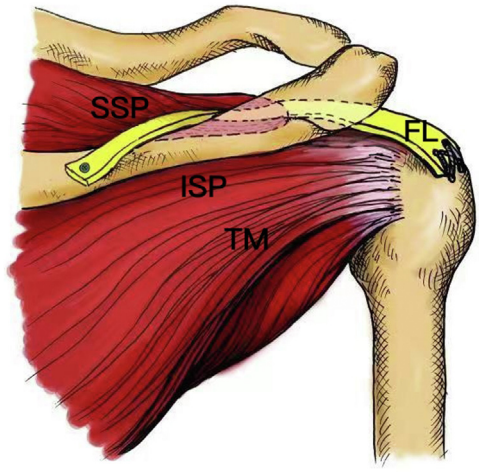

Fig 1. A schematic of graft placement. The STR technique connects autogenous FL between the footprint of the rotator cuff and SSP muscle. An autogenous FL is fixed in a double-row style in the footprint, goes through the SSP muscle, and finally is fixed in the medial spine of scapular for the moment using a suture anchor to ensure good fascia–muscle healing. (FL, fascia lata; ISP, infraspinatus; SSP, supraspinatus; STR, supraspinatus tendon reconstruction; TM, teres minor.)

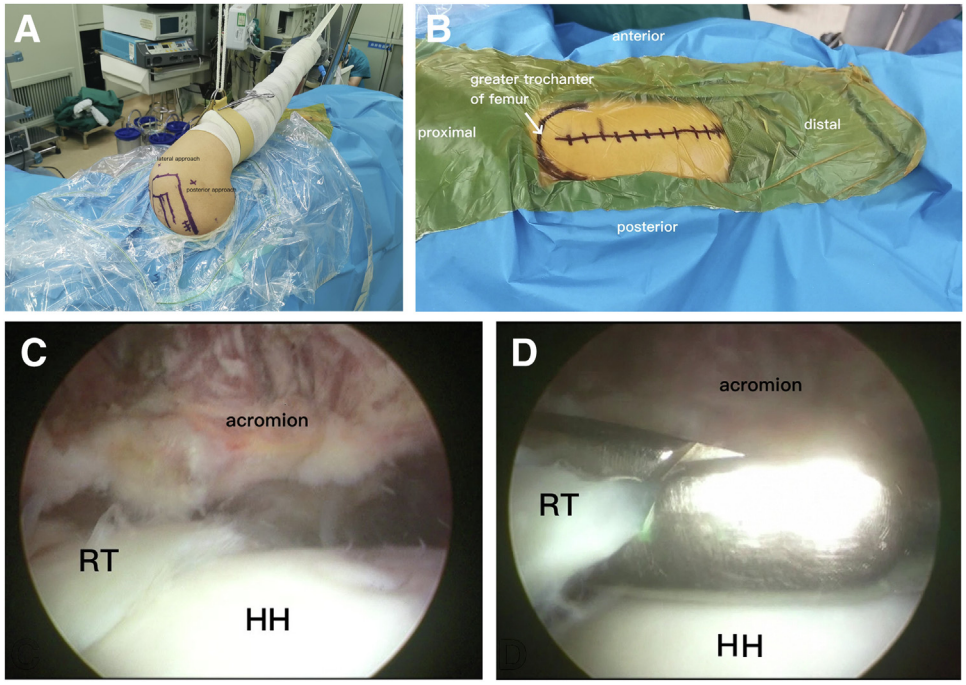

Fig 2. (A) The decubitus position and the conventional posterior and anterolateral approaches. (B) Planed incision of harvesting FL graft. (C). Arthroscopic view of the subacromial space from the posterior approach. (D) Confirmation of the irreparable MRCT through grasper after a complete mobilization. (FL, fascia lata; HH, humeral head; MRCT, massive rotator cuff tear; RT, remnant tendon of SSP; SSP, supraspinatus.)

should wear the sling at all times, except while showering and during formal physical therapy, for the first 6 weeks. After 6 weeks, the patients are instructed to perform closed-chain passive table slides and scapular-stabilization exercises. Active range of motion and strengthening exercises are started around 3 months' postsurgery.

By comparison with the preoperative magnetic resonance imaging (MRI) (Fig 6A), the FL graft is fixed under the appropriate tension at 2 days after surgery (Fig 6B). At 6 months' follow-up, the postoperative MRI shows that the graft has healed well (Fig 6C).

Discussion

SCR and bridging patch techniques achieve good clinical outcomes for irreparable posterosuperior MRCT.[11] These 2 techniques present 2 different types of treatment tactics based on the different biomechanics of

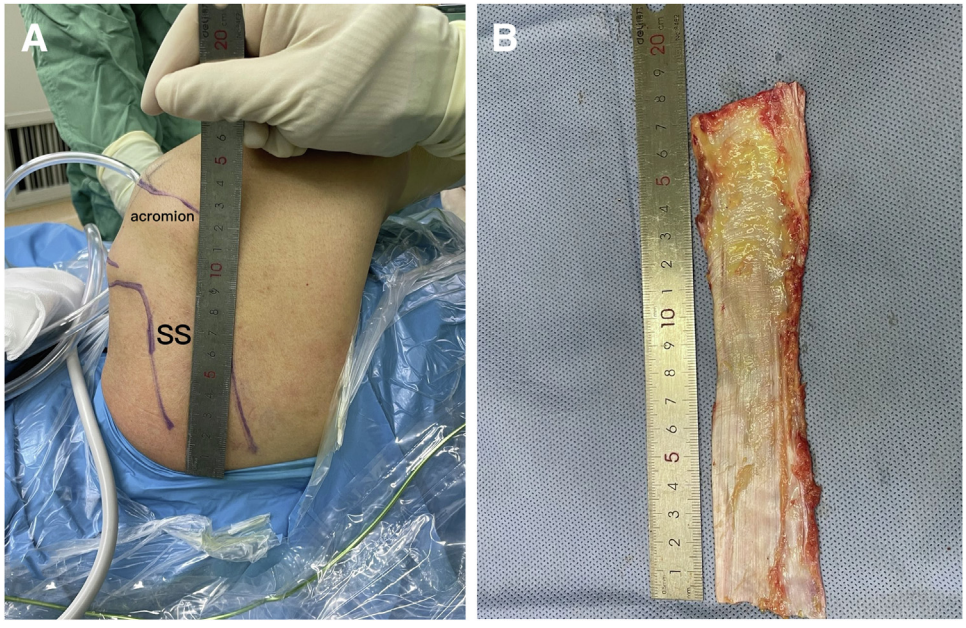

Fig 3. (A) The length of the FL graft is measured based on the distance from the lateral edge of acromial to the most medial spine of the scapula. (B) The appearance of FL graft is harvested according the measurement. (FL, fascia lata; SS, scapular spine.)

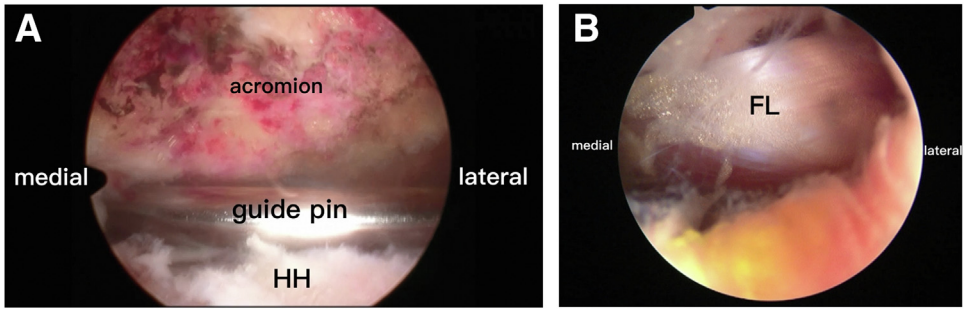

Fig 4. (A) The guide pin is passed through the subacromial from the lateral portal, is run through the SSP muscle to the most medial part of the spine of the scapula, and then penetrates the dorsal skin. (B) The FL patch under the acromion when the traction wire is pulled out of the skin in the medial part of the spine of the scapula. (HH, humeral head.)

the shoulder: conventional SCR side-to-side sutures between the graft and the infraspinatus tendon and between the graft and the residual anterior SSP tendon or subscapularis tendon to improve force coupling in the shoulder joint.[1] However, torn medial SSP tendons, which act as dynamic stabilizers, are left untreated. The aim of the bridging patch technique is to restore dynamic stability by recombining the patch or graft and the remnant of the SSP tendon and has a high retear risk on the fascia–tendon interface. The STR technique fuses the FL patch with the SSP muscle. Therefore, STR not only restores the dynamic stability of the shoulder joint but also minimizes the risk of retear at the interface between the FL graft and remnant of SSP tendon.

An arthroscopic-assisted modified Debeyre–Patte procedure was introduced with a dermal allograft for symptomatic irreparable posterosuperior MRCT.[12] Two key points for patch augmentation surgery are achieving good patch graft bone healing and in the lateral side and graft–tendon healing in the medial side. The STR technique achieves similar fascia–bone healing in the footprint of the rotator cuff with SCR technique and the bridging patch technique. Regardless of different types of grafts used, SCR and the bridging patch technique have been reported to have good short- and long-term clinical outcomes,[6] which means different grafts achieved good graft-bone healing in the lateral part. The conventional SCR technique restores superior balance of the glenohumeral joint based on good graft–bone healing in the glenoid and the footprint of the rotator cuff.[1] However, the bridging patch technique requires not only graft–bone healing in the lateral footprint but also graft–tendon healing in the medial side. FL autograft regenerates the fibrocartilaginous insertion at the footprint and the superior glenoid. The midsubstance of the grafted fascia is gradually remodeled into tendon- and/or ligament-like tissue.[13] Fascia–bone healing using autografts can promote faster biological healing and better fixation strength.[14] Compared with allograft or auto tendon bone healing, fresh cellular FL has good-to-excellent bone healing potential.[14,15] The tendon–fibrocartilage–bone composite bridging patch also achieved greater ultimate tensile load and stiffness at the graft–bone healing in a canine model. This composite tissue transforms traditional tendon–bone healing into a pair of bone–bone in the lateral and tendon-to-tendon interfaces in the medial part.[16] Altogether, enhancing graft bone healing

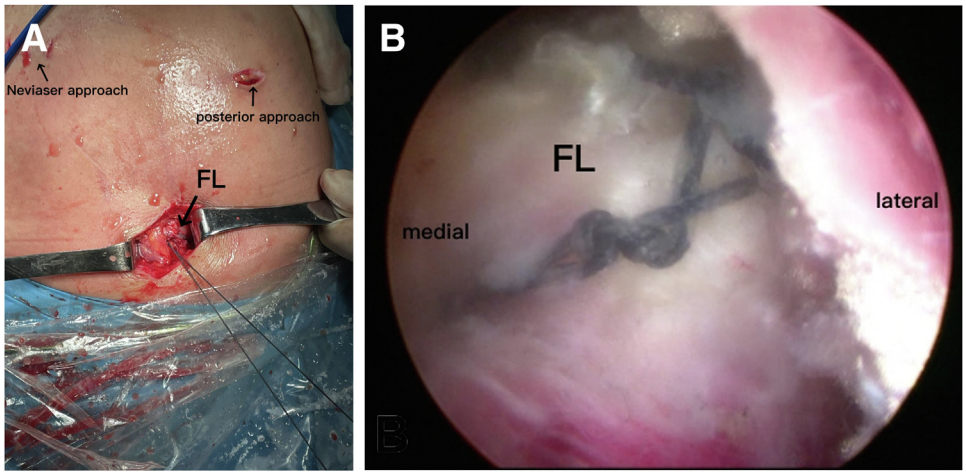

Fig 5. (A) An absorbable lupine anchor is implanted at the most medial site of the scapular spine, and the FL graft is sutured and fixed under appropriate tension. (B) In the footprint of the rotator cuff, the FL graft is fixed in the double-row style. (FL, fascia lata.)

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
• The length of the fascia lata patch could be measured outside of the shoulder joint from the lateral edge of the rotator cuff footprint to the most medial spine of the scapula. • Sutured at the medial end of the fascia lata patch in a Kessler' style to avoid an avulsion, when used guide pin to penetrated the dorsal skin in the most medial part of the spine of the scapula. • A transverse incision of 3 cm in length at the most medial side of the scapular spine was useful to expose the most medial side of scapula spine.	• The medial of fascia lata is easy to tear when pull out from the skin in the medial spine of scapular if braided suture is not enough intensive. • The bone at the most medial side of the scapular spine was thin and easy to broken when implanting the suture anchor to fix the fascia lata.

is the biomechanical rationale for the best possible long-term clinical outcome, and the FL autograft had a good fascial bone healing ability.

In addition to graft–bone healing, shoulder surgeons must pay special attention to the interface between the graft and the remnant of the SSP tendon.[17] The arthroscopic patch graft procedure sutured the graft to the native remnant cuff in a mattress fashion.[18] A bridging technique using allograft or xenograft techniques appears to be favorable, given demonstrated functional improvement, imaging-supported graft survival.[7] Mori et al.[18] reported Debeyre-Patte procedure for irreparable large and MRCT with a retear rate of 8.3%. When the grade of fatty infiltration was 3 or greater, the retear rate reached approximately 14.3%.[19] The graft retear rate after arthroscopic SCR assessed by MRI was 29%, and failures occurred mostly in the medial.[20] Because of the high retear rate, the arthroscopic FL autograft patch bridging procedure was not as beneficial for MRCTs with high-grade fatty degeneration of the SSP and infraspinatus.[21] SCR for reinforcement prevented retear and improved the quality of the repaired tendon, with a high rate of graft healing at the 2-year follow-up.[2,3,22] Bone marrow aspirate concentrate dermal allograft augmentation was introduced for transtendinous RCT repair.[23] In summary, different techniques and scaffolds were used to improve the enthesis's healing quality and reduce the graft's retear rate.

A previous study found that the FL could fuse well with muscle in a rabbit model.[24] To minimize the healing failure rates between the graft and remnant tendon, we designed a new STR technique using a FL autograft for irreparable posterosuperior MRCT or a severely degenerated tendon and muscle. As usual, the lateral ending of the FL was fixed on the footprint using the double-row technique. The medial part of the FL runs through the SSP muscle and is fixed at the most medial site of the spine scapula for the moment to ensure a good fascia–muscle healing. This technique affords a large contact area between the FL graft and SSP muscle and transfers the healing of the graft–remnant tendon to the graft–muscle model. The STR technique restores the dynamics of SSP tendon and superior instability after fascia–muscle fusion and minimizes the risk of retear in the medial bridging patch.

In conclusion, STR using the FL autograft represents a unique surgical option for severe rotator cuff tendon and muscle degeneration. We present a reproducible

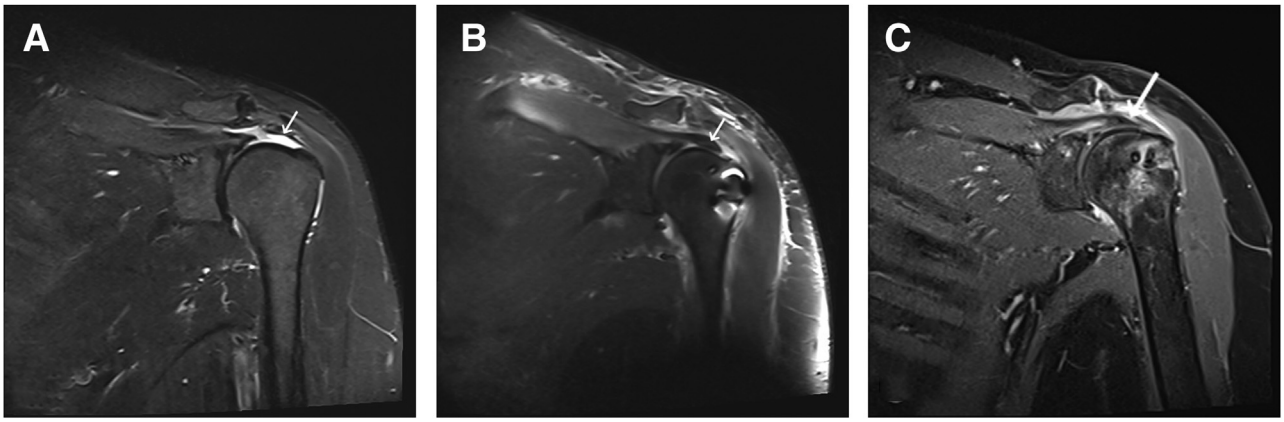

Fig 6. (A) Preoperative magnetic resonance imaging (MRI). The arrow indicates an MRCT. (B) MRI at 2 days after surgery. The arrow indicates the fascia lata graft. (C) MRI at 6 months after surgery. The arrow indicates the FL graft. (FL, fascia lata; MRCT, massive rotator cuff tear.)

technique for arthroscopic repair, biological augmentation, and dynamic recovery. High-quality clinic trials on the STR technique are still required for an objective long-term outcome evaluation.

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