

# Arthroscopic Patch Bridging Using Fascia Lata for Irreparable Rotator Cuff Tears



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**Abstract:** We describe an arthroscopic technique for irreparable rotator cuff tears using patch bridging reconstruction with fascia lata autograft. Compared with conventional rotator cuff repair, this technique reconstitutes the rotator cuff as a dynamic structure, preserves the rotator cuff remnant, reduces excessive tension of the rotator cuff, and preserves the shoulder joint. The fascia lata patch itself is low cost and avoids risks of transmission of blood-borne infectious diseases and rejection. Although the bridging reconstruction is a complex operation with a long learning curve, we believe patch bridging using fascia lata is a highly effective and reproducible surgical protocol for appropriate irreparable rotator cuff tear patients.

Due to severe rotator cuff retraction, muscle atrophy, and fatty infiltration, repair of irreparable rotator cuff tears to the footprint area was difficult to achieve by conventional surgical methods. In addition, the postoperative retear rate for this kind of rotator cuff repair is high, and the postoperative functional recovery of patients is not satisfactory, making it a difficult problem for shoulder surgeons. At present, there is no internationally recognized ideal, standard treatment method.<sup>1</sup> Patch bridging is one of the treatment options for irreparable rotator cuff tears, and its short-term clinical efficacy is satisfactory.<sup>2-4</sup>

## Indications

Indications are the key factors to the clinical efficacy of fascia lata patch bridging surgery. We believe that for patients with irreparable rotator cuff tears, mild fatty infiltration (Goutallier grade  $\leq 2$ ) of the supraspinatus alone or combined with the infraspinatus and subscapularis, Hamada grade 3 or lower, and an intact or

repairable subscapularis are the best indications. For patients with severe fatty infiltration (Goutallier grade 3-4) of the supraspinatus or infraspinatus confirmed by magnetic resonance imaging (MRI), patch bridging surgery is not recommended.<sup>5</sup> We believe that the significant improvement of pain after patch bridging is related to the avoidance of excessive tension during partial repair by the bridging patch. Therefore, fascia lata patch bridging is a highly effective and reproducible surgical protocol for appropriate patients.

In this article, we introduce an arthroscopic technique for irreparable rotator cuff tears using patch bridging reconstruction with fascia lata autograft. Compared with conventional rotator cuff repair, this technique helps rebuild a completed structure of the defective irreparable rotator cuff without structural failure. This technique allows the rotator cuff to remain a dynamic structure, preserves the rotator cuff remnant, reduces excessive tension of the rotator cuff, and helps achieve functional recovery of the shoulder. The fascia lata patch itself is low cost and avoids risks of transmission of blood-borne infectious diseases and rejection. We believe patch bridging using fascia lata is a highly effective and reproducible surgical option for appropriate irreparable rotator cuff tear patients.

## Surgical Technique

### Anesthesia and Patient Positioning

After the administration of general anesthesia combined with brachial plexus anesthesia, the patient is placed in the lateral position, and the affected limb is suspended in 45° of abduction and 20° of flexion with a

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traction weight of 3 to 4 kg. The shoulder and ipsilateral hip are disinfected at the same time (Fig 1). The portals are shown in Figure 2.

### Evaluation

A diagnostic arthroscopy is performed to evaluate the rotator cuff tear and retraction through the Kim portal. After complete release and debridement of the rotator cuff remnant, the torn supraspinatus and infraspinatus are verified to be difficult to reattach to the footprint area.

### Partial Repair of Subscapularis or Infraspinatus

If needed, the subscapularis and infraspinatus are first repaired; then, 2 anchors (TWINFIX Ultra PK, 5.5 mm; Smith & Nephew, London, England) are preset at the anterior and posterior edges of the defect near the cartilage margin, which are termed “post anchors.” One suture limb of each post anchor is left for the patch fixation. In addition, we preset 1 to 2 medial-row anchors for later use.

### Measurement of Rotator Cuff Defect Area

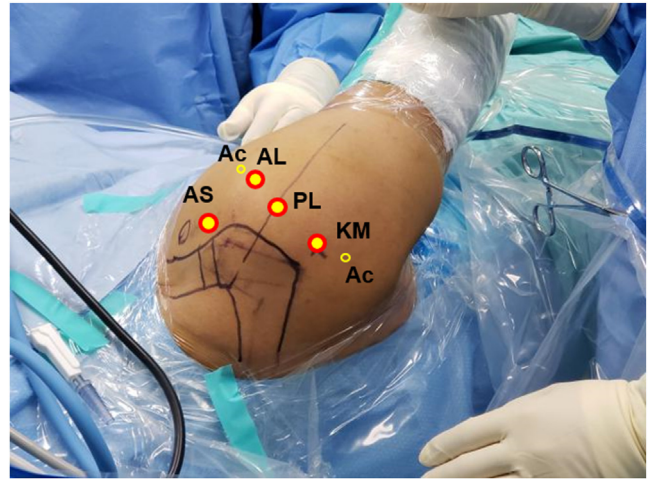
The size of the rotator cuff defect area is measured with a calibrated probe. The length from the edge of the medial rotator cuff remnant to the cartilage margin is the medial-lateral diameter, and the length from the posterior edge to the anterior edge of the defect area is the anteroposterior diameter (Fig 3).

### Graft Harvesting

A longitudinal incision of 8 to 10 cm in length is made at the center of the top of the ipsilateral greater trochanter of the femur. After skin incision, the subcutaneous tissue is separated and the fascia lata is



**Fig 1.** Patient positioning. The patient is placed in the lateral decubitus position, the affected shoulder and ipsilateral hip are exposed, and the area where the fascia lata will be taken is marked (apex of greater trochanter [GT] of femur).



**Fig 2.** Surgical portals in shoulder: anterosuperior portal (AS), anterolateral portal (AL), posterolateral portal (PL), Kim portal (KM); and accessory portals (Ac) for traction sutures.

exposed. The length of fascia lata obtained should be 10 mm greater than the anteroposterior diameter of the rotator cuff defect area and 15 mm greater than the medial-lateral diameter of the rotator cuff defect area; the thickness of the patch is about 5 mm (Fig 4).

### Patch Preparation

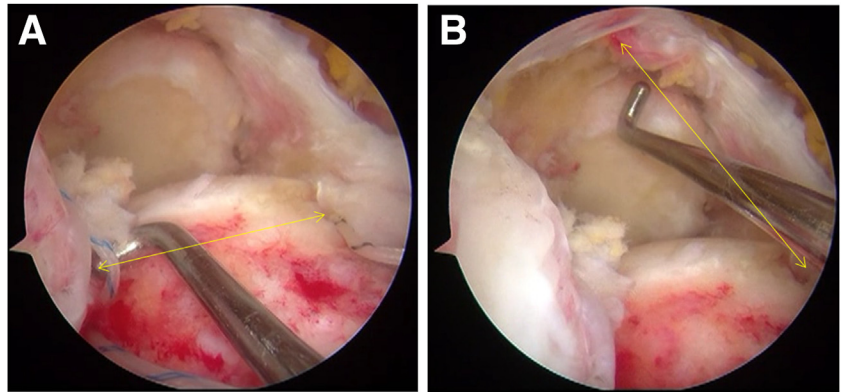
The autograft fascia lata is trimmed and marked. At least 5 high-strength sutures (No. 1 Vicryl; Ethicon, Norderstedt, Germany) of different colors should be placed on the anterior, medial, and posterior edges of the patch. The high-strength sutures are called “short-tailed interference knot” (STIK) sutures<sup>2</sup>; one end is knotted on the upper surface of the patch to prevent escape, and its free end is prepared for suturing with the rotator cuff remnants. Traction sutures should be placed at the anterior and posterior corners of the lateral edge of the patch (Fig 5).

### Suture Shuttling and Patch Placement

A silicone cannula (Passport Button, 8 mm; Arthrex, Naples, FL) is placed in the anterolateral portal, and 2 traction sutures are passed into the subacromial space and then pulled out by the accessory portals first. All free ends of the STIK and post anchor sutures are shuttled passing the rotator cuff remnants in an order of anteriorly, medially, and posteriorly. Care should be taken to ensure that the sutures are kept parallel to each other.

The patch is pushed into the subacromial space by a “push-pull technique.” The silicone cannula is removed, and the anterolateral portal is extended to 3 cm; then, the fascia lata is pushed into the subacromial space with tissue-grasping forceps. All the free ends of the STIK sutures are tightened from the anterosuperior and Kim portals, and the traction sutures are

**Fig 3.** Measurement of size of rotator cuff defect with calibrated probe. The remnants of the supraspinatus and infraspinatus are verified to be difficult to reattach to the footprint area. (A) The length from the edge of the medial rotator cuff remnant to the cartilage margin is the medial-lateral diameter (arrow). (B) The length from the posterior edge to the anterior edge of the defect area is the anteroposterior diameter (arrow).



tightened from the accessory portals (Fig 6). During the procedure, the arthroscope is kept in the posterolateral portal for monitoring.

**Securing of Patch and Rotator Cuff Remnant**

The ends of each STIK suture are tied one by one, and the patch is reliably sutured side to side with the free edges of the rotator cuff remnants (Fig 7 A and B).

**Fixation of Lateral Edge of Patch**

By use of the suture bridge technique, the lateral edge of the patch is fixed by the preset medial-row anchors and a lateral-row anchor (BioComposite SwiveLock C, Closed Eyelet, 5.5 mm; Arthrex) (Fig 7C).

**Postoperative Rehabilitation and Follow-Up**

After the operation, the affected shoulder is fixed in a neutral position with a shoulder brace at 30° of abduction. All patients follow a postoperative functional exercise protocol guided by the same rehabilitation therapist as follows: (1) Immediately after surgery, the shoulder abduction brace is worn on the affected

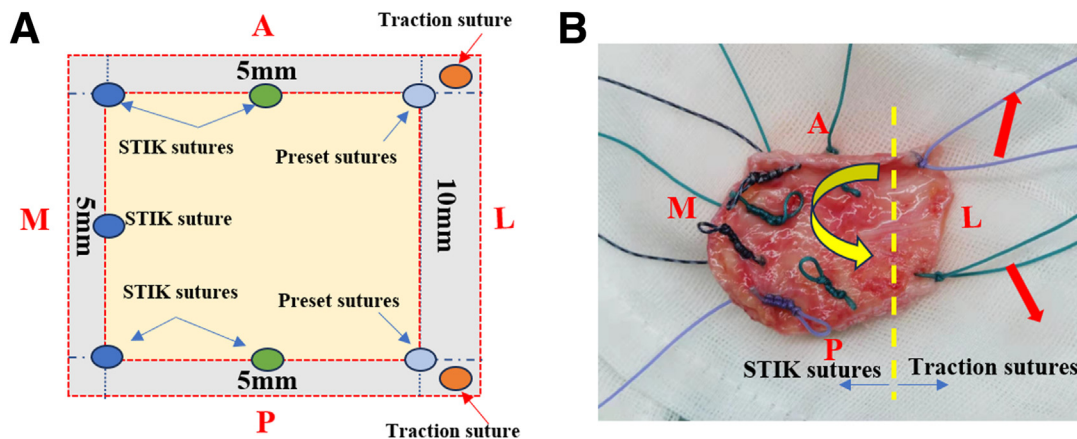
shoulder to maintain the abduction position at 30° for 8 weeks. (2) Active movement training of the elbow, wrist, and metacarpophalangeal joints is started on the first day after the operation. (3) Rehabilitation training with passive range of motion of the affected shoulder is started 8 weeks after the operation; auxiliary movement training of the affected shoulder is started 3 months later, and active strength training of the shoulder muscles is performed 4 months later. The surgical procedure and MRI follow-up assessment (Fig 8) are shown in Video 1.

**Discussion**

Rotator cuff tear is a common reason for shoulder pain and limited mobility. A massive rotator cuff tear is defined as a rotator cuff tear larger than 5 cm<sup>6</sup> or involving more than 2 tendons,<sup>7</sup> and its incidence accounts for 40% of all rotator cuff tears.<sup>8</sup> If the massive rotator cuff tear is not treated in time, the rotator cuff will gradually show pathologic changes such as retraction, muscle atrophy, and fatty infiltration<sup>9</sup> and the tear



**Fig 4.** Fascia lata harvesting from ipsilateral hip. (A) Patch size determination. The length of fascia lata obtained should be 10 mm greater than the anteroposterior diameter of the rotator cuff defect area and 15 mm greater than the medial-lateral diameter of the rotator cuff defect area. (B) The fascia lata patch is harvested from the center of the top of the ipsilateral greater trochanter of the femur. (C) The thickness of the patch is measured as about 5 mm by a sterile ruler.

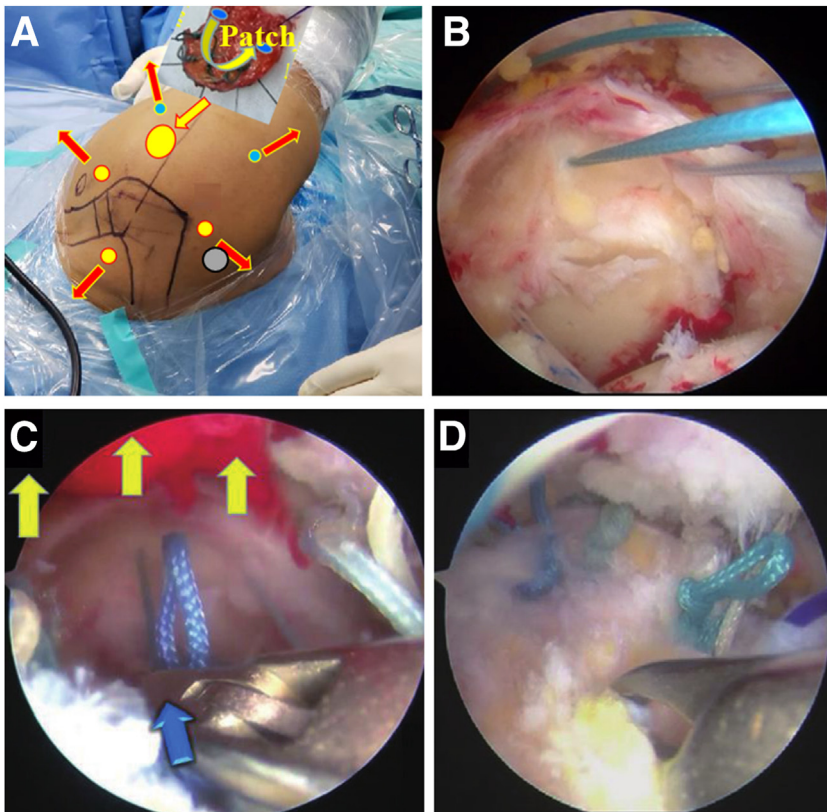


**Fig 5.** Suture preparation for bridging patch. (A) Suture management of short-tailed interference knot (STIK) sutures, post anchor sutures, and traction sutures. (B) Appearance of patch with STIK sutures and traction sutures. One end of each STIK suture is placed on the upper surface of the patch with a STIK to prevent slippage, while its free end crosses the patch for suturing. The traction sutures are on the anterior and posterior corners of the lateral edge of the patch. A, L, M and P represent Anterior, Lateral, Medial and Posterior. The dashed yellow line divides the STIK sutures and the traction sutures. The red arrows represent the traction directions of the traction sutures.

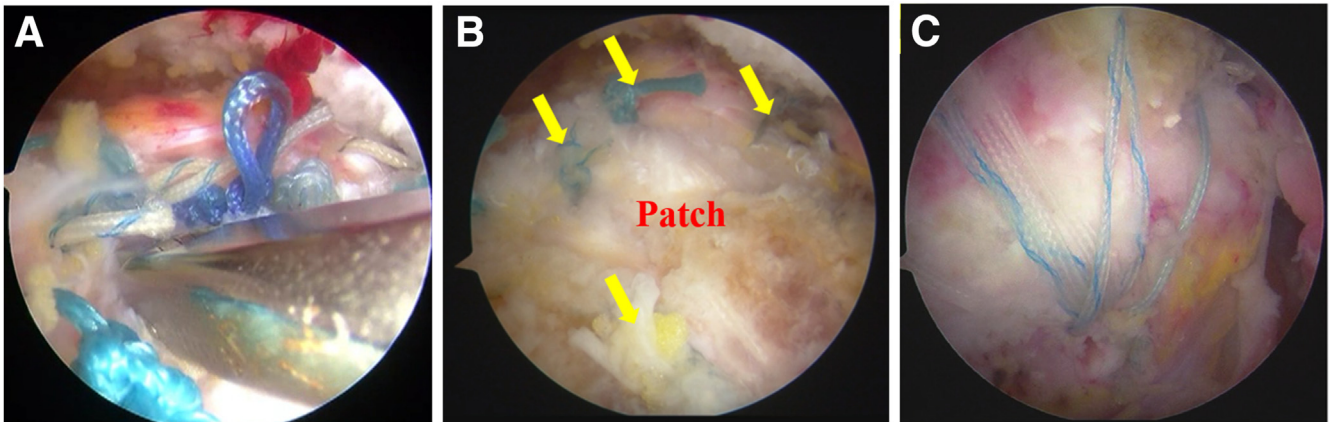
will evolve into an irreparable rotator cuff tear.<sup>10</sup> Owing to the poor quality of the rotator cuff,<sup>11</sup> it is difficult to achieve in situ repair in the anatomic footprint area of the greater tuberosity. In this situation, the postoperative retear rate is high,<sup>12-14</sup> and the shoulder function and muscle strength of patients are poor.<sup>15</sup>

Therefore, irreparable rotator cuff tear is a difficult problem for shoulder surgeons.

At present, the treatment methods for irreparable rotator cuff tears mainly include conservative treatment, arthroscopic debridement, biceps tendon bridging fixation, partial rotator cuff repair, superior



**Fig 6.** Placement of patch via anterolateral portal. (A) Directions of short-tailed interference knot (STIK) sutures and traction sutures of patch when patch is pushed into subacromial space by push-pull technique. The yellow arrow and the big yellow dot indicate the incision where the patch is inserted, while the other red arrows and small yellow dots indicate directions in which the patch is being pulled. (B) The free ends of the STIK sutures are crossed through the remnants of the supraspinatus and infraspinatus and are extracted by the anterosuperior portal, anterolateral portal, and Kim portal, respectively. (C) The patch is pushed into the subacromial space with tissue-grasping forceps (blue arrow), and the sutures in the anterosuperior and Kim portals are slowly pulled (yellow arrows). The traction sutures at the anterior and posterior corners of the lateral shoulder are tightened through the accessory portals, and the patch is successfully inserted and expanded. (D) Completion of patch placement.

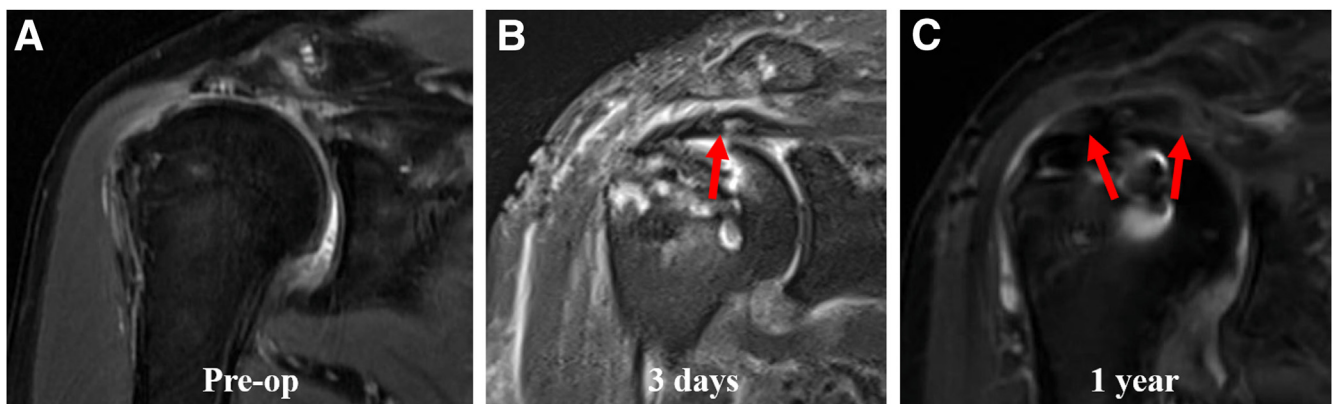


**Fig 7.** Arthroscopic view of secured patch via posterolateral portal. (A) The fascia lata patch is unfolded and is completely covering the defect area of the rotator cuff. (B) The patch is reliably sutured side to side with the remnants of the infraspinatus and supraspinatus (yellow arrows). (C) The lateral patch is fixed to the footprint area by the suture bridge technique with a lateral-row anchor.

capsular reconstruction, subacromial balloon spacer placement, tendon transposition fixation, and reverse shoulder arthroplasty.<sup>10</sup> The treatment of irreparable rotator cuff tears is challenging. Shoulder surgeons need to comprehensively evaluate the patient's age and daily functional needs, type of rotator cuff tear, rotator cuff quality, humeral head displacement, glenohumeral osteoarthritis, and many other factors. At present, there is still a lack of consensus on the best treatment option for irreparable rotator cuff tears.<sup>16</sup>

Irreparable rotator cuff tears can be partially repaired after extensive and sufficient release via arthroscopic surgery. According to the "suspension bridge" system, partial repair of irreparable rotator cuff tears aims to

restore the mechanical conduction of the shoulder; thus, these tears are converted into "functional" rotator cuff tears, and good functional results can be achieved at short-term follow-up.<sup>17</sup> However, the efficacy at medium- and long-term follow-up is poor, patient satisfaction is low, and the retear rate is high.<sup>18-20</sup> Partial repair can only restore—or partially restore—the horizontal mechanical equilibrium of the shoulder. Therefore, besides partial repair, some scholars have proposed using a patch bridging technique to bridge the irreparable rotator cuff to the footprint area at the same time to reconstruct the defective rotator cuff so as to restore the normal biomechanical function of the rotator cuff.<sup>21</sup>



**Fig 8.** Magnetic resonance imaging (MRI) follow-up scans of patch bridging in 67-year-old female patient with irreparable rotator cuff tear. (A) A preoperative oblique coronal T2-weighted image shows that the continuity of the supraspinatus is interrupted and the remaining cuff is retracted to the level of the glenoid. (B) An oblique coronal T2-weighted image obtained 3 days after the operation shows that the area between the patch and the supraspinatus is well fixed. The location pointed to by the red arrow indicates the patch and the remnant of the supraspinatus. (C) An oblique coronal T2-weighted image obtained 1 year after surgery shows good healing of the patch at the suture site and good healing of the patch in the footprint area (The location pointed to by the red arrows).

**Table 1.** Pearls and Pitfalls of Patch Bridging Using Fascia Lata for Irreparable Rotator Cuff Tears

Pearls	
	The fascia lata patch should be harvested at the center of the top of the greater trochanter to ensure a good thickness and initial strength.
	The size and shape of the patch should be as consistent as possible with the size of the rotator cuff defect area (smaller is better than larger); otherwise, the difficulty of the subacromial operation will be significantly increased.
	The lateral side of the patch should be preset with traction sutures. This will help to build a good visual field, allow a sufficient operating space, and increase convenience during patch placement.
	The anchors for medial-row fixation should be inserted before patch placement.
Pitfalls	
	When one is securing the patch, the preset STIK sutures and traction sutures of the patch should be tightened to make the patch expand smoothly like a sheet and cover the rotator cuff defect area smoothly, instead of being crowded in the subacromial space, to obtain a good operating space.
	At least 5 high-strength STIK sutures and 2 traction sutures should be prepared before the patch is placed into the subacromial space.
	Suture management is the key factor of patch bridging; suture shuttling should be carried out in an order of anteriorly, medially, and finally, posteriorly, and the sutures should be kept parallel to each other. Otherwise, the patch and sutures will become entangled.

STIK, short-tailed interference knot.

Biomechanical studies have shown that patch bridging can restore the stability of the humeral head, maintain the concentric stable relation between the humeral head and the scapular glenoid, reduce displacement of the humeral head and be used as a cushion between the humeral head and acromion, reduce subacromial compressive stress, and restore glenohumeral joint mobility without increasing glenohumeral joint stress.<sup>22</sup> In addition, the patch can close the rotator cuff defect area by bridging the anterior-to-posterior and medial-to-lateral rotator cuff remnants, which can improve the biomechanical balance of the shoulder and provide a more favorable biomechanical rotation fulcrum for the function of the deltoid muscle.<sup>23</sup> It has been reported that the use of patch bridging in the treatment of irreparable rotator cuff tears has achieved good short-term clinical results.<sup>2,24</sup>

At present, the types of patches include autologous patches, allogeneic patches, heterogeneous allogeneic patches, and synthetic patches.<sup>1</sup> In our technique, the ipsilateral autologous fascia lata is used as the bridging patch, which is simple to perform at a low cost, and there is no risk of transmission of blood-borne infectious diseases or rejection. No complications related to the site of the patch have been found at short-term follow-up. Patients usually have mild pain at the thigh donor site during the week after surgery;

however, this does not affect the function of the lower limbs.

Indications are the key factors to the clinical efficacy of fascia lata patch bridging surgery. We believe that for patients with irreparable rotator cuff tears, mild fatty infiltration (Goutallier grade  $\leq 2$ ) of the supraspinatus alone or combined with the infraspinatus and subscapularis, Hamada grade  $\leq 3$  and an intact or repairable subscapularis are the best indications. For patients with severe fatty infiltration (Goutallier grade 3-4) of the supraspinatus or infraspinatus confirmed by MRI, patch bridging surgery is not recommended.<sup>5</sup> We believe that the significant improvement of pain after patch bridging is related to the avoidance of excessive tension during partial repair by the bridging patch. Therefore, fascia lata patch bridging is a highly effective and reproducible surgical protocol for appropriate patients.

Arthroscopic fascia lata patch bridging surgery is a complex operation with a long learning curve. Surgeons should pay attention to the following points during the operation: (1) The fascia lata patch should be harvested at the center of the top of the greater trochanter to ensure a good thickness and initial strength. The patch has an average thickness of 4 to 6 mm, and sometimes, the thickest part can reach up to 8 mm. (2) The size and shape of the patch should be as consistent as possible with the size of the rotator cuff defect area (smaller is better than larger); otherwise, the difficulty of the subacromial operation will be significantly increased. (3) The anchors for medial-row fixation should be inserted before patch placement. Two anchors (post anchors) are preset at the anterior and posterior edges of the defect near the cartilage before patch placement, and all of the free ends of the post anchor sutures are pulled outside through the accessory portals (about 2 mm) to reduce tangling of

**Table 2.** Advantages and Disadvantages of Patch Bridging Using Fascia Lata for Irreparable Rotator Cuff Tears

Advantages	
	Compared with the reverse total shoulder replacement, tendon transfer, and superior capsular reconstruction surgical procedures, arthroscopic patch bridging reconstruction with fascia lata autograft is a minimally invasive surgical procedure, reconstitutes the rotator cuff as a dynamic structure, and preserves the rotator cuff remnant and the shoulder joint.
	The fascia lata patch itself is low cost.
	The risks of transmission of blood-borne infectious diseases and rejection are avoided.
	No complications related to the site of the patch have been found at short-term follow-up.
Disadvantages	
	The technique is more difficult than conventional rotator cuff repair; it requires a long learning curve owing to the difficulty of suture management in the limited subacromial space.
	The technique requires an extra incision in the outer thigh.

sutures in the subacromial space. The patch will cover the footprint area after placement, which can avoid poor vision and an insufficient operating space. (4) The lateral side of the patch should be preset with traction sutures. This will help to build a good visual field, allow a sufficient operating space, and increase convenience during patch placement. After the patch is placed into the subacromial space, the preset STIK sutures and traction sutures of the patch should be tightened to make the patch expand smoothly like a sheet and cover the rotator cuff defect area smoothly, instead of being crowded in the subacromial space, to obtain a good operating space. (5) Suture management is the key factor of patch bridging. At least 5 high-strength STIK sutures and 2 traction sutures are prepared before the patch is placed into the subacromial space. The operation of suture shuttling should be carried out in an order of anteriorly, medially, and finally, posteriorly, and the sutures should be kept tight and parallel to each other. Otherwise, the patch will flip over in the subacromial space or become entangled with the sutures. If the described situation occurs during the operation, it should be once again to start a new suture shuttling. Pearls and pitfalls of our technique are summarized in Table 1, and advantages and disadvantages are summarized in Table 2.

Early follow-up results show that arthroscopic patch bridging with fascia lata for irreparable rotator cuff tears can significantly relieve pain, improve range of motion, restore the function of the shoulder, and rebuild a completed integrity of the rotator cuff. This technique is a surgical technique worthy of promotion and application.

### Disclosures

All authors (Y.S., J.C., Y.W., X.X.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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