Technical Note

Use of an Arthroscopic Bridging Graft for Irreparable Rotator Cuff Tears With the Modified Mason–Allen Stitch Using a Tendon Autograft

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Abstract: We describe a technique for treating irreparable rotator cuff tears (RCTs) by bridging grafts with a long tendon autograft. In this technique, the plantaris tendon is harvested and prepared in a Y-shaped graft. The folded end of the graft is anchored to the greater tubercle and the other 2 limbs are fixed to rotator cuff tissue using modified Mason-Allen stitches. The autograft can decrease the tension on the repair of irreparable RCTs and has biological superiority. Our clinical experience indicates this technique will bring superior integrity to irreparable RCT repairs.

The inferior tissue quality of the irreparable rotator cuff tears (RCTs) precludes healthy repair, and the unavoidable tension may predispose to failure of the repair.[1,2] A bridging graft spanning the residual stump of the rotator cuff and tuberosity bone can be a viable option.[3-8] An ideal graft must be securely anchored to the remaining rotator cuff tissues and the footprint. In addition, it should promote cell recruitment and adherence, thus facilitating tendon regrowth.[9] Our working hypothesis is that a modified Mason–Allen stitch with the use of a long tendon autograft can be securely fixed to rotator cuff tissue and the other side of the tendon may be robustly anchored into the humeral bone with biotenodesis screws. The purpose of this study is to describe a technique for treating irreparable RCTs by bridging grafts with a long tendon autograft.

Surgical Indications

This technique is indicated for active patients diagnosed as having irreparable RCTs. Preoperative magnetic resonance imaging findings have to be consistent with irreparable RCTs, such as a full-thickness medial retraction greater than 5 cm and grade 3 or greater fatty infiltration of the supraspinatus or grade 2 greater change of the infraspinatus on T1-weighted sagittal oblique imaging.[10] Diagnostic arthroscopy is performed to confirm the irreparability of the tears because the torn edge of the rotator cuff is not able to attach to the

Fig 1. The plantaris tendon is folded in a Y-shaped graft, and the 3 ends are prethreaded with a No. 2 ETHIBOND.

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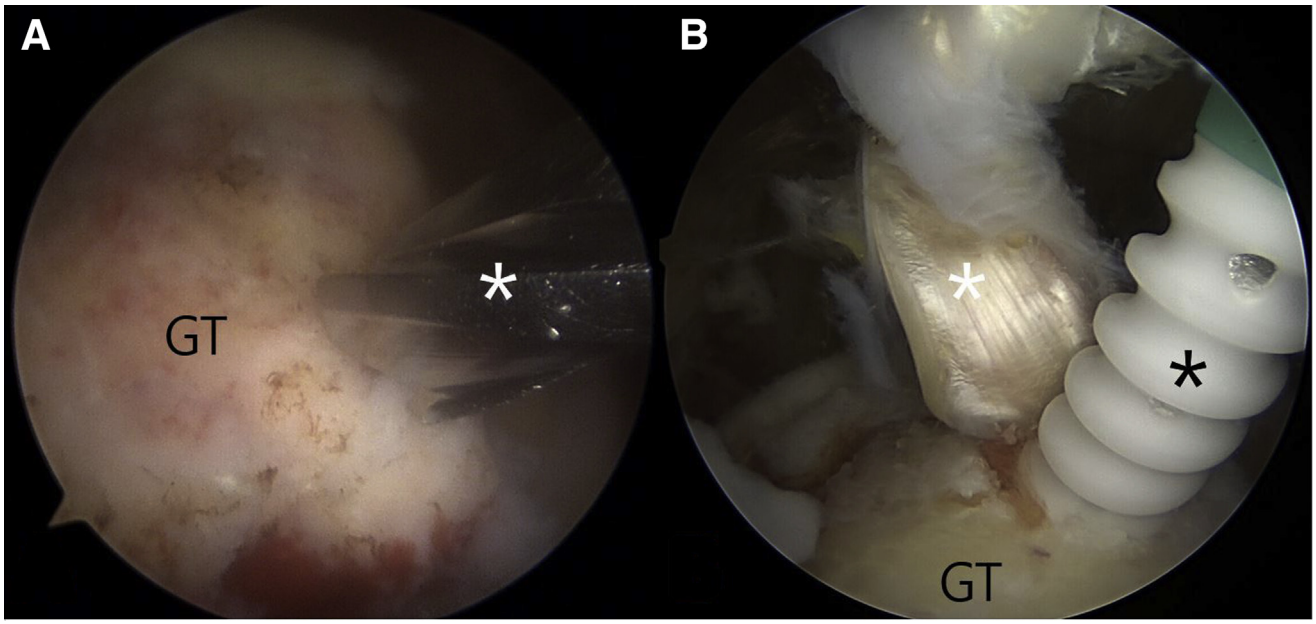

Fig 2. Fixation of the folded end of the plantaris graft. The procedure for the right shoulder is performed in a lateral decubitus position. In this procedure, we used the lateral portal as the viewing portal and the anterolateral portal as the working portal. (A) A hole is made with a diameter 6.5-mm cannulated reamer identified with a white asterisk in the middle of the footprint. (B) The folded end of the graft identified with a black asterisk is engaged in the hole with SwiveLock tenodesis biocomposite anchor (identified with a black asterisk). After the graft and device is fully engaged in the pilot hole, the prethreaded sutures are cut. (GT, greater tuberosity of humerus.)

medial margin of the footprint with less than 30N tension, after maximum mobilization.[11]

Surgical Technique (With Video illustration)

Intra-Articular and Subacromial Debridement

The procedure is performed with the patient in a lateral decubitus position. The routine 4 portals are created (posterior, anterior, lateral, and anterolateral). After diagnostic arthroscopy, a bursectomy and acromioplasty are performed through an anterolateral portal. Under the view from the lateral portal, the mobility of the rotator cuff is assessed after thorough release.

Plantaris Tendon Harvesting and Graft Preparation

The plantaris tendon on the opposite side of the shoulder is harvested. After making a 3-cm incision and blunt subcutaneous dissection, the distal insertion of the plantaris tendon is transected. The distal tendon is threaded through a tendon stripper (Link America, Inc., Denville, NJ). The tendon stripper is advanced slowly until the musculotendinous connections are severed, and the tendon is retrieved. The harvested tendon is then folded in a 15-cm long Y-shaped graft, and the 3 ends are prethreaded with No. 2 ETHIBOND (Ethicon, Somerville, NJ) or FiberWire sutures (Arthrex, Naples, FL) as the hamstring tendons in anterior cruciate ligament reconstruction (Fig 1).

Plantaris Graft Fixation

The footprint of the greater tuberosity is prepared to cause bleeding and to medialize approximately 5 mm using a round burr. An additional portal is made just anterior to the acromion and a cannulated reamer (6.5 mm diameter) is passed through the portal to drill a hole approximately in the center of the footprint. The folded end of the graft is fixed into the hole with SwiveLock tenodesis biocomposite anchors (4.75 × 19.1 mm; Arthrex) (Fig 2, A and B). A BirdBeak suture passer (Arthrex) is inserted 5 to 10 mm more proximal than the conventional suture site, in line with the posterior edge of the irreparable portion of the tear. First, one limb of the graft is passed in the articular-to-bursal direction through the cuff, and the thread holding the graft limb is retrieved through the posterior portal. For the second passage, the BirdBeak is reloaded with the thread through the posterior portal and passed through the cuff 1 cm anterior to the first passage in the bursal-to-articular direction. A transverse loop is then made on the bursal surface of the cuff (Fig 3A). For the third passage, the passed graft limb situated at the articular side is re-passed to the bursal side just medial to the transverse loop to complete a modified Mason–Allen stitch (Fig 3B).[12] A lateral pilot hole is made using a punch at the point that excessive tension is not applied to the rotator cuff. The 2 FiberWire strands threaded to the first graft limb are loaded through the Bio-SwiveLock (4.75 × 19.1 mm) eyelet

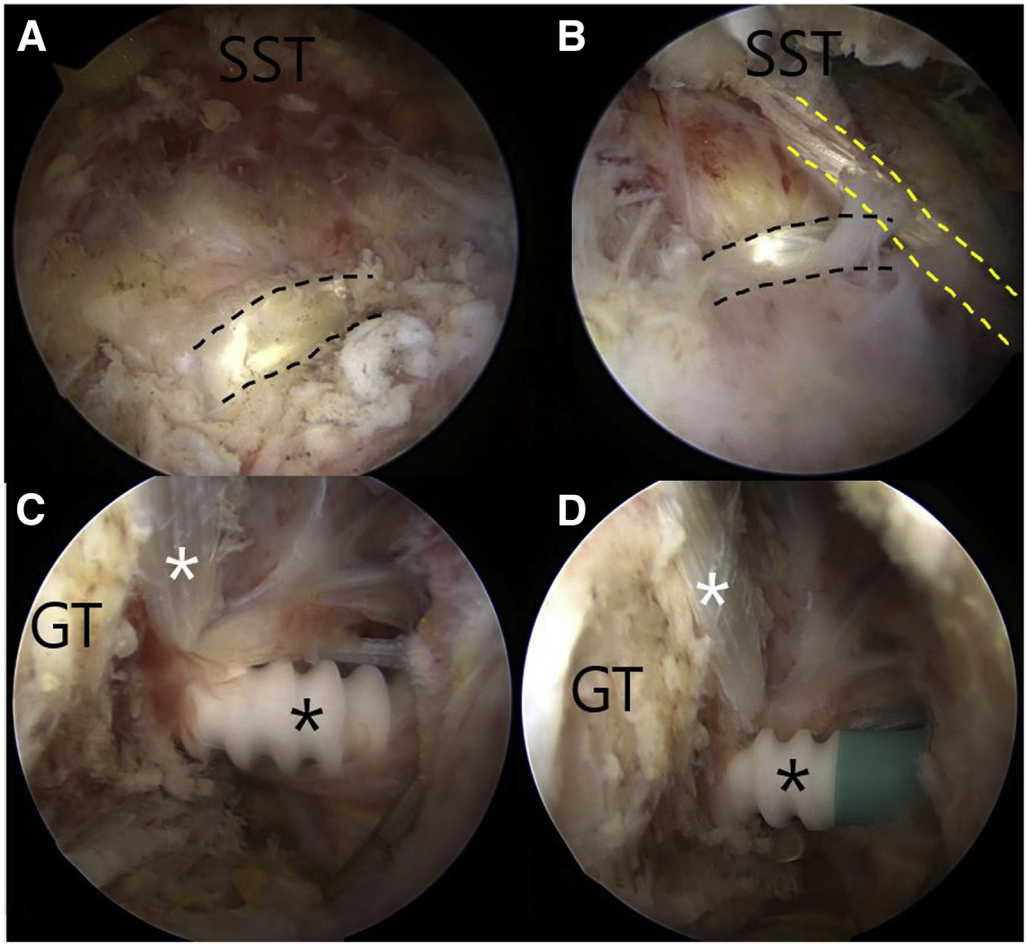

Fig 3. Modified Mason–Allen stitch using a plantaris autograft. The procedure for the right shoulder is performed in a lateral decubitus position. In this procedure, we used the lateral portal as the viewing portal and the anterolateral portal as the working portal. (A) First, one limb of the graft is passed in the articular-to-bursal direction through the cuff. Then, the BirdBeak is reloaded with the thread through the posterior portal and passed through the cuff at 1 cm anterior from the first passage. A transverse loop (identified with a black dashed line) is made on the bursal surface of the cuff. (B) The passed graft limb is repassed to bursal side just medial to the transverse loop to complete modified Mason–Allen stitch (identified with a black and yellow dashed line). Then, we move to lateral aspect of greater tuberosity of humerus. (C) The lateral fixation point is determined by checking the position of the tip of the graft limb (identified with a white asterisk). Tip of the Bio-SwiveLock (identified with a black asterisk) is brought to the edge of the pilot hole to engage the first limb of the graft. (D) The driver is then turned to advance the Bio-SwiveLock into the pilot hole completely until resistance is felt. (GT, greater tuberosity of humerus; SST, supraspinatus tendon.)

and the first limb of the graft is engaged to its desired position (Fig 3 C and D). After the graft and device are fully engaged in the pilot hole, the prethreaded sutures are cut. This procedure is repeated with the other graft limb while moving anteriorly to the anterior edge of the irreparable portion of the cuff tear to be grafted.

Final Repairable Rotator Cuff Repair

Usually, the anterior and posterior margins of the cuff tears are repairable. A 5.5-mm Bio-Corkscrew suture anchor (Arthrex) is inserted just lateral to the remaining margin of the articular surface of the repairable portion of the cuff tear. All suture limbs are passed 2 to 3 mm lateral to the musculotendinous junction using a retrograde shuttle relay technique and tied with transosseous-equivalent repair techniques (Fig 4).

Postoperative Protocol

After surgery, the shoulder is immobilized in a sling with an abduction brace for 6 weeks. Passive range of motion exercises began at 6 weeks after surgery. Daily activities are initiated after 12 weeks. Full return to activities, including overhead lifting, are allowed

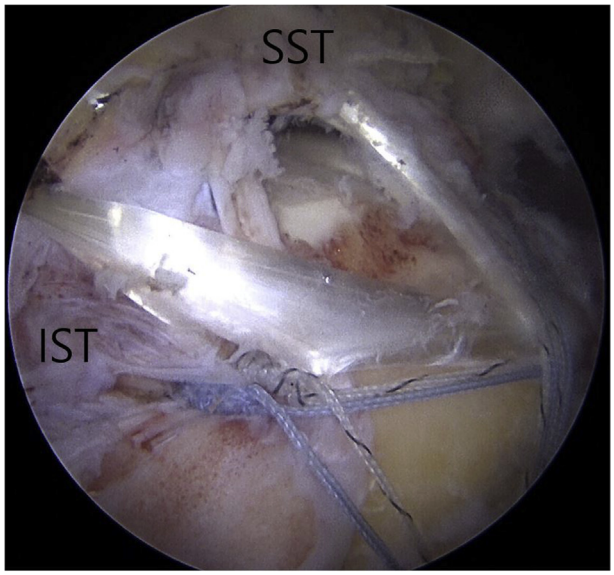

Fig 4. Final repairable rotator cuff repair. The procedure for the right shoulder is performed in a lateral decubitus position. In this procedure, we used the lateral portal as the viewing portal and the anterolateral portal as the working portal. All sutures are passed 2 to 3 mm lateral to the musculotendinous junction using a retrograde shuttle relay technique. After tying the medial-row sutures, knotless anchors for the lateral row are placed distal to the greater tuberosity as transosseous-equivalent repair techniques, if possible. (IST, infraspinatus tendon; SST, supraspinatus tendon.)

6 months after surgery. The pearls and pitfalls are presented in Table 1.

Discussion

According to available systematic reviews on patch augmentation and bridging grafts for massive RCTs, despite having a more severe tear, bridging grafts exhibited a high healing rate due to the low tension of the repair construct. However, the clinical outcomes are not significantly better than patch augmentation, suggesting that the bridging procedure may provide better tendon healing but may not necessarily improve function.[3,5,6]

Table 1. Technical Pearls and Pitfalls of Arthroscopic Bridging Graft With a Modified Mason–Allen Stitch Using a Tendon Autograft

1. The interposed tendon is usually about 3-mm thick and will look thin visually. However, if the tendon is too thick, it is difficult to pass through the healthy part of rotator cuff
2. In graft preparation, it is better to use the Krackow method, which usually used in anterior cruciate ligament reconstruction
3. When using ETHIBOND, it sometimes breaks off, so it is better to use FiberWire
4. If you make a hole at the rotator cuff using a Suture Lasso, it is sometimes difficult to pass through the graft, so it is recommended to use the BirdBeak suture passer

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
1. Plantaris autograft is easy to harvest and has strong potential biological superiorities over allograft materials	1. It is not the easiest of all arthroscopic techniques
2. Easy to pass through the rotator cuff	2. Longer operation time
3. Sufficient length allows for complex stitches such as modified Mason–Allen	3. Possible donor-site morbidities
4. It costs less compared with using allograft	4. Absence of the plantaris tendons up to 20%

We hypothesized that this technique might be used to decrease the tension on the repair of irreparable RCTs and to restore the length–tension relationship of the musculotendinous unit. The modified Mason–Allen stitches, with the use of the plantaris tendon securely anchored to the relatively healthy proximal portion of the remaining rotator cuff and the other side of the graft, could be robustly fixed into the humeral bone with bioabsorbable interference screws. Consequently, the grafts are intended to withstand the rotation and tension stresses of the rotator cuff and perhaps might transport force couples from the rotator cuff to the humeral head, similar to healthy rotator cuff tendons.

Our technique using plantaris autograft has several potential advantages, as the tendon is easy to harvest and has strong potential biological superiority over allograft materials that may enhance healing with no inflammatory reactions. These techniques are also adaptable to the use of other types of autografts, such as half peroneus longus, semitendinosus, and gracilis tendons in the absence of the plantaris tendon.

The limitations of these techniques include longer operating time, tedious graft preparation, possible donor-site morbidities, the absence of the plantaris tendons, and frequent anatomical variation of the tendon.[13] The advantages and disadvantages of the procedure are outlined in Table 2. Although this is an unproven technique for massive irreparable rotator cuff tears in relatively healthy patients, the short-term clinical outcomes at our institution have shown promising results. Further studies and follow-ups are needed to determine the success of this technique.

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