Technical Note

Double-Row Rotator Cuff Repair Technique With Dermal Allograft Augmentation

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Abstract: Rotator cuff tears are common and debilitating injuries in the orthopaedic patient population. Although arthroscopic repair of the rotator cuff generally leads to satisfactory outcomes, some tears would benefit from augmentation with allograft to supplement the native tissue. This biological augmentation has been shown to decrease retear rates and can be beneficial in certain cases based on the size of the tear, amount of retraction, age of the patient, and chronicity. In this technical note, we describe a simple and effective technique for arthroscopic rotator cuff repair with biological augmentation.

Rotator cuff tears (RCTs) are the most common tendon pathology encountered by orthopaedic surgeons, with an estimated prevalence of greater than 20% in the general population.[1] Determining the optimal course of treatment is dependent on several factors including tear size, patient function, and tear location.[2] Postoperatively, retear rates have been estimated to be as high as 21% at 2 years' follow-up, with higher rates particularly in older patients; patients with larger initial tears; patients with fatty infiltration; and patients with comorbidities including obesity, diabetes, or high cholesterol levels.[3,4] A variety of techniques have been described in the literature to decrease the retear rate, with the most clinically proven method being biological scaffolding with various grafts.[5] "Graft augmentation" refers to the use of either allografts, autografts, synthetic grafts, or xenografts to reinforce the mechanical stability of the rotator cuff repair. These have all been shown to decrease the rate of reinjury and increase the strength of the repair.[5] However, patients receiving allograft have been shown to have lower visual analog scale pain scores and higher postoperative range of motion (ROM) than patients receiving the other graft types.[4] In this technical note, we describe a technique for the arthroscopic repair of RCTs using a knotless double-row configuration with dermal allograft augmentation (CuffMend system, Arthrex, Fl) (Video 1).

Technique

Preoperative Evaluation

The diagnosis of an RCT is made based on a detailed history and physical examination and is confirmed by magnetic resonance imaging. The subjective history often varies, with older patients being more likely to present with shoulder pain of insidious onset and younger patients being more likely to present after a traumatic injury. Patients typically present with shoulder pain exacerbated by overhead activities, with aggravated symptoms during nighttime. Inspection of both extremities, followed by palpation and ROM testing, is performed during the physical examination. Objective findings include weakness in abduction and external rotation of the shoulder, as well as a positive empty-can test. Magnetic resonance imaging is the gold standard to confirm the diagnosis before possible surgical intervention and can aid in evaluation of tear size, morphology, and degree of retraction for proper surgical planning.

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Fig 1. Patient draped and positioned in beach-chair position with McConnell arm holder (McConnell Orthopedic Manufacturing Company, Greenville, TX).

Patient Setup

The patient is initially placed supine, and an interscalene nerve block is placed in the upper extremity, followed by induction of general anesthesia. The patient is prepared and draped in sterile fashion in the beach-chair position (Fig 1). An intraoperative examination is then performed with the patient under anesthesia to confirm the preoperative impression. The operating chair is well padded with head cushions, and the operative site is sterilely prepared and draped; an arm holder is used.

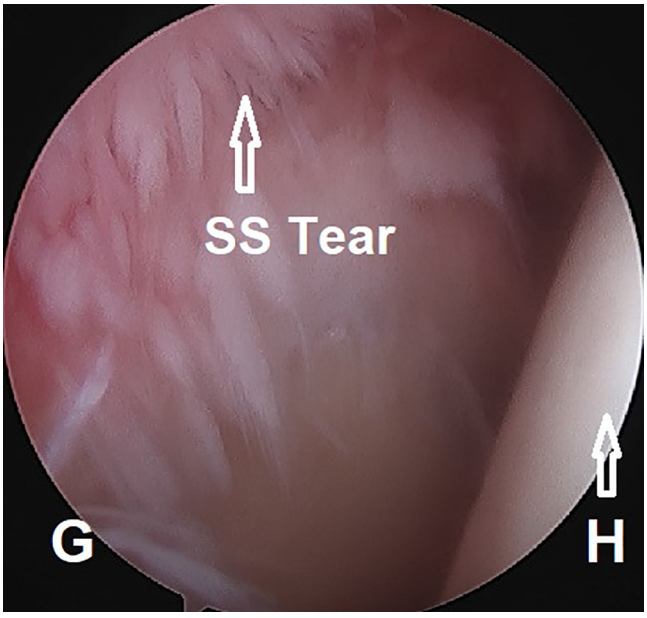

Fig 2. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing full thickness supraspinatus tear. (G, glenoid; H, humerus; SS, supraspinatus.)

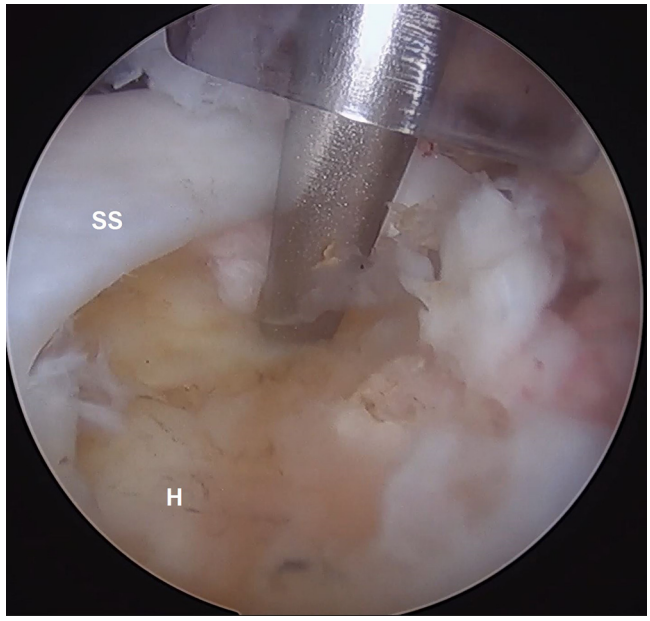

Fig 3. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing medial-row bone tunnel on humerus (H) being prepared via bone punch. (SS, supraspinatus.)

Arthroscopic Portal Placement

A marking pen is used to delineate the anatomic landmarks of the shoulder (Fig 1). A posterior portal is created with a small incision using a No. 11 blade in the soft spot of the shoulder. The glenohumeral joint is

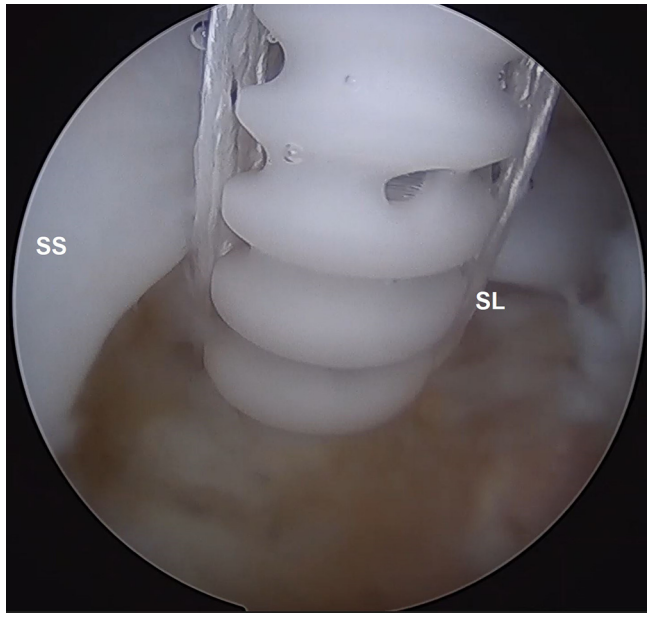

Fig 4. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing medial-row suture anchor being deployed into prepared bone tunnel. (SL, SwiveLock; SS, supraspinatus.)

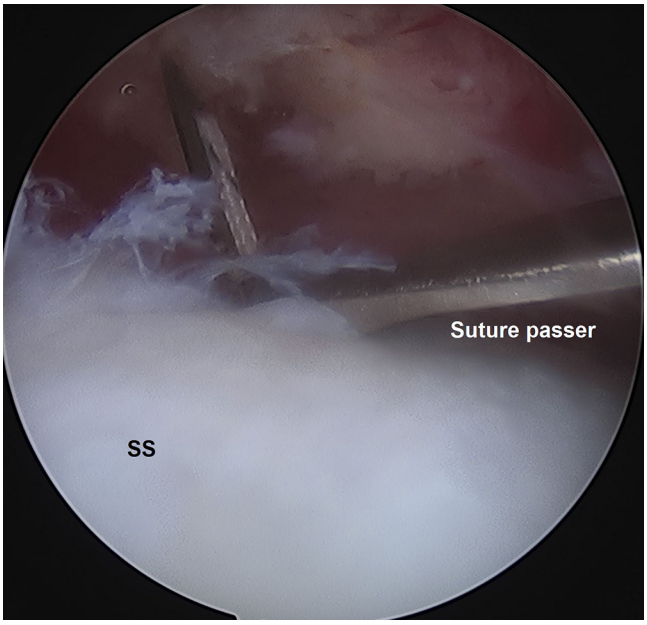

Fig 5. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing suture passed through torn rotator cuff using arthroscopic suture passer. (SS, supraspinatus.)

then entered with a blunt trocar with a scope and sheath. A 30° 4.0-mm arthroscope is used to visualize the glenohumeral joint. A spinal needle is used to localize the anterior portal under arthroscopic visualization. A lateral percutaneous portal is made slightly

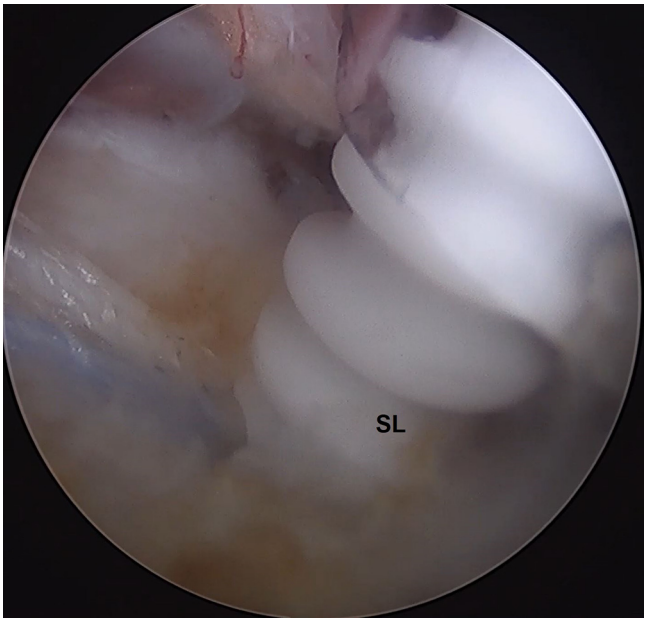

Fig 6. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing lateral-row suture anchor being deployed into prepared bone tunnel. (SL, SwiveLock.)

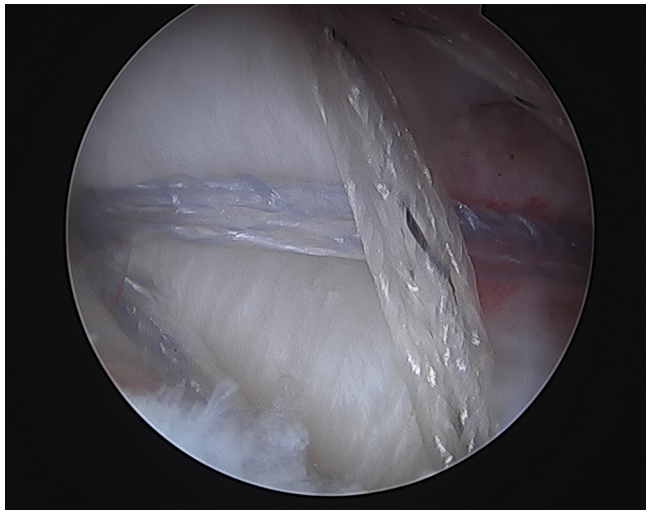

Fig 7. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the anterior portal with a 30 degree arthroscope showing completed repair using double-row technique.

superiorly under needle localization to access the subacromial space. After standard diagnostic arthroscopy and confirmation of the full-thickness supraspinatus tear (Fig 2), attention is turned to subacromial decompression and rotator cuff repair.

Rotator Cuff Repair With Dermal Allograft Augmentation

The inferior acromial surface is prepared using electrocautery. Then, a subacromial decompression is performed using a 4.0-mm burr with resection of 6 to 7 mm of the acromion. Next, electrocautery is used to prepare the periosteum of the humerus at the rotator cuff footprint. The scope is moved to a posterior viewing portal, and a punch is used to create a pilot hole lateral to the articular margin of the humeral head anterior to midline (Fig 3). A 4.75-mm SwiveLock (Arthrex, Naples, FL) is tacked into the hole, achieving appropriate bony purchase by holding the thumb pad steady while rotating the driver handle (Fig 4). The preloaded high-strength suture tape is then released from the thumb pad, and the No. 2 FiberWire (Arthrex) is discarded. The high-strength suture tape is retrieved laterally. Next, the tail of the high-strength suture tape is loaded onto a Scorpion suture passer (Arthrex) and is passed through the healthy tendon and back out; it is then moved aside through an accessory portal (Fig 5). This process is repeated for the second medial anchor. The high-strength suture tape loop is cut at the swage, or at the end of the doubled portion of suture, to separate the tails. One end of each high-strength suture tape is retrieved and preloaded onto the locking anchor. Next, a lateral bone socket is created, the locking anchor is inserted into the socket, and the remaining

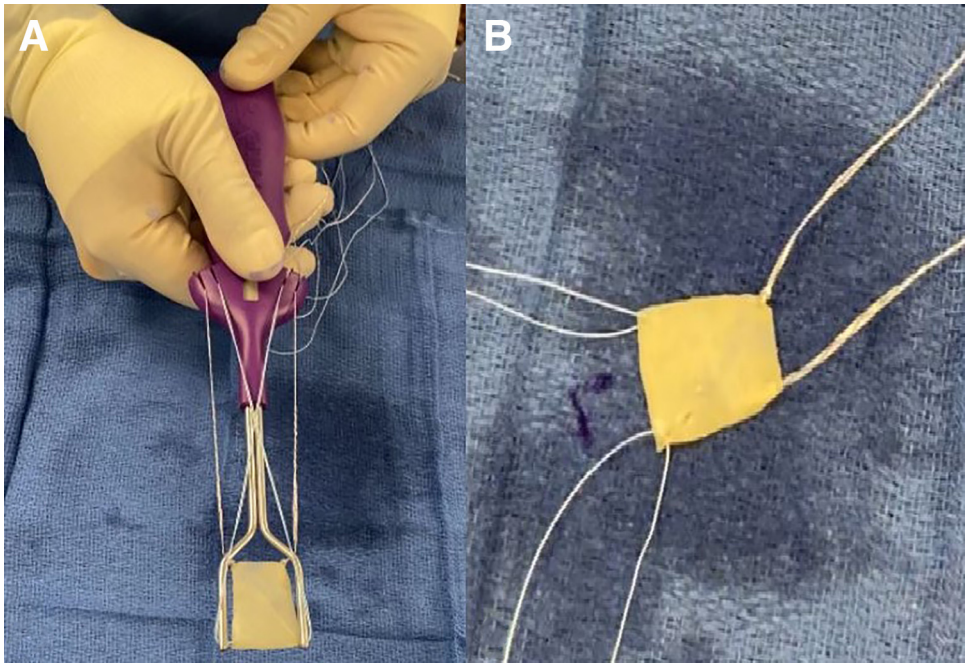

Fig 8. (A) Graft loaded onto graft deployment device. (B) Graft prepared with high-strength retention sutures loaded on all 4 corners.

suture ends are cut (Figs 6 and 7). This process is repeated for the second lateral bone socket.

The dermal allograft is prepared on the back table (Fig 8). The non-looped end of a No. 0 TigerLoop (Arthrex) is passed using a Scorpion suture passer on the lateral corner of the graft. A FiberLoop (Arthrex) is then converted into a cinch configuration by passing the tail through the loop. This process is repeated once more for the other corner of the lateral aspect of the graft. Next, a No. 0 FiberWire (Arthrex) is passed with a needle driver through the medial corner of the graft. This is again repeated on the other medial corner of the graft.

The graft construct is loaded onto the graft spreader (Arthrex) by first loading the lateral tails of the No. 0 TigerLoop into each corresponding arm of the graft

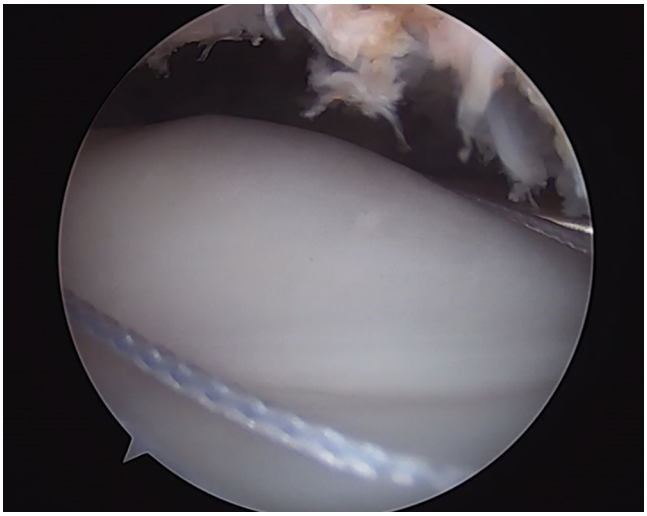

Fig 9. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing the dermal allograft being deployed.

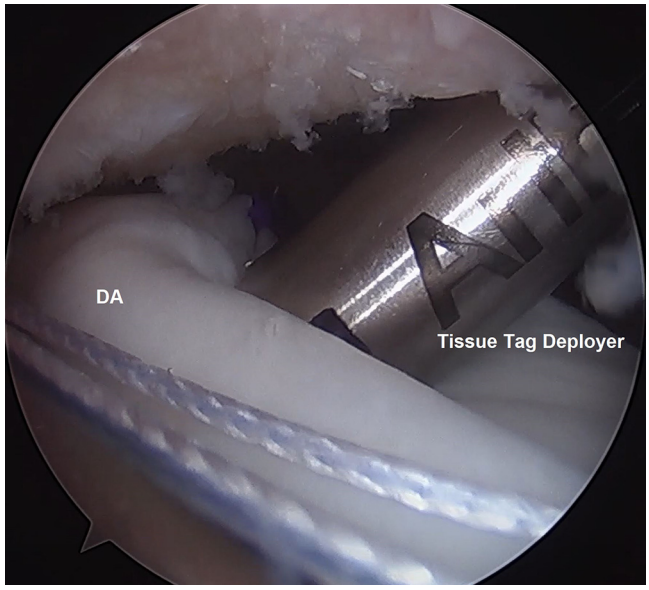

Fig 10. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing tissue tag anchors (purple tag) being deployed through luggage-tag device. These are used to tack down the allograft to the repair. (DA, dermal allograft).

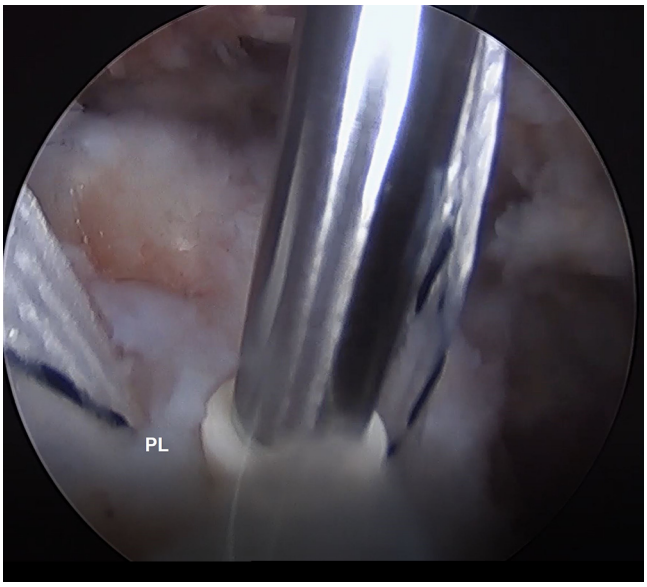

Fig 11. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing the suture anchors being deployed to secure graft over rotator cuff repair. (PL, PushLock.)

spreader. The tails are then tucked into the inner cleat located on the handle of the graft spreader in a criss-cross fashion. Each lateral high-strength suture tape is docked directly straight into the outer cleat of the graft spreader. The graft is folded in half by retracting the button on the graft spreader toward the surgeon and is inserted into a lateral PassPort cannula (Arthrex) into the subacromial space. The graft is then unfolded and deployed by sliding the button forward (Fig 9). Next, a TissueTak tendon anchor inserter (Arthrex) is introduced through the superolateral portal via a 4.75-mm cannula. Pressure is applied on the tissue with the inserter shaft, and TissueTak tendon anchors (Arthrex) are deployed in a posterior-to-anterior fashion along the medial border of the graft (Fig 10). To achieve lateral fixation of the graft, a bone tunnel is made with a 3.5-mm punch inferior to the lateral bone tunnel from the medial row of the repair. The tail of the high-strength retention suture is loaded onto a 3.5-mm PushLock suture anchor (Arthrex) and tensioned into the prepared bone tunnel (Fig 11). This protocol is repeated for the second lateral bone tunnel. This concludes the dermal allograft augmentation (Fig 12). Table 1 presents pearls and pitfalls of the described technique, and Table 2 lists advantages and disadvantages.

Final Examination and Postoperative Care

The portal incisions are closed in standard fashion and covered by an abundant dressing. The operative arm is then immediately placed into an immobilizer sling that will be used for the first 6 weeks after the surgical procedure. During the first 6 weeks postoperatively, passive ROM of the operative shoulder is allowed; however, patients are advised to avoid active ROM.

Discussion

RCTs are common injuries that lead to significant shoulder pain and disability.[6] The incidence of RCTs is high, with full-thickness tears present in approximately 25% of individuals in their 60s and 50% of individuals in their 80s.[7] RCTs also have a high propensity to retear after repair, with rates ranging from 10% to 94%.[7-13] Several sociodemographic factors have been cited as showing an increased propensity for retears, including advanced age, high body mass index, hypercholesterolemia, and diabetes.[3,14] Given the high incidence of RCTs as well as the high retear rates, much research and much effort have been dedicated to finding ways to improve patient outcomes.

Much of the pathophysiology of rotator cuff retears has been attributed to poor healing of the tendon-bone surface. Various techniques have been reported in the literature to optimize healing at the tendon-bone junction, such as platelet-rich plasma, growth factors, stem cells, and biological scaffolds. Among the various treatment modalities, biological scaffolds appear to be the most promising and reliable.[15] The tendon-bone

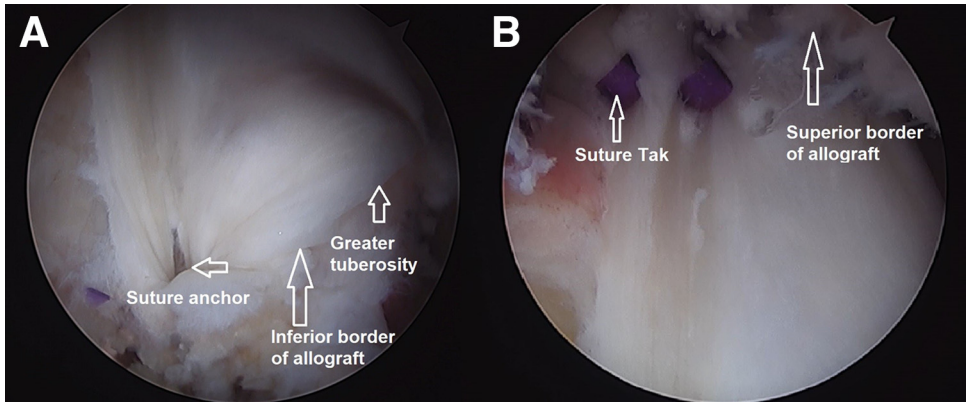

Fig 12. Patient positioned in the beach chair position. Arthroscopic image of the right shoulder through the posterior portal with a 30 degree arthroscope showing the (A) Final dermal allograft placement over lateral row of rotator cuff repair. (B) Final dermal allograft placement over medial row of double-row repair.

healing surface after a rotator cuff repair differs biologically from that of its former native tissue, with native tissue primarily being composed of type I collagen versus type III collagen in the repaired tissue.[16] Type III collagen is notably inferior compared with its type I counterpart, with less tensile strength, hence explaining the susceptibility to retears.[3] Other factors that have been mentioned to affect retear rates include but are not limited to original tear length, tear size area, amount of retraction,[3] and adequate compliance with postoperative bracing,[17] as well as an occupation ratio of the supraspinatus of less than 43% or fatty infiltration of the infraspinatus of grade 2 or higher.[14]

Recently, several studies have explored the use of the different grafts available to reinforce rotator cuff repairs and decrease retear rates. A large meta-analysis by Bailey et al.[5] suggested that among grafts commonly used for rotator cuff augmentation (allografts, autografts, synthetic grafts, and xenografts), xenografts showed the least favorable results in terms of lower American Shoulder and Elbow Surgeons scores, less improvement in visual analog scale scores, lower postoperative ROM, and lower repair integrity. However, graft augmentation as a whole has shown significantly lower retear rates compared with rotator cuff repair alone[12] and is a promising treatment option for patients at high risk of retear.

In animal models, graft augmentation can increase collagen expression compared with rotator cuff repair alone, as well as exhibit a higher ultimate failure load.[18] A large randomized clinical trial by Cai et al.[19] showed a significantly lower retear rate after rotator cuff repair with graft augmentation compared with repair alone. Additionally, among the retears in both groups, there were significantly more favorable tears in the graft augmentation group. However, biological grafts are not without consequences and complications, with studies showing potential adverse tissue reactions and increased inflammation due to grafts.[20] Further studies should be performed to evaluate the long-term outcomes and efficacy of these grafts and the preservation of remnant tissue, as well as to investigate methods to decrease retear rates altogether.

We have described a technique for arthroscopic rotator cuff repair with biological augmentation using a dermal allograft. Although the use of graft augmentation in rotator cuff repair is supported by current biomechanical and animal studies, further investigations can better elucidate long-term outcomes, particularly in patient groups at high risk of rotator cuff retear.

Table 1. Pearls and Pitfalls

Pearls
Care should be taken to ensure that the inferior trans-deltoid portal is placed inferiorly enough to match the plane of the humerus to lie down flat.
The lateral portal should be placed at a 15° trajectory that will allow the surgeon to angle the TissueTak's properly to deploy the suture anchors through the graft and native tissue.
The graft can be prepared earlier on with a second assistant to save operative time.
Pitfalls
If suture is placed too peripherally in the graft, it can pull out. Thus, the surgeon should ensure that there is at least 2 mm of tissue lateral to the suture.
The graft should lie over the rotator cuff. If the graft is overtensioned, it will not lie properly over the native tissue and may delay healing.

Table 2. Advantages and Disadvantages

Advantages
Reinforced repair
Decreased retear rate
Graft facilitates cell proliferation, migration, and vascularization
Disadvantages
TissueTak's, if fired prematurely, can be cumbersome and time-consuming to retrieve
Increased operative time
Increased patient cost
Potential for adverse tissue reaction

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