Technical Note

Augmentation of Arthroscopic Rotator Cuff Repair With Cannulated Dermal Allograft Implant

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Abstract: Arthroscopic rotator cuff repair (RCR) is a popular treatment for rotator cuff tears. Retear after RCR remains a significant concern even with modern techniques. Augmentation of RCR has been described using multiple different grafts, one option including a cannulated dermal allograft implant (DePuy Mitek). The utilization of this implant avoids significantly increased surgical time, allows for augmentation at the weakest area of repair, and does not lead to any wasted allograft material.

Arthroscopic rotator cuff repair (RCR) is currently the gold standard for treatment of rotator cuff tears. Although an overall successful procedure, RCR failure remains a significant fear, with failure rates classically reported to be as high as 94% in large or massive rotator cuff tears.[1] Even with newer techniques, such as knotless anchors and double-row repair, retear rates have still been reported to be between 5% and 33%.[2]

Successful repair depends on tendon-to-bone healing. As such, the use of biologic augmentation in RCR has recently garnered major interest. Dermal allograft has been identified as a promising option for augmentation in RCR as it has already demonstrated good results in superior capsular reconstruction and nonorthopaedic applications such as cystocele repair, nasal septal perforation, ophthalmic plastic surgery, and treatment of burns.[3-6] Dermal allograft not only provides additional strength to a repair immediately at the time of surgery but also acts as a scaffold that promotes organized healing and scar formation, and it has already shown promise in both primary and revision RCR.[7-9] Of the multiple sources of dermal tissue grafts, such as bovine, porcine, or human dermal tissue, the best outcomes thus far have come from human dermal allograft, with lower retear rates than xenografts.[10,11]

Classically, dermal allograft is offered as a sheet of acellular tissue that must be cut to size prior to fixation. This requires accurate measurement prior to application and the placement of multiple anchors for fixation, leading to significant implant waste, longer surgical times, and the placement of separate implants within the graft.[12,13]

As an alternative, cannulated dermal allograft reduces many of those shortcomings. Designed to be used directly in line with surgical procedures, the cannulated dermal allograft can be applied quickly and integrates within the repair construct itself, preventing the need for additional stabilization. One such product, Dermis on Demand (DePuy Mitek), is human dermal allograft prepared as a 15-mm-long × 4.5-mm-wide × 3-mm-thick cannulated rectangular prism. This implant is stored at room temperature, has a 5-year shelf life, and comes ready to use as it does not require prehydration. Furthermore, it does not need to be trimmed to size, resulting in no wasted tissue, and is scalable, meaning multiple units can be added in tandem depending on the size of the repair. Here, we describe how to perform double-row RCR augmented with cannulated dermal allograft in the beach-chair position.

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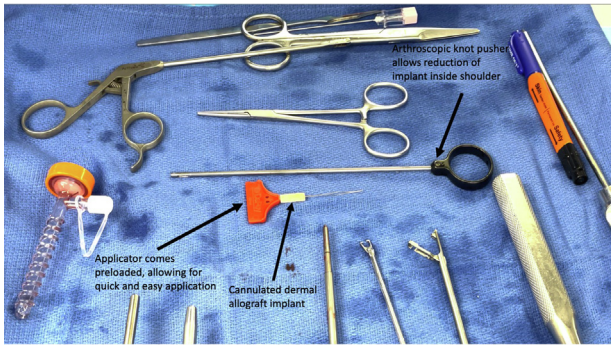

Fig 1. Required instruments for application. This figure is a photograph of the instruments required for application of the cannulated dermal allograft implant. The implant comes loaded on an applicator. A knot pusher is required to place the implant in the joint. A hemostat can be used to help apply traction to the suture while placing an implant. The implant will fit through most arthroscopic cannulas.

Surgical Technique

Indications and Preoperative Planning

Augmentation with the cannulated dermal allograft implant has similar indications to other dermal allograft products. These include large rotator cuff tears, poor tissue quality, and in revision cases.[11] Preoperatively, it is important to assess whether the tear is truly reparable. This can be done by examining the patient's magnetic resonance imaging (MRI) for size of the tear, tissue quality, and level of retraction of the tear. If the patient has considerable arthritis, as with any rotator cuff repair performed, benefit of the procedure is limited. The implant does not require any preparation or cutting at the time of surgery. The implant is, by design, associated with the repair as it is attached to the suture. Therefore, anchors or other separate fixation devices are not necessary to place the implant. It can be added to any standard rotator cuff repair construct, but the authors prefer a double-row, transosseus equivalent repair construct.

Diagnostic Arthroscopy and Preparation for Repair

With the patient in the beach-chair position using regional anesthesia, a right shoulder diagnostic arthroscopy is performed with a posterior viewing portal and an anterior working portal (Video 1). A 3.5-mm shaver is used to debride the undersurface and footprint of the torn supraspinatus tendon while in the glenohumeral space.

Attention is then turned to the subacromial space. Posterolateral and anterolateral working portals are created. Again, a 3.5-mm shaver is used to perform a bursectomy and to remove any fibrotic tissue. The tear is then inspected, noting degree of retraction and tendon integrity. The supraspinatus tendon undersurface is debrided and the greater tuberosity decorticated to bleeding, cancellous bone to prepare for repair.

Rotator Cuff Repair Technique

A double-row, transosseus equivalent repair is performed. A single, double-loaded 4.5-mm suture anchor (Depuy Mitek) is placed in near the articular surface in the central aspect of the tear. This anchor is loaded with one #2 suture and one 2.5-mm suture tape (Depuy Mitek). Using an arthroscopic suture passer, the sutures are passed through the tendon, ensuring good purchase along with acceptable spread between sutures. The sutures are placed on the anterior and posterior aspect of the tear. The suture tapes are passed together in the midportion of the torn tendon. The suture tapes are passed via a looped suture that itself is passed through the tendon using a suture passer. The posterior suture and one of the tapes are then shuttled into the posterolateral portal to allow them to be loaded into a 5.5-mm knotless, self-punching anchor (Depuy Mitek).

Loading the Cannulated Dermal Allograft Implant

Before loading the anchor, the cannulated dermal allograft implant (Depuy Mitek) is placed (Fig 1). This can be placed on any or both sutures. The suture or tape is placed through the islet of the applicator, then pulled through the graft (Fig 2). The implant is then brought to the working portal. This can be simply pushed into place by hand; however, if difficult, a moist sponge can be used to bring the graft into place (Table 1). At that time, an arthroscopic knot pusher is used to place the graft into position inside the shoulder itself (Fig 3).

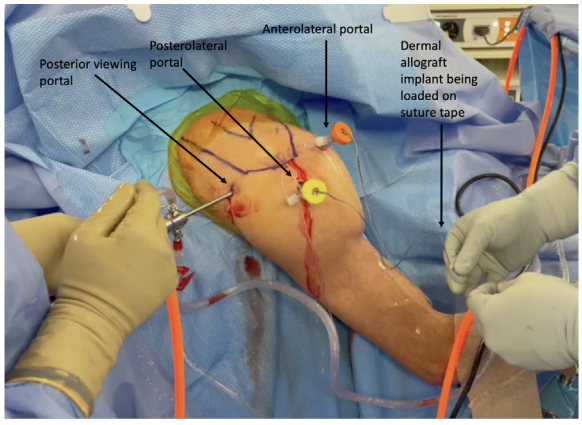

Fig 2. Loading of cannulated dermal allograft implant onto suture. This figure is a photograph of the right shoulder in beach-chair position. The posterior portal is used as a viewing portal. The anterolateral and posterolateral working portals are used to position the dermal allograft implant and place the lateral row anchors. The cannulated dermal allograft is loaded onto the suture tape by placing it thought the islet of the applicator. Once loaded, the implant is brought to the cannula, and a knot pusher is then used to place the implant intraarticularly.

Table 1. Pearls and Pitfalls of Using Cannulated Dermal Allograft to Augment Rotator Cuff Repair

Pearls
Implant can be placed on either/both sutures or suture tapes
If difficult to slide the implant into position, a moist sponge can be used to ease the process
Use preoperative MRI to plan repair construct and allow for augmentation at desired areas
Pitfalls
Ensure placement of implant before placing anchor
The implant can move when reducing the tear by tightening the sutures; ensure appropriate placement before final reduction
The dermal allograft implant acts simply as a scaffold for healing and therefore use in patients with significant fatty atrophy can be associated with failure

Anchor Placement

The sutures are now loaded into the anchor. The anchor is introduced, ensuring correction position. The first anchor placed is the posterolateral row anchor. The anchor is malleted into place until the threads start to engage. Then, the sutures are tensioned sequentially until satisfactory reduction is obtained. The anchor is then tightened to its final position (Fig 4). The sutures are then cut using an arthroscopic suture cutter. This process is repeated for the anterolateral row anchor.

Final Inspection

Afterward, repair is examined through the posterolateral portal. The cannulated dermal allograft is noted to be in position at the area of repair to allow for augmentation of tendon healing (Fig 5). Final pictures are taken. Incisions are closed with nylon sutures.

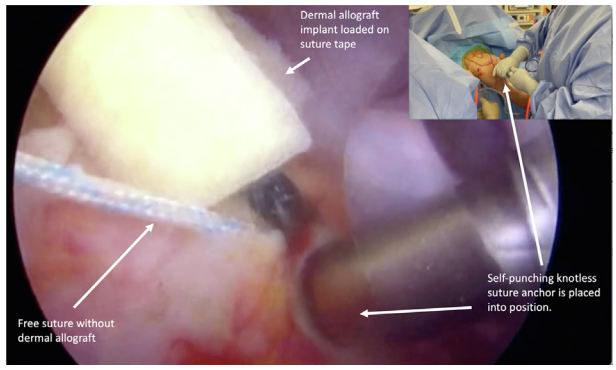

Fig 4. Lateral row anchor placement. This is an arthroscopic photograph of the right shoulder in the beach-chair position viewing from the posterior portal in the subacromial space. The cannulated dermal allograft implant is in position on the suture tape. A self-punching knotless suture anchor is impacted, and then the sutures are tightened sequentially, reducing the tear. The anchor is then screwed down into the final position. Once seated, the suture tails are cut.

Postoperatively, standard protocol is not deviated from, starting with pendulum exercises in week 1 and progressing to active range-of-motion exercises around week 6.

Discussion

The quality of the torn rotator cuff tendon is important to repair integrity. During healing, scar that forms from disorganized collagen ultimately leads to decreased tendon integrity and a weak repair.[11,14]

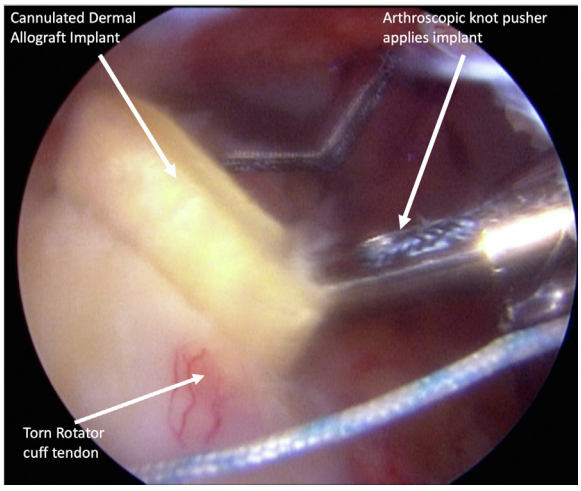

Fig 3. Placement of cannulated dermal allograft implant. This figure is an arthroscopic photograph of a right shoulder in the beach-chair position from the posterior viewing portal showing a knot pusher being used to place the cannulated dermal allograft implant in position inside the shoulder. It is important to ensure the implant is placed deep enough, as it can migrate as the tendon is reduced during final tensioning. Here, the implant is being placed on a 2.5-mm suture tape, but it can be used on most sizes of sutures/suture tapes.

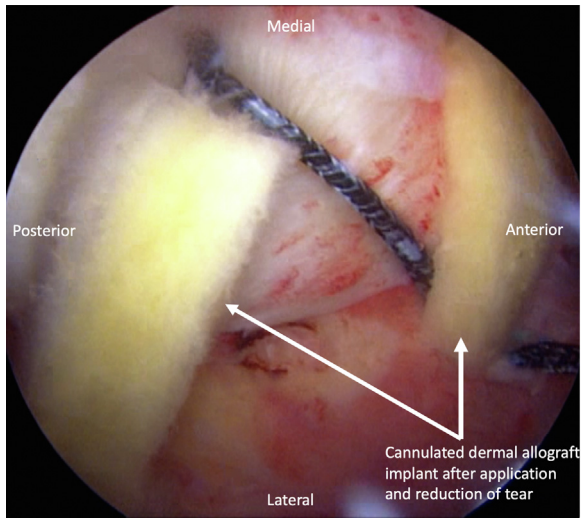

Fig 5. Final repair construct. This is an arthroscopic photograph of the right shoulder in the beach-chair position from the posterolateral portal showing the cannulated dermal allograft implants in position after final placement of the lateral row anchors and reduction of the rotator cuff tear. The implants are in position on the sutures to allow augmentation of healing and may potentially benefit in bolstering the repair at the suture-tendon interface.

Table 2. Advantages and Disadvantages of Cannulated Dermal Allograft

Advantages
Minimal increase in surgery time
No wasted material
Does not require additional fixation
Implant in position by design at suture-tissue interface
Disadvantages
Placement restricted to area of repair
Only comes in one size
Must be placed on suture and is unable to be freely placed

While healing, type III collagen predominates type I collagen and leads to weaker tissue and higher chances of retear.[15] Among the multitude of different materials and tissue sources (e.g., xenografts, allografts, and synthetic tissues) that have been used to prevent disorganized collagen formation and to increase RCR repair strength, dermal allograft has proven most useful in many soft tissue applications, and several studies have demonstrated superior results when dermal allograft was used to augment a soft tissue repair.[15] In a canine model, partial rotator cuff tears repaired with dermal allograft augmentation were shown to lead to superior tendon thickness, muscle and tendon histologic architecture, and range of motion when compared to debridement, collagen patch, and amniotic membrane patch.[16]

In patients treated with superior capsular reconstruction with dermal allograft, the grafts were found to be well incorporated, with well-organized host collagen fibers and significant host cellular infiltration.[17] Patients with rotator cuff tears treated with a dermal allograft patch showed similar findings in a second-look procedure; the graft was noted to have revascularization, host cell infiltration, organized collagen fibers, and minimal inflammatory response.[18] Clinically, patients with large rotator cuff tears treated with dermal allograft patch had roughly half the retear rate compared to those without dermal augmentation.[7] In a study involving both revision and primary repair of rotator cuff tears, augmentation with a dermal allograft led to improved outcomes.[19] However, high degree of preoperative fatty atrophy on MRI was associated with poorer functional results, which shows evidence that although augmentation can help healing, it cannot rectify significant atrophy of host muscle.[19]

Thus, along with providing additional strength at time of implantation, dermal allograft likely provides a scaffold that is conducive to healing, leading to continued improvements in repair strength over time.[20] Despite these advantages, however, the use of dermal allograft in its classic form as patches has been somewhat limited because it is time-consuming, is technically challenging, and requires additional surgical fixation.

As evident by the above surgical demonstration, cannulated dermal allograft is a viable alternative as it provides the benefits previously mentioned while being easy to use, fast, and reproducible (Table 2). Additionally, given that the most common failure method following RCR is by way of tendon pulling through suture,[20] dermal allograft should be localized to the suture-tendon interface. An additional strength of cannulated dermal allograft is its integration at the site of repair because of its in-line design.

Overall, cannulated dermal allograft is a promising adjunct for RCR. The in-line, cannulated design keeps the allograft localized at the site of the suture-tendon interface and does not require timely, wasteful preparation or the placement of additional fixation. Although clinical studies are required to demonstrate outcomes of the cannulated dermal allograft delivery system, this is a promising technique that is fast and relatively easy to perform in a reproducible fashion.

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