The information contained in this document is intended for healthcare professionals only.
Abstract
Arthroscopic rotator cuff repair has become increasingly popular for chronic, massive rotator cuff tears. Over the last decade, arthroscopic techniques, instrumentation, and knowledge of tear patterns have greatly advanced to allow these complex, difficult tears to be repaired arthroscopically. Despite technical advancements, the biology of healing within these chronic tears continues to be an issue. Several biologic tissue augments have been introduced in recent years. These augments have been used to reinforce repairs of massive chronic rotator cuff tears with poor quality tissue. This paper describes a new technique for arthroscopic insertion of a biologic rotator cuff tissue augment.
Arthroscopic rotator cuff repair is becoming increasingly popular. Throughout the last decade, several studies have been conducted showing results that parallel those of open repair. More recently, a variety of techniques have been developed to help achieve arthroscopic repair of massive rotator cuff tears. One issue that remains unsolved is the biology of healing within large to massive rotator cuff tears. The rotator cuff tissue present in chronic, massive tears is typically of poor quality. Several studies have shown that despite achieving an initial, technical repair of large rotator cuff tears, recurrent tears and defects seen in rotator cuff tissue after repair of large to massive tears ranges from 41% to 94%.

To aid in the healing of difficult, chronic tears, several biologic tissue augments have been developed. Generally speaking, these augments function by providing a collagen-based scaffold to the area of repair. Over time, host cells populate the scaffold and gradually remodel the device, thus providing for a potentially better healing response and an improvement in the quality of tissue within the repaired rotator cuff.

To date, the insertion of biologic tissue augments has been described for open repair only. Many surgeons who perform all-arthroscopic rotator cuff repairs may choose not to use biologic tissue augments because of the need to insert the augment using an open technique. This paper describes a technique for the all-arthroscopic insertion of a biologic tissue augment.

**Figure 1**
Fibroblast and supporting blood vessels within acellular collagen matrix

**Figure 2**
Remodeling of implanted collagen device
The patient is placed in a beach chair position. Standard posterior, anterior, and lateral portals are created. Large, clear cannulas are placed in each of the portals. The rotator cuff tear is evaluated and repaired using double-loaded suture anchors (Figure 3). Two suture anchors are needed for the rotator cuff repair and the tissue augment fixation. One anchor is placed in the humeral head at the most anterior part of the tear, and one is placed posteriorly. One suture from each anchor is used for the rotator cuff repair, and one suture is used for the tissue augment fixation. The sutures from the anchors for the tissue augment are left exiting through accessory portals.

The arthroscope is then placed in the lateral portal. Two free sutures are passed through the repaired rotator cuff; one anteromedially and one posteromedially. These sutures should be placed at the most medial aspect of the rotator cuff repair. We have found that a curved suture passer works best for this part of the procedure. Each suture is pulled through the anterior and posterior cannulae (Figure 4).

Note:
* A & B represent the anteromedial and posteromedial sutures.
* C & D represent the anterolateral and posterolateral sutures needed for tissue augment.
After the sutures have been pulled through the cannulae, the camera is placed in the posterior portal through the clear cannula with the posterior suture. One limb from each of the four sutures (anteromedial, posteromedial, anterior suture anchor, and posterior suture anchor) is retrieved through the lateral portal and clamped.

The tissue augment (TissueMend®) is cut to the appropriate size and the edges are marked with methylene blue to allow for better visibility. Each of the four limbs exiting through the lateral portal is passed through the corresponding corner of the tissue augment. Once passed through the augment, Mulberry knots are tied on top of the tissue augment in each suture limb and are tested to ensure they do not pull through the augment (Figure 5).

After tying all four Mulberry knots, the suture limbs of the four sutures exiting through the posterior, anterior, and accessory (2) portals are pulled simultaneously to reduce the tissue augment down the cannula and onto the repaired rotator cuff (Figure 6). A trocar is used to help push the tissue augment through the cannula.
After the tissue augment is passed into the shoulder, the Mulberry knots from each of the sutures are retrieved sequentially (Figure 7) and tied arthroscopically to secure the tissue augment (Figure 8).

Note:
A, B, C, & D represent each of the sutures which have been retrieved sequentially and tied to secure tissue augment.

Figure 7
Mulberry knots are retrieved and arthroscopic knots are tied on all four corners of the tissue augment.

Upon retrieval and subsequent tying of Mulberry knots, the repair is complete.

Figure 8
Final repair with tissue augment.
Discussion

Despite our technical ability to repair complex rotator cuff tears, the healing potential of the tissues being repaired remains poor using either open or arthroscopic techniques. Studies have shown that recurrent tears and rotator cuff defects are present after repair of large to massive tears in 41% to 94% of cases.\textsuperscript{16-19} To address this issue, biologic tissue augments were developed to help promote healing after rotator cuff repair.

There are several biologic tissue augments currently available. These products are TissueMend\textsuperscript{®}, Restore\textsuperscript{®}, GRAFT JACKET\textsuperscript{®}, and Cuff Patch\textsuperscript{™}. TissueMend\textsuperscript{®} is derived from fetal bovine dermis, Restore\textsuperscript{®} and Cuff Patch\textsuperscript{™} are derived from porcine small intestine submucosa, and GRAFT JACKET\textsuperscript{®} is derived from human cadaveric tissue.

The author's preference for biologic tissue augment is TissueMend\textsuperscript{®}. The basis for this preference is the strength of the product as well as its handling characteristics, storing capacity, and biocompatibility. TissueMend\textsuperscript{®} is processed in a proprietary manner to produce a sheet of pure, naturally cross-linked collagen, which acts as a biologic scaffold for the patient's host cells and tissue to grow into and over. Furthermore, TissueMend\textsuperscript{®} is 1 mm thick and holds sutures very well. Its strength and ability to hold a suture is essential for arthroscopic insertion using the described technique because the sutures aid in the placement of the tissue augment onto the repaired rotator cuff. TissueMend\textsuperscript{®} is also pliable, similar to a piece of fascia, which allows it to be folded easily for arthroscopic insertion.

Indications for biologic tissue augments include repair of chronic tears with poor tissue, revision rotator cuff repair, and rotator cuff repair in patients with chronic diseases. Biologic tissue augments should not be used to substitute for a stable repair, nor should they be used to span a gap between the cuff and bone or to "patch a hole" in the rotator cuff.\textsuperscript{21} Before using tissue augments, repair techniques such as margin convergence\textsuperscript{8}, interval slides\textsuperscript{9,10,11}, reinforcing suturing techniques\textsuperscript{12,13}, or margin convergence to the biceps tendon\textsuperscript{14} should be utilized to achieve the best repair possible. After a repair is technically achieved, tissue augments can be used to aid in the biology of healing in these complicated, difficult cases.

Arthroscopic insertion of a biologic tissue augment is a technically demanding procedure. As with most advanced arthroscopic techniques, proper portal placement and suture management are critical to the success of the procedure. It is important to isolate each limb on the suture that corresponds to each corner of the augment. Care should be taken to ensure that the suture limbs do not cross. The Mulberry knots must also be large enough to pull the tissue augment without pulling through the device. During the passage of the tissue augment through the cannula, all four limbs should be pulled simultaneously with equal tension to allow the augment to lay flat on the repaired cuff. For this step, using a trocar to push the augment through the cannula will be helpful.

It is the author's opinion that tissue augments play an important role in repair of chronic rotator cuff tears, revision rotator cuff repair, and rotator cuff repairs in patients with chronic diseases. Arthroscopic insertion of a tissue augment after rotator cuff repair is another technique that will aid the surgeon in handling these challenging rotator cuff repairs.

Description

TissueMend\textsuperscript{®} is a remodelable collagen scaffold derived from bovine skin to be used to reinforce soft tissues where weakness exists. The device is supplied sterile and is provided in sheet form to be trimmed and sutured by the surgeon to meet the individual patient's needs.

Indications

TissueMend\textsuperscript{®} is intended for surgical implantation to reinforce soft tissue where weakness exists and for the repair of damaged or ruptured soft tissue membranes. In addition, the device is intended to reinforce soft tissues that are repaired by suture or suture anchors, limited to the supraspinatus, during rotator cuff surgery.

Contraindications

• TissueMend\textsuperscript{®} is not designed, sold, or intended for use except as indicated.
• TissueMend\textsuperscript{®} should not be used for patients with a known history of hypersensitivity to collagen or bovine products.
References


