Technical Note

Prevention, Reduction, and Stabilization of Dog-Ear Deformities During Arthroscopic Rotator Cuff Repair

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Abstract: Arthroscopic rotator cuff repairs (ARCRs) are common procedures that have been increasing in incidence. When performing ARCR, the surgeon often identifies an undesirable flap or fold, referred to as a “dog-ear” deformity, between sutures or knots. The height and/or thickness of a dog-ear deformity may decrease the rotator cuff to acromion distance, resulting in possible impingement and repair compromise. Furthermore, the goal of ARCR is to achieve complete restoration of the tendon-to-footprint relation. To restore the entire footprint, this lesion must be reduced and stabilized. We present a technique using looped sutures to augment the rotator cuff repair and prevent dog-ear formation.

Surgical Technique

Positioning, Diagnostic Arthroscopy, and RC Tear Evaluation

After the induction of general anesthesia, the patient is positioned based on surgeon preference. The shoulder and upper extremity are prepared and draped in a sterile fashion. A diagnostic arthroscopy of the glenohumeral joint is performed, and any intra-articular pathology is addressed as indicated.

After completion of the glenohumeral portion of the case, the RC is evaluated arthroscopically within the subacromial space. If indicated, subacromial decompression is performed. The tear pattern and tissue quality of the RC are assessed in terms of thickness,

Fig 1. A left shoulder, viewed from the lateral portal, shows a rotator cuff tear with a dog-ear deformity (dotted line) during reduction to the anatomic footprint on the greater tuberosity using an arthroscopic tendon grasper.
retraction, footprint coverage, fibrosis, and delamination. The amount of excursion of the RC is evaluated after full mobilization, including possible release of the rotator interval and/or posterior interval if needed. In planning the type of repair, the surgeon evaluates the potential for a reduction or compression repair that may still have an irregular flap or dog-ear appearance (Fig 1). To restore the entire tendon to its footprint, we believe these lesions should be reduced and incorporated into the repair.

Portals and Cannulas
When performing RCR, we typically use 6 standard portals (Fig 2). The standard cannulas are a Gemini cannula (Arthrex, Naples, FL) placed in the lateral (“50-yard line”) portal, an 8-mm × 3-mm PassPort cannula (Arthrex) in the anterolateral portal, and an 8-mm × 4-mm PassPort cannula in the posterolateral portal. The Gemini cannula serves as a visualization and working cannula as well as a soft-tissue retractor that can be manipulated to increase visualization in the lateral “gutter” (the space between the greater tuberosity and the subdeltoid fascia). The anterolateral and posterolateral portals are located just off the corresponding corners of the acromion. The lateral portal is centered over the RC tear with the arm in a neutral position, approximately 4 cm distal to the lateral edge of the acromion. Standard posterior and anterior portals are used for suture management. At times, an accessory portal may be required for medial-row anchor placement with a preferred trajectory. This portal is located at the lateral edge of the acromion and is typically directly midline between the anterolateral and posterolateral portals.

Footprint Preparation
The greater tuberosity is prepared by removing residual RC or fibrous tissue. Bony irregularities and osteophytes are removed from the greater tuberosity footprint area using a shaver or high-speed burr until a smooth healing surface is established. Care is taken to ensure that the footprint is not weakened and a “trough” is not created. Microfracture of the footprint can be performed at the surgeon’s discretion.

Placement of Medial-Row Anchors and Passage of Compression Suture and Tape
We often perform a double-row, transosseous-equivalent, knotless RCR with the goal of re-

Fig 2. View from outside the left shoulder showing superficial skin markings, portals, and cannulas.

Fig 3. A left shoulder, viewed from the lateral portal, shows a remaining dog-ear deformity (dotted line) after placement of marginal sutures at the anterior and posterior margins of the repair.
establishing tendon-to-footprint fixation, thus minimizing tension to allow for a secure repair with desirable healing potential. The articular margin is identified, and the decision on the number of medial-row anchors is made based on the available area within the torn tendon footprint. In this example, we use 3 medial-row 4.75-mm bio-composite, vented, SwiveLock anchors (Arthrex), loaded with FiberTape (FT) sutures (Arthrex).

The FiberWire “stay” sutures (Arthrex) from the most anterior and posterior anchors are passed in a mattress fashion and tied. This additional mattress suture fixation at the anterior and posterior peripheral locations adds strength to the repair and, in addition, helps lay down the edges to minimize the dog-ear appearance. In this case, the dog-ear deformities remain after placement of these marginal stitches (Fig 3). After placement of the medial-row anchors and passage of sutures through the RC tendon, bleeding bony channels are made in the footprint with a microfracture tool.

Placement of Reduction Sutures

We use No. 2 FiberLink (FL) sutures (Arthrex) for reduction of the RC with a FastPass Scorpion suture passer (Arthrex) through the lateral portal (Video 1). Visualization is best from the posterolateral portal for placement of anterior sutures and from the anterolateral portal for placement of posterior sutures. Efficiency can be improved by placing the shaft of the Scorpion device through the FL loop before introducing it into the shoulder. This allows for automatic cinching when the Scorpion device is removed (Fig 4). In this example, we place 6 FL sutures because of the large tear size (Fig 5). When using the Scorpion device to pass the FL, care should be taken not to inadvertently spear the FT sutures. We place the central reduction sutures approximately 3 mm lateral to the medial-row FT sutures in the tendon. During placement, these sutures are docked in the anterolateral portal. The number of FL sutures ultimately used depends on the size and character of the tear.
Provisional Reduction and Fixation of Reduction Sutures

Fixation of the RC tear starts by anchoring the central FL sutures. These are retrieved through the lateral cannula. While tension is held on these reduction sutures, the inner sleeve of the Gemini cannula can be pushed forward to determine the amount of tension and the desired anchor location (Fig 6). Once the location of the reduction anchor is determined, a bone punch is used for a 4.75-mm SwiveLock anchor in an “intermediate row.” Marking the punch tip with a surgical marker can aid in relocating its position. The 4 central reduction sutures are then loaded into the eyelet of the anchor. The sutures are individually tensioned prior to seating and screwing in the anchor (Figs 6 and 7). Over-tensioning can lead to bone or tissue cutout near the anchor, compromise tissue and/or suture security, and ultimately, compromise healing. Under-tensioning can result in suboptimal cuff reduction and a suboptimal footprint contact area.

Lateral-Row Fixation of FL and FT Sutures

Three lateral-row 4.75-mm SwiveLock anchors are used complete the transosseous-equivalent repair. The most anterior FL is included in the anterolateral anchor, and the posterior FL is included in the posterolateral-row anchor. Each FL and FT are gently tensioned prior to placement and fixation of the anchor. In this case, the 2 peripheral FL sutures are used to augment the strength of the repair and to aid in preventing a dog-ear deformity at the margins (Fig 8).

Discussion

The surgeon’s goal during ACR is to re-establish the anatomic footprint. We favor a double-row anchored, transosseous-equivalent repair. The double-row anchor repair has been shown in anatomic and biomechanical
studies to have a larger footprint.2-4 This technique has also been shown to be biomechanically stronger than single-row and transosseous repair.5 In systematic reviews, double-row ARCR has been shown to have superior structural healing with fewer retears compared with single-row ARCR.6,7 In our experience, the dog-ear deformity is frequently encountered during ARCR, regardless of the technique used. The described technique offers many advantages (Table 1).

The dog-ear lesion has a few possible negative consequences. The elevated flap decreases the RC-to-acromion distance, resulting in possible impingement and repair compromise. The goal of ARCR is to achieve complete restoration of the tendon-to-footprint relation for optimal healing. Left untreated, the elevated flap will be unable to heal to the bony footprint, and this flap must be reduced and stabilized for optimal healing.

Kim et al.8 recognized the unwanted dog-ear deformity and described a technique for prevention of a marginal dog-ear deformity. We used a technique similar to their technique in the described case, but a dog-ear deformity remained (Fig 3). Although the technique of Kim et al. is useful, it is not always able to prevent dog-ear deformities. The use of looped FL sutures is an effective and reliable method for prevention and/or reduction and stabilization of the dog-ear lesion.

Table 1. Pearls and Pitfalls of Rotator Cuff Repair With Loopeder Suture Augmentation for Prevention of Dog-Ear Deformities

| Pearls                                                                 |
|------------------------------------------------------------------------|
| The Gemini cannula serves as a visualization and working cannula, as well as a soft-tissue retractor, and offers preliminary reduction. |
| Efficiency can be increased by placing the shaft of the Scorpion device through the FiberLink loop, allowing for automatic cinching. |
| Visualization is best from the posterolateral portal for placement of anterior sutures and from the anterolateral portal for placement of posterior sutures. |
| Marking the punch tip with a surgical marker can aid in relocating its position. |

| Pitfalls                                                                 |
|------------------------------------------------------------------------|
| Over-tensioning can lead to bone cutout near the anchor, compromise tissue and/or suture security, and ultimately, compromise healing. |
| Under-tensioning can result in suboptimal cuff reduction and a suboptimal footprint contact area. |
| When using the Scorpion device with FiberLinks, care should be taken not to inadvertently spear the suture tapes. |

**Fig 8.** Left shoulder, viewed from lateral portal, showing final rotator cuff repair construct including intermediate-row and lateral-row anchors with attached FiberTapes and FiberLinks. (A) Most anterior construct with anterior anchor and FiberLink. (B) Mid construct with 4 central FiberLink sutures. (C) Posterior construct with posterior FiberLink in posterior-most anchor.

**References**

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