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Operative Techniques in

Sports Medicine

Technique and Outcomes for Knotless Transosseous Rotator Cuff Repair

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Rotator cuff tears are a common cause of shoulder disability. Arthroscopic rotator cuff repairs can lead to significant improvement in pain and function, though follow-up imaging studies may still demonstrate a substantial rate of rotator cuff tendon re-tearing. The double-row transosseous-equivalent repair is biomechanically superior to other repair techniques and thereby may improve tendon-to-bone healing. This article describes our preferred technique for knotless rotator cuff repair using a transosseous-equivalent technique.

KEYWORDS Rotator cuff repair, double row, shoulder arthroscopy, knotless, trans-osseous equivalent

Introduction

Rotator cuff tears are a common source of shoulder pain and disability in older adults, with full-thickness tears seen in up to 30% of patients over the age of 60.[1] The incidence of rotator cuff tears increases with age, with increasing symptoms correlating with tear size progression.[2] Indications for rotator cuff repair vary substantially, with a lack of clinical agreement on when to perform a surgical repair.[3] Despite this, the rate of rotator cuff repair in the United States has steadily increased.[4] These rotator cuff tears, often the result of trauma, chronic degeneration, or a combination of both, most commonly involve the supraspinatus tendon.[5]

Arthroscopic rotator cuff repair is considered to be the treatment of choice after nonoperative management fails. Unfortunately, while good outcomes are expected, high re-tear rates are seen. Historically, open repairs of 1 tendon had a 20% re-tear rate that increases to 50% when more than 1 tendon is involved.[6] More recently, re-tear rates up to 30% are still reported; however, functional outcomes still improve above baseline.[7,8] In a literature review, Randeli et al[9] found re-tear rates ranging from 11%-94%. Chung et al[10] found that older age, female sex, fatty infiltration of the rotator cuff muscle, medial retraction of the tendon, and tear size as predictors of rotator cuff repair failure. In addition, poor tendon quality, even in partial-thickness rotator cuff tears, is a strong predictor of rotator cuff repair failure.[11] Although it is important to achieve tendon healing after rotator cuff tears, some authors suggest that functional outcomes continue to improve despite re-tear rates.[12-14] Nevertheless, there is concern if the repair does not heal, progression of these tears can negatively affect recovery and function.[15-17] Furthermore, longer follow-up suggest the outcomes deteriorate over time when the rotator cuff tendon does not heal.[18,19]

Re-tear rates continue to be of clinical significance, and improving the structural integrity of the repair is of clinical interest. The goal is to achieve the best possible initial repair as revision rotator cuff repairs are twice as likely to re-tear at 2 years and are associated with loss of function and pain.[20]

Transosseous-Equivalent Repair

TOE rotator cuff repair was developed to enhance initial structural integrity of the rotator cuff repair. This repair was performed using 2 medial anchors with crossing sutures that are anchored by 2 lateral row anchors. Biomechanical studies found that tendon footprint pressures are improved with TOE repair when compared to standard double-row repair.[21,22] Furthermore, when compared to DR repair techniques, TOE is biomechanically stronger with increased load to failure in a cadaveric model.[22] Furthermore, Quigley et al[23] found TOE to be superior to DR and SR with biomechanical properties including improved ultimate load to failure, energy absorbed

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prior to yield, and yield load. Interestingly, as load is increased on TOE, the contact pressures increase at a higher rate than in SR repairs suggesting a self-reinforcing capacity for a the repair.[24] Theoretically, this biomechanically superior repair may improve tendon healing.

When compared to single-row repairs, transosseous-equivalent (TOE) and double-row repairs (DR) had significantly lower re-tear rates than single-row (SR) repairs for small, medium, and large rotator cuff tears.[25] In a systematic review of 7 high-quality studies, single-row repairs had a significantly increased risk of re-tear after rotator cuff repair; however, functional differences compared to double-row repairs were seen only in medium to large rotator cuff tears.[14] Lee et al[26] compared TOE to a modified tension band technique and found similar re-tear rates in small to medium sized rotator cuff tears; however, the large to massive re-tear rates were significantly improved with the TOE repair. Furthermore, they found significant improvements in muscle size and fatty infiltration in the TOE repair.[26]

There are multiple clinical studies demonstrating good clinical outcomes after the TOE repair technique with re-tear rates ranging from 0% in small- to medium-sized tears and up to 42% in large to massive rotator cuff tears. [27–32]

Surgical Technique

Patients receive a regional block prior to surgery to reduce the amount of intraoperative anesthesia needed and for post-operative pain control. We prefer to perform our rotator cuff repairs in the beach chair position using a standard operating table. Two rolled towels are placed on the medial edge of the scapula to stabilize the scapula during surgery. A mechanical arm holder (Trimano Arm Holder, Arthrex, Naples, FL) is used to support and position the arm. An examination under anesthesia is performed to assess for range of motion (ROM) and stability.

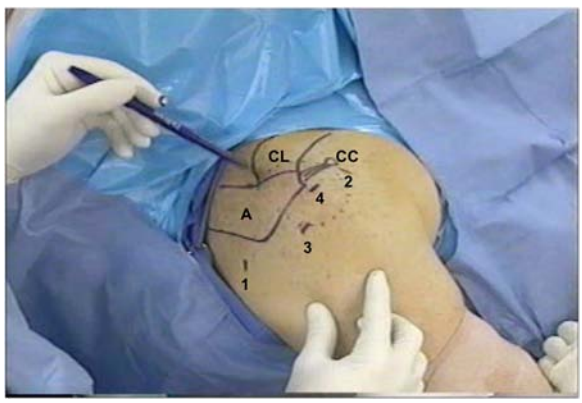

Figure 1 Skin markings for our standard arthroscopic portals are shown for a right arm in the beach chair position. A: acromion, CL: clavicle, CC: coracoid. (1) posterior portal, (2) anterior portal, (3) lateral subacromial portal, and (4) anterolateral portal. (Color version of figure is available online.)

Portal Placement and Diagnostic Arthroscopy

The arm is placed in line with the body and slight anterior traction is achieved using the mechanical arm holder. Our posterior portal is approximately 1-2 cm distal and medial to the posterolateral edge of the acromion (Fig. 1). Our anterior portal is made using an outside-in technique with its typical location being just lateral to the superior margin of the coracoid. A smooth 5.75 mm cannula (Arthrex, Naples, FL) is placed anteriorly. A standard diagnostic shoulder arthroscopy is performed and all intra-articular pathology is addressed. We critically evaluate the subscapularis and the undersurface of the rotator cuff. Any rotator cuff fraying is debrided, and concerning areas of potential partial-thickness tears are marked using a polydioxanone suture (PDS, Ethicon,Cincinnati, OH) that is passed from the subacromial space laterally using a spinal needle (Fig. 2).

Subacromial Decompression and Acromioplasty

We enter the subacromial space using the blunt arthroscopic trochar from the standard posterior portal, aiming for the anterolateral edge of the acromion. A lateral sweeping motion will help open the subacromial space for viewing. A spinal needle is used to localize a lateral subacromial portal approximately 2-3 cm lateral to the acromion and just posterior to the posterior edge of the acromioclavicular joint (50-yard line). When viewing from the lateral portal, we then achieve an in-line view of the rotator cuff tear. A thorough subacromial bursectomy is performed with care to release all adhesions from the rotator cuff tendon. The bursa medial to the acromion is more vascular and is not debrided. The lateral gutter is also released to allow clear identification of the greater tuberosity for anchor insertion. We routinely elevate the coracoacromial ligament off the anterior margin of the acromion using a radiofrequency (RF) device. We prefer to perform an acromioplasty to improve visualization in the subacromial space and to reduce the critical shoulder angle which may be associated with a higher re-tear rate.[33,34] Furthermore, acromioplasty may reduce extrinsic factors that can lead to re-tears, such as bursitis and mechanical wear.[35] An acromioplasty is performed using a posterior cutting block technique using an arthroscopic burr.

Evaluation of the Rotator Cuff

Viewing from the lateral subacromial portal, the rotator cuff tear pattern is evaluated. It is important to understand the tear characteristics, including tear delamination (Fig. 3) and pattern recognition of U-shaped, L-shaped, reverse L-shaped, and crescent-shaped tears.[36,37] The rotator cuff tendon is then appropriately mobilized using a capsular and interval release when necessary.[38] Once free, arthroscopic forceps are used to reduce the rotator cuff tendon to the tuberosity for visualization of optimal anchor and suture placement to achieve appropriate reduction and fixation of the tendon. The greater tuberosity should be appropriately prepared using an