Partial Rotator Cuff Tears: a review of the literature

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Abstract

Partial- thickness rotator cuff tears are the most common cause of shoulder pain in adults and have been classified into subtypes according to location and depth. The frequency rate and tear size progression increase with age, tobacco use and medical comorbidities. Partial tears are divided into tears of acute, chronic or acute-on-chronic onset. Surgical treatment is indicated in symptomatic patients with persistent pain after failed conservative treatment of at least 3 months, mainly with tears that exceed 50% of the tendon thickness. Arthroscopic repair techniques include in situ and tear completion repair. Authors' preferred technique for in situ repair is described followed by the postoperative rehabilitation protocol. The surgical techniques described have various advantages and disadvantages with regard to intra- operative complications, clinical outcomes, recovery time and re-tear rates which make it difficult to decide on which technique to use. The option is a matter of surgical indications, philosophy and skills.

Keywords: Partial-thickness rotator cuff tears, transtendon repair, in-situ repair, shoulder, arthroscopy

Introduction

Partial-thickness rotator cuff tears (PT-RCTs) are the most common cause of shoulder pain in adults [1, 2, 3]. A partial tear is defined as a disruption of the tendon fibers and it should be distinct from superficial fraying of the articular capsule [4, 5]. The pain seems to increase with progress of the size of the tear [6, 7], mainly in adults older than 60 years with tears of grade III according to Ellman classification [1, 6, 8].

As Ellman proposed, PT-RCTs are divided into articular, bursal and interstitial based on location and less than 3mm deep, from 3 to 6mm deep or deeper than 6 mm in correlation with the thickness of the tendon involved [2-5, 7-11, 13]. The frequency rate of articular-sided tears is two to three times higher than the other two subtypes [2, 4-5, 11-12], whereas bursal- sided tears are the most painful tears [5, 13], mainly the hat-like everted type because of subacromial impingement [10, 13]. The supraspinatus tendon is the most commonly involved tendon [14].

Ellman designed a classification system for partial tears with regard to location and depth including also intratendinous lesions which were absent from Snyder' s classification scheme [5, 9, 14]. However, Neer was the first to propose a staging of rotator cuff tears based on histological characteristics such as hemorrhage, edema and fibrosis [9] whereas Codman was the first to describe them [11]. Curtis and Ruotolo also proposed a similar classification system based on tear size [9]. Articular- sided rotator cuff tears are further divided into 5 grades regarding tendon fraying and number of fibrous fragments according to the Southern California Orthopedic Institute (SCOI) [15].

Pathogenesis of PT-RCTs is multifactorial. PT-RCTs are most common in adults with medical comorbidities including increased bone and mass index (BMI), hypertension, hyperlipidemia, osteoporosis and diabetes mellitus [1, 8, 16] while increased age and tobacco use seems to increase the speed of tear size progression [5, 17]. Other risk factors include trauma and overuse so that partial tears are divided into tears of acute and chronic onset or acute-on-chronic onset. In one of two patients with PT-RCTs in one shoulder for more than 20 years there are also full- thickness tears in the contralateral shoulder [18]. Superior partial articular tears are most common in young adults with glenohumeral instability [15]. Apart from causative factors, prognostic factors also play an important role in surgical decision making. Some of the factors that affect the healing of PT-RCTs are the size of the tear, muscle atrophy and fatty infiltration [1], especially in patients of higher BMI who present with increased rates of fatty infiltration as well as older female patients who present with higher rate of fatty infiltration of the deltoid muscle [16].

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Indications for surgery

Surgical treatment of PT-RCTs is indicated in symptomatic patients who present with persistent pain after at least 3 months of conservative treatment and includes in situ or complete repair of tears which exceed 6mm of the thickness of the involved tendon [2-3, 5-7, 11, 19-22, 23-29]. Arthroscopic debridement is indicated in intrarticular tears which do not exceed 50% of the tendon thickness [30] and in young athletes with tears of acute onset. If conservative treatment fails and PT-RCTs become to exceed 50% of the thickness of the tendon, in situ repair with soft anchors is the second treatment of choice.

Complete repair either double or single row repair is indicated in older patients with partial tears of chronic onset as a result of overuse and subacromial impingement. Complete repair with horizontal mattress sutures is further indicated in intra-articular lesions if conservative treatment including platelet-rich plasma (PRP) injections fails. On the other hand, transtendon repair requires good quality of the involved tendon and is not indicated in PT-RCTs deeper than 6mm of the tendon thickness [31].

Various other factors are important in surgical decision making. Some of these factors are patients' age and level of sports, response to conservative management including medical and physical therapy and modification of every-day activities, medical comorbidities as well as patients' expectations [5, 19, 21, 24-25].

Surgical techniques

PT-RCTs arthroscopic repair techniques include in situ and transtendon repair as well as tear completion repair. In contrast with the other two techniques, in situ repair allows the repair of the tear to the footprint without sacrificing the involved tendon [23, 30]. In tear completion repair the involved tendon is released and repaired to the footprint [20, 23] whereas in transtendon technique the medial footprint is repaired, and the lateral footprint is preserved as soft anchors are placed into the tendon to the footprint [30].

Tear completion repair includes conversion of PT-RCTs to full- thickness tears by detachment of the tendon in the articular side, debridement and repair by insertion of the tendon to the original footprint. The advantage of this technique is the removal of degenerated tissue. If the tear is larger than 1cm, double- row repair is suggested as it demonstrates higher healing rates compared with single-row repair in several studies [6].

In contrast to complete repair in which part of the intact tendon may be detached, in situ repair allows preservation of the involved tendon [6]. In situ repair includes transosseous repair, all- inside intraarticular repair and transtendinous repair which is the most commonly used [6]. Transtendon repair technique was first described by Snyder, Burkhart and Lo [31]. The intratendinous placement of soft anchors into the greater tuberosity allows restoration of the rotator cuff footprint with enhancement of the healing of the remaining tissue [31]. However transtendon repair of PT-RCTs decreases forward flexion and external rotation strength after surgery as a result of decreased translation in both directions while overtension of the tendon repair against the bursal side may lead to post-operative stiffness [28], which would be avoided with elimination of the sutures placed in the bursal side [28, 31].

Author's preferred Surgical Technique for in-situ repair

The goal of in-situ repair of PASTA lesions is the reattachment of the torn tendon surface to the native "footprint" area on the greater tuberosity with preservation of the healthy fibers' attachment.

Standard posterior, anterior and lateral portals are used routinely for the introduction of scope and instruments and accessory portals are used if needed. The joint side is initially inspected for additional lesions. Tenodesis of biceps or repair of a SLAP lesion is performed at this stage if needed. The portion of the greater tuberosity that is visible from the articular side is the area where the torn tendon's fibers were attached. Debride the frayed tendon fibers until the bone is visible. Mark the tear with a needle in order to locate it when scoping the subacromial space (Figure 1). When inspecting the subacromial side, the bursa is removed until the supraspinatus tendon is visualized. It is not possible to locate the tear from the bursal side, but you can see the needle placed as marker. Two useful tips are the followings: firstly, put the arm in internal rotation in order to clear the posterior bursa (lateral decubitus). This is helpful in order to find and recognize the tendons. In addition, remove the thickened bursa in order to see the edge of the cuff ending to the greater tuberosity.

Articular side tendon preparation

Debride the greater tuberosity and the torn ends of supraspinatus. Use a 16G catheter loaded with a Nylon suture in order to pass a shuttling suture through the supraspinatus tendon (Figure 2). Put the needle in the healthy portion of the tendon, retrieve the shuttling suture and exchange it with an orthopaedic multi-strand, long chain ultra-high-molecular-weight polyethylene suture or tape that provides strength, soft feel and abrasion resistance. Repeat the same maneuvers in order to pass all two sutures or tapes in a mattress fashion (Figure 3).

Subacromial side preparation

Locate the sutures in the subacromial side and perform a suture bridge repair using one or two knotless anchors at the lateral side of the greater tuberosity (Figure 4). At this stage acromioplasty is performed if needed.

Postoperative Rehabilitation

Post- operative rehabilitation protocol involves 2 to 4 weeks of immobilization of the arm in a sling [26, 28, 30-31]. This brief period includes passive motion to the level that pain is tolerated by the patient for 6 weeks when active- assisted exercises are started followed by resisted range of motion [7, 26, 28-32]. Muscle strengthening exercises are allowed after 12 weeks [2-3, 7, 25-26, 30, 32]. As patients return to pre- injury level of strength, weightlifting and overhead activities are started 3 to 6 months post-operatively [7, 26].

Discussion

Surgical treatment of PT-RCTs includes three techniques based on preservation of the involved tendon. Transtendon repair includes transtendon placement of suture anchors into the medial rotator cuff footprint preserving the lateral margin whereas in situ repair of the footprint preserves the remaining tendon which is repaired to the footprint. Transtendon repair is still an in-situ repair technique but requires high surgical skills for preserving the tendon intact although poor visualization [2, 23-24]. On the other hand, in tear completion technique the remaining tissue is excised, repaired and reattached to the footprint [23].

In the literature, transtendon repair is associated mainly with intra- operative complications such as malpositioning of anchors, chondral damage [30] or overtension of the tendon against the bursal side [2, 11, 25]. However, Fukuta et al reported significant improvement of functional scores at 1 year follow up in 13 patients who underwent transtendon repair of PT-RCTs without any intra-operative complications [30]. Shin et al also demonstrated significant improvement of shoulder pain and function in 18 patients at final follow up of 3 years with no retear diagnosed by MRI at 6 months post- operatively [28] while Vinanti et al reported 98% satisfaction rate after arthroscopic transtendon repair [7]. Integrity of the involved tendon is the main biological and biomechanical advantage of transtendon repair technique as long as there is balance in tension of repair [2, 7, 11, 29]. Otherwise tension mismatch may cause shoulder stiffness as a result of the decreased forward flexion and external rotation translation by alteration of the glenohumeral contact area [7, 28, 29].

The debridement effect of the tear completion technique shows superior healing rates of the rotator cuff [20] allowing tendon-to-bone healing [11] in contrast with in situ repair which decreases pain but requires longer time of recovery [24] and may lead to shoulder stiffness as a result of the remaining degenerated tendon [20]. However, Kim et al reported higher re-tear rates of bursal- sided PT-RCTs after tear completion repair in comparison with in situ repair and no difference in retear rates of articular- sided PT-RCTs or post-operative functional scores [23]. Rossi et al further demonstrated satisfactory long- term functional outcomes after in situ repair and reported high rates of return to pre- injury level of sports without re-tear incidence at final follow up of 8 years [27].

Although single row completion repair demonstrates increased post- operative strength in forward flexion and external rotation, the re-tear rates are high as Heuberer et al reported in their long-term study of 30 patients who underwent single- row repair and presented with better Constant scores if the involved tendons remained intact according to Magnetic Resonance Imaging (MRI) and clinical examination at final follow up of 10 years [32]. Double- row repair seems to offer better contact area between the tendon and the footprint and as a result better biomechanical environment for the healing of the tendon involved. Although single- and double- row repair techniques demonstrate similar results in short- term studies, retear rates of PT-RCTs are higher in patients undergoing single- row repair while double- row mattress construct seems to provide more biomechanical stability.

The advantages and disadvantages of these techniques make it difficult for experienced and inexperienced surgeons to decide on which technique to use for the successful surgical treatment of PT-RCTs. Tear completion repair is a more familiar technique which offers better visualization, faster recovery with good clinical outcomes and similar healing rates and postoperative function with in situ repair [7, 23]. With the improvement of surgical tools, in situ repair becomes simpler in preservation of the remaining tendon [23]. Ranalletta et al demonstrated various studies comparing complete and transtendon repair [26]. Although both techniques showed similar results regarding clinical outcomes and pain relief, a meta- analysis by Sun et al underlined significantly higher re-tear rates in patients undergoing tear completion repair of PT-RCTs [26].

Conclusion

The best surgical treatment for PT-RCTs is an endless debate as surgical techniques and instruments continue to improve. Tear completion and in situ repair with or without biologic augmentation demonstrate similar functional results as well as complication and satisfaction rates. In situ repair offers anatomical restoration of the rotator cuff footprint by preservation of the tendon integrity whereas complete repair is a more familiar and less demanding technique which offers earlier recovery. Surgical option is a matter of surgical indications, skills and philosophy of the repair.

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