Partial-thickness rotator cuff tear: the secret of spinal needle

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Aim
The aim of this study is to prospectively evaluate the functional outcome after repair of PTRCT, moreconcisely partial-thickness articular surface tear, through converting it into complete tear and repairing in a routine manner using a spinal needle as a guideline for localization of the tear.
Objectives
Repair of PTRCT, through converting it into complete tear and repairing in a routine manner using a spinal needle.
Background
Partial-thickness rotator cuff tears (PTRCTs) involve all tears that do not connect the subacromial space with the glenohumeral joint but the fibers are disrupted. They may be articular-side tear, intertendinous tears, or bursal-side tears. The histopathological changes leading to rotator cuff rupture are gradual and progressive. The exact location and extent of incomplete tear can be shown by shoulder arthroscopy.
Methods
A total of 50 patients who underwent arthroscopic repair for a partial-thickness articular-sided rotator cuff tear between March 2013 and July 2015 were included in this study.
Results
Range of motion of the shoulder preoperatively was forward elevation of 135?5.6, mean external rotation of 44 3.5, and mean internal rotation of L3 level. Postoperatively, the range finally improved significantly to forward elevation of 165?4, external rotation of 60?5, and internal rotation of L1 level.
Conclusions
The use of spinal needle in arthroscopic repair of PTRCT facilitates the site of tear and as a guide for the healthy bursal side of the cuff. The limitations of our study included patient were highly selected regarding PTRCT and there was no postoperative imaging study.

Keywords:
rotator cuff, shoulder, tear

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Introduction

Rotator cuff tears are common orthopedic pathology that affect a wide variety of populations. Increased both interest and knowledge about rotator cuff led to the appreciation of the contribution originally discovered and published by Matava [1] and Neer [2,3].

Partial-thickness rotator cuff tears (PTRCTs) involve all tears that do not connect the subacromial space with the glenohumeral joint but the fibers are disrupted [4]. They may be articular-side tear, intertendinous tears, or bursal-side tears. The histopathological changes leading to rotator cuff rupture are gradual and progressive. The exact location and extent of incomplete tear can be shown by shoulder arthroscopy.

The mean thickness of the rotator cuff tendon is 10–12 mm. Grade I tears are less than 3 mm of depth, grade II tears measure from 3 to 6 mm, and grade III tears involve more than 50% of tendon thickness [5].

Although the definition and classification of PTRCT are well established, the incidence is still uncertain [1,6,7]. However, the prevalence of articular-side tear was found to be two to three times as bursal-side tear, and supraspinatus was more affected than infraspinatus, subscapularis, and tears minor [8].

The pathogenesis of partial-thickness tears of the rotator cuff is multifactorial, encompassing intrinsic factors such as ageing-related degenerative changes, poor tissue mechanical properties, poor blood supply, and extrinsic factors, including anatomical impingement, trauma, and repetitive microtrauma in overhead athletes [9,10]. The location of the cuff tear on either the articular or the bursal surface may offer a

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clue to the cause of the tear [10]. Rotator cuff pathology can result from extrinsic or intrinsic factors. Extrinsic examples include a traumatic tear in tendon from a fall or accident, overuse injury, from repetitive lifting, pushing or throwing. Intrinsic factors include poor blood supply, degeneration with aging, and calcification of tendon [11].

Degenerative tears are often associated with extensive lamination and may remain entirely intratendinous. In addition, the articular surface of the rotator cuff has an ultimate stress to failure that is approximately half that of the bursal surface, with thinner and less uniformly arranged collagen bundles [12].

Trauma is more often associated with articular-surface tears than with bursal-surface tears. This association is also seen in cases of repetitive microtrauma. Glenohumeral instability and traction stress on the rotator cuff in the throwing athlete can lead to undersurface tears in the absence of extrinsic anatomic impingement. Articular surface tears in young athletes generally occur in otherwise healthy tissue, in contrast to the degenerative tears seen in older individuals [13].

Walch *et al*. [14] and Jobe [15] described a subset of articular surface PTRCTs that develop secondary to 'internal impingement.' Throwers and other overhead athletes may experience posterior shoulder pain when repetitive contact occurs between the undersurface of the supraspinatus and the poster superior glenoid during the late cocking phase of the throwing motion. Fatigue of the dynamic stabilizers and excessive external rotation secondary to overstretching of the anterior capsule may predispose individuals to development of internal impingement.

The natural history of PTRCT has never been completed. For long decades, it was thought that spontaneous healing may occur. Fukuda *et al.* [16] examined histologic sections of PTRCTs and found no evidence of active tissue repair.

The surgical treatment of PTRCTs has generally involved one of three approaches: tear debridement, acromioplasty along with tear debridement, or cuff repair in addition to acromioplasty [17].

Generally, PTRCTs are considered for repair when they extend to more than 50% of the tendon thickness, although decisions are influenced by various factors such as patient age, sports activity, tendon quality, and surgeons' experience [7,18].

Two repair techniques are widely used. Some surgeons prefer to convert to full-thickness tears followed by repair using a more traditional method, and satisfactory clinical outcomes have been reported. However, others advocate the transtendon repair technique, because completion of a tear sacrifices the intact bursal-sided rotator cuff tendon [19–21].

The aim of this study is to prospectively evaluate the functional outcome after repair of PTRCT, more concisely partial-thickness articular surface tear, through converting it into complete tear and repairing in a routine manner using a spinal needle as a guideline for localization of the tear.

Patients and methods

A total of 50 patients who underwent arthroscopic repair for a partial-thickness articular-sided rotator cuff tear between March 2013 and July 2015 were included in this study. The institutional review board approved the study proposal, and informed consent was obtained from every patient. Partial-thickness articular-sided rotator cuff tears were diagnosed by use of preoperative MRI findings, and tear depths were confirmed at the time of arthroscopic surgery. The depth of a rotator cuff tear and the size of the exposed footprint can be determined with an arthroscopic instrument of known size (a 4.5-mm-wide full radius shaver and a probe with a 4-mm tip). Indications for surgery included symptomatic partial-thickness articular-sided rotator cuff tears exceeding 50% of the tendon thickness in nonathletic patients in whom conservative treatment failed. All patients had been treated conservatively for at least 3 months before surgery. Exclusion criteria included patients with motor vehicle accident; a rotator cuff tear with combined pathology, such as a concomitant bursal-sided rotator cuff tear, a Bankart lesion, or a superior labrum anterior to posterior lesion; patients with prior shoulder surgery; and patients treated with surgical debridement alone.

Arthroscopic treatment for PTRCTs was performed in 82 patients during the study period at one institution. There were 32 patients excluded, for not meeting inclusion criteria.

There were 22 men and 28 women. The dominant extremity was involved in 15 patients. The mean age at surgery was 52.5 years (range, 40–60 years). The mean time between symptom development and surgery was 7 months (range, 3–30 months). A total of 10 patients had an insidious symptom onset without any trauma history, 28 had symptoms after minor trauma, and 12 had overuse injuries owing to heavy manual labor.

Corticosteroid injections were administered in the shoulder joint during conservative treatment in 10 patients. Overall, 18 patients had diabetes mellitus.

Standard radiograph views include an anteroposterior view of the shoulder, an axillary lateral view, and a supraspinatus outlet view. The supraspinatus outlet view best demonstrates curved or hooked acromial morphology, which is seen in some individuals with PTRCTs owing to supraspinatus outlet narrowing. Os acromiale, which can cause impingement symptoms, can be seen on an axillary lateral film. Degenerative changes of the acromioclavicular joint are seen with a 15° cephalic-tilt anteroposterior (Zanca) view. An apical oblique (Garth) or West Point axillary view may be added if glenohumeral instability is suspected.

MRI has become an established technique for diagnosis of full-thickness rotator cuff tear. Diagnosis of PTRCT is suggested by increased signal in the rotator cuff without evidence of tendon discontinuity on T1-weighted imaging. A PTRCT is depicted as further signal increase on T2-weighted images with a focal defect that is intratendinous or limited to one surface and does not extend through the entire tendon.

Tendinitis is distinguished from PTRCT by the finding of only moderate or decreased signal on T2-weighted images (Fig. 1).

Surgical technique

All cases were performed under general anesthesia in beach chair position. After sterilization, diagnostic arthroscopy had been done through standard posterior portal. Anterior portal had been done at the upper border of subscapularis muscle and was guided by a spinal needle (just lateral to the coracoid process). A cannula was inserted over a Wassinger rod. A probe was used for palpation of the biceps anchor and the articular surface of the rotator cuff (to evaluate the width as well as the depth of the tear). A spinal needle is inserted from the lateral aspect of the shoulder through the subacromial space, reaching the articular side of the rotator cuff to localize the tear.

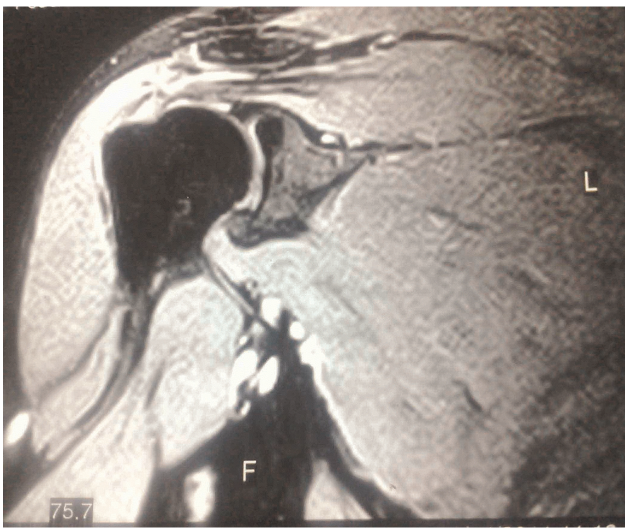
The scope is then withdrawn and pushed in the subacromial space. Through the lateral portal, the use of radiofrequency probe and shaver acromioplasty is performed.

The scope is then pushed again inside the shoulder joint, and the spinal needle is inserted to localize the site of the tear, leaving the needle in place and returning back to the subacromial space to detect the needle as a guide for the healthy bursal side of the cuff. Working now on the bursal side of the tear, it is converted into a complete tear. Repair is performed using either one or two anchors according to the size of the tear (Fig. 2).

Postoperative protocol

A shoulder brace with 0° of external rotation and 15° of abduction was applied to all patients for 4 weeks postoperatively. Passive pendulum and gentle range of shoulder motion exercises are started at 3 days

Figure 1



Decreased signal on T2-weighted image, indicate partial articular surface tear.

Figure 2

Postoperative radiograph showing the position of single anchor.

postoperatively. Active assisted range of shoulder motion exercises began at 6 weeks and resisted shoulder motion exercises at 3 months. Clinical evaluations were performed regularly at 2, 4, and 6 weeks and then at 3 and 6 months.

Clinical evaluations were performed with a visual analog scale. Shoulder range of motion consisting of glenohumeral and scapulothoracic motion was measured to the point of pain with a goniometer. Functional outcomes were evaluated with American shoulder and elbow surgeons (ASES) [22] and Constant shoulder scores. Postoperative adhesive capsulitis was defined as a 25% decrease of shoulder motion at 6 months after surgery as compared with preoperative range of motion.

Results

Acromioplasty had been performed in all patients. One anchor had been used in 32 patients and two anchors in 18 patients. A statistically significant improvement between preoperative and postoperative visual analog scale scores for pain was found (Table 1). Range of motion of the shoulder preoperatively was forward elevation of 135±5.6, mean external rotation of 44 ±3.5, and mean internal rotation of L3 level. Postoperatively, the range finally improved significantly to forward elevation of 165±4, external rotation of 60±5, and internal rotation of L1 level (Fig. 3).

Table 1 Visual analog scale score

	Preoperative	3 months	6 months	Final
VAS	5.2±0.6	5.8±0.5	2.4±0.4	1.4±0.2
ASES score	50±4.2	56±5.6	80±3.5	90±1.2

ASES, American shoulder and elbow surgeons; VAS, visual analog scale.

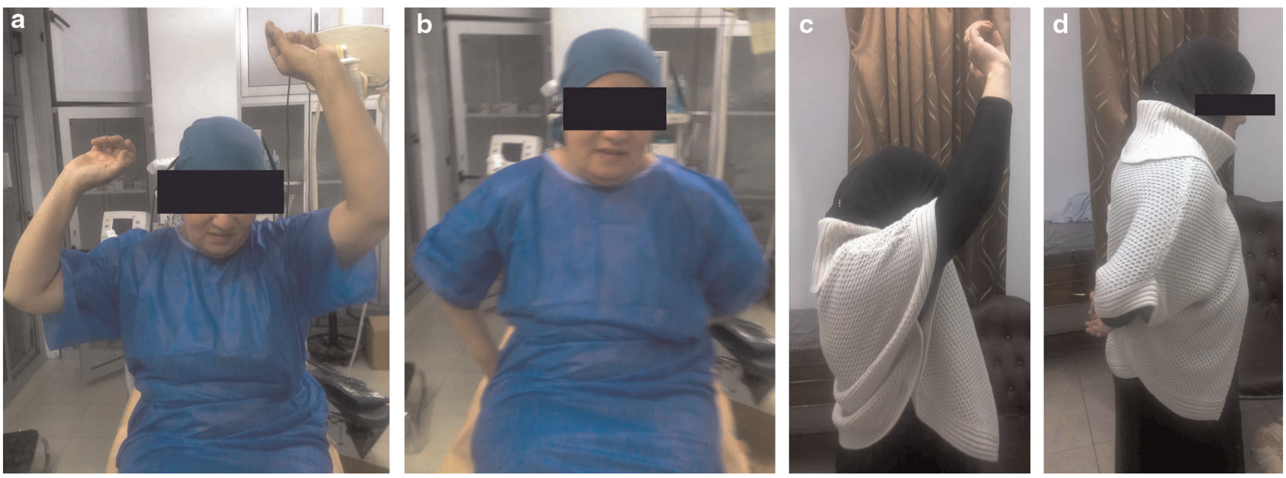
Discussion

PTRCTs have been recognized as one of the most common pathologies of the shoulder. Fukuda [4] described that these conditions occupy a significant proportion in the spectrum of rotator cuff disease. PTRCTs usually cause persistent pain and disability in the general population. There are several established classifications described in the literature. Ellman [5] proposed a classification considering the site and extent of tear. The grades were determined according to the depth of the tear measured during arthroscopic surgery. Snyder *et al*. [23] described a classification based on the tear size and location, as there are a variety of factors such as size, shape, depth, and location in PTRCTs.

Several biomechanical studies reported that rotator cuff tears usually begin at the anterior insertion site of the supraspinatus tendon because this region may be structurally the weakest and a high concentration of stress is localized here [24–26]. Owing to the inordinate stresses seen at the leading edge of the supraspinatus tendon, repairs in this location are more prone to failure. The high stresses seen here also explain the existence of tears involving both articular and bursal sides without communications, described as type IV tear in a classification system proposed by Kwon and Kelly [27].

Treatment options in PTRCT are either conservative or arthroscopic treatment (debridement with or without acromioplasty, transtendinous repair, or completion into complete tear and repair).

Figure 3



(a) Limited forward elevation. (b) Limited internal rotation. (c) Postoperative improvement in forward elevation. (e) Postoperative improvement in internal rotation.

Weber [28] reported significantly worse outcomes in patients treated with acromioplasty only and recommended rotator cuff repair in grade III partial tears.

In 2008, Liem *et al*. [29] evaluated 46 patients with Ellman grade I or II tears. A total of 26 Ellman grade I tears were managed with acromioplasty alone and 20 Ellman grade II tears were treated with debridement and acromioplasty. At an average follow-up of 50 months, the ASES score improved from 37.4 to 86.6. Mean postoperative Constant score was 87.6 points. No significant differences were found when comparing the outcomes of grade I and grade II tear treatment.

In 2007, Deutsch 21 evaluated the outcome of 41 Ellman grade III partial-thickness tears; 33 were articular-sided and eight were bursal-sided. Tear thickness was between 60 and 90% of the tendon thickness, with a mean tear depth of 75% or 9 mm. All patients underwent completion of the partial tear and suture anchor repair. Of 41 patients, 39 had a subacromial decompression. Mean follow-up was 38 months (range, 24–50). Average ASES scores improved from 42 preoperatively to 93 postoperatively. Pain level and satisfaction scores were significantly improved in all patients.

In 2009, Kamath *et al*. [30] reported on 42 cases which underwent arthroscopic completion of a partial-thickness tear greater than 50% (5–6 mm) to a full-thickness tear with subsequent repair. There were 33 articular-sided tears and nine bursal-sided tears. All patients had a subacromial decompression. A total of 17 shoulders had concomitant procedures in addition to the rotator cuff repair. At the time of arthroscopy, if the tear involved is greater than 50% of the tendon thickness, the tendon was split longitudinally to verify the thickness. The tear was completed and either a single-row or double-row suture anchor repair was performed. The average ASES score improved from 46.1 preoperatively to 82.1 postoperatively. Overall patient satisfaction was 93%. In our study, we performed 50 cases of PTRCT. Acromioplasty had been done in all cases. We excluded cases of associated injuries. We completed the tear and used one or two anchors for repair. The average ASES score improved from 50 preoperatively to 90 postoperatively.

The higher frequency of associated synovitis reflects that this is likely to be an intraarticular pathology and would support the theory that PTRCTs begin on the articular side. It has been suggested PTRCT lesions more than 50% of the width of the tendon are best managed with surgical repair.

Conclusion

The use of spinal needle in arthroscopic repair of PTRCT facilitates the site of tear and as a guide for the healthy bursal side of the cuff. The limitations of our study included patient were highly selected regarding PTRCT and there was no postoperative imaging study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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