Outcome analysis of arthroscopic treatment of partial thickness rotator cuff tears

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ABSTRACT

Background: Partial thickness rotator cuff tears occupy an important position in the spectrum of rotator cuff disease. The development of a more comprehensive classification has been sought to address both the tear location and extent, which may influence clinical results. The purpose of this study is to classify partial thickness rotator cuff tears according to the arthroscopic findings and to evaluate the clinical outcomes after arthroscopic repair of partial thickness tears.

Materials and Methods: One hundred and two patients had arthroscopic treatment of partial thickness rotator cuff tears. The inclusion criterion for the study was a partially torn supraspinatus tendon involving articular or bursal side, verified by direct arthroscopic visualization. Outcome analysis was exclusively applied to patients who underwent transtendon repair, using the shoulder index of American Shoulder and Elbow Society and the University of California Los Angeles (UCLA) rating system.

Results: Partial thickness rotator cuff tears were divided into five groups according to arthroscopic findings. There was significant improvement after surgery in all parameters of clinical evaluation in the tears that warranted repair. Arthroscopic repair in situ (transtendon technique) may be the preferred option in unstable partial thickness tear.

Conclusion: The proposed classification system may assist decision making in the treatment of partial thickness rotator cuff tears.

Key words: Arthroscopic repair, partial thickness tears, rotator cuff, shoulder joint

MeSH terms: Arthroscopy, rotator cuff, shoulder, tears

INTRODUCTION

Partial thickness rotator cuff tears (PTRCT) occupy an important position in the spectrum of rotator cuff disease.1,2 According to the available literature, both prevalence and incidence are considerable in the general population. Patients with these tears typically present clinically with shoulder pain and dysfunction. Several classification systems have been previously established.1,3 Recently, the development of a more comprehensive classification has been proposed to address both the tear location and extent, which may influence clinical results.4 An improved classification system should be developed to provide more guidance for management. We retrospectively reviewed 102 patients with PTRCT and classified the tears into subgroups according to arthroscopic findings. Clinical outcomes were evaluated subsequent to arthroscopic inspection.

MATERIALS AND METHODS

102 patients had arthroscopic treatment of PTRCT between May 2004 and December 2006. The inclusion criterion was a partially torn supraspinatus tendon involving articular or bursal side, verified by direct arthroscopic visualization. Patients with full thickness tears, rheumatoid disease and previous surgery were excluded. The type of injuries included sports related (n = 22), military training (n = 13), heavy labor (n = 28), fall (n = 11), motor vehicle accident (MVA) (n = 4), and others (n = 24). Shoulder instability or SLAP lesion was noted in 26 cases.

The average age of patients was 47 years (range 21-63 years). Fifty three patients were male and 49 were females. The average followup period was 30 months (range 18-45 months). The indication for arthroscopic surgery was persistent pain despite a minimum of 3 months of nonoperative treatment including physiotherapy and/or corticosteroid injection.
Arthroscopic technique
All arthroscopic surgeries were performed by a single surgeon (OSK) under general anesthesia in the lateral decubitus position. The rotator cuff was examined from both articular and bursal sides with a linear measuring probe notched in 1-mm increments. Configuration of the tear was described and documented in the operative record. A standard posterior viewing portal was established and inspection was performed. After identification of the tear, frayed, unstable edges were debrided back to stable, healthy margins with a full radius resector. Size and depth of the tear were discerned using a probe. A suture marker (No. 1 nylon) was inserted to identify the relationship between articular and bursal sided tears. Attention was turned to the subacromial space and a complete bursectomy was performed to obtain better visualization for suture management. The arthroscope was reintroduced into the glenohumeral joint through the posterior portal. Tears demonstrating any footprint compromise were repaired with either a transtendinous technique (articular sided tear) or bursal side based repair (bursal sided tear). For bursal sided tears, unless three fourth width tendon violation was present, native tissue was preserved and completion of the tear was not performed. After localization of the ideal position for anchor placement, a stab incision was made just off the lateral edge of the acromion. A double-loaded suture anchor (BioCorkscrew; Arthrex, Naples, FL, USA) was inserted via this portal and advanced into the greater tuberosity to effect repair of the footprint.

Once the anchor was fixed in the desired position, the suture limbs were advanced into the glenohumeral joint with a sheath from the articular sided tears and they were retrieved through the anterior cannula. The medial portion of the tear was pierced with an 18-gauge spinal needle for passing a shuttling suture (No. 1 nylon). Strand by strand, each limb of the suture was retrieved with the utility loop and brought back into the subacromial space to effect a horizontal mattress pattern. The arthroscope was then advanced into the subacromial space to check suture placement. Before tensioning the suture limbs from the articular side, another suture anchor was inserted for repair of any concomitant bursal sided tears, if present. Bursal sided tears had anchors placed while viewing from the subacromial space with sutures shuttled through the remaining cuff edge. Articular sutures were tied first, followed by those from the bursal side. The arthroscope was returned to the glenohumeral joint to verify a near-anatomic final reduction of the cuff.

**RESULTS**
Outcomes analysis was exclusively applied to patients who underwent transtendon repair. Patients were analyzed preoperatively and postoperatively using Visual Analogue Scale (VAS), range of motion including forward flexion and external rotation side, the shoulder index of American Shoulder and Elbow Society (ASES), and the University of California Los Angeles (UCLA) rating system.

| Classification of partial thickness tears |
|-----------------------------------------|
| Type I | Fraying or fibrillation |
| Type II | Fiber disruption |
| Type III | Flap formation or fragmentation |
| Type IV | Both sides tears |
| Type V | Impending full thickness tear |

PTRCT were divided into five types according to the arthroscopic inspection and probing. Type I included fraying or fibrillation on either side of the cuff [Figure 1]. These minimally involved lesions were simply debrided with a motorized shaver or a radio frequency device to provide a smooth surface of the cuff. Type II was evidenced by fiber disruption of the cuff on either the articular or bursal side. There was no overt footprint violation with the tear defect occurring longitudinally. This tear was inherently unstable and tendon-to-tendon repair was performed with nonabsorbable suture [Figures 2 and 3]. Type III revealed flap formation or fragmentation of the cuff with footprint violation. These tears were usually unstable and repaired with a transtendon technique for articular tear and tendon-to-bone fixation for bursal tear [Figures 4 and 5]. In both cases, native tissue was not taken down. Type IV tears demonstrated tissue disruption involving both articular and bursal sides [Figures 6]. However, significant thickness of tendon remained and no communication between the tears could be probed. In cases of the unstable Type IV tear with 75% or less tendon violation, repair was attempted to both articular and bursal sides simultaneously with a transtendon technique for the articular component. Type V involved considerable thickness of the cuff and was a nearly a complete tear, which was completed and repaired as a full-thickness tear.

![Figure 1: Arthroscopic view showing fraying or fibrillation on articular side of the cuff (Type I)](image-url)
Clinical outcomes
Clinical outcomes were analyzed exclusively in 34 patients who had repair with transtendon technique. Postoperative shoulder pain and function scores were significantly improved compared with preoperative values. After the arthroscopic repair of partial tears, the mean UCLA and ASES scores significantly improved from 17.9 and 32.7 points to 31.1 and 47.1 points, respectively. Followup evaluation using the UCLA scale showed excellent results in 16 patients, good results in 15 patients, and fair results in 3 patients.

Discussion
PTRCT have been recognized as one of the most common pathologies of the shoulder. Fukuda described that these conditions occupy a significant proportion in the spectrum of rotator cuff disease. PTRCT usually cause persistent pain and disability in the general population. There are several established classifications described in the literature. Ellman 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. Synder 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 PTRCT, previous classifications cannot reflect every configuration of the partial tears. A more comprehensive and useful classification is required to influence the assessment of treatment options and outcomes by addressing both tear location and extent. Our classification was designed on the basis of arthroscopic findings, and delineated the location and configuration of tears. Although this classification does not completely reflect the biological or biomechanical aspects of the tears, we believe that this simplified classification will be useful in decision making during the arthroscopic treatment of PTRCT.

Weber reported significantly worse outcomes in patients treated with acromioplasty only and recommended rotator...
cuff repair in grade 3 partial tears. Others advocate rotator cuff repair in patients with extensive partial thickness tears. We exclusively reviewed 34 patients who had unstable tears repaired with a transtendon technique to assess the clinical outcomes. We excluded low grade partial tears (Type I or II) because current treatment recommendations do not typically involve repair. Good clinical outcomes were obtained in our midterm followup study. These results are important in both subjective improvement of the patients and delay in propagation of partial tears to larger tears.

Previous papers have advocated completion of partial tears into complete tears and repair them as full thickness tears. However, according to reports of the biomechanical properties of rotator cuff tears, partial thickness tears could maintain strength even if the tear involved up to one-third of the entire thickness. Completion and repair is not without consequence and may lead to damage to normal tissue, alteration of the normal footprint, and tension-length mismatch of the cuff. Regarding tear propagation, once a tear manifests, its size usually increases and propagates with time, and eventually larger tears result. There is minimal or no spontaneous healing potential in rotator cuff tears. Rotator cuff tears generally produce an inadequate healing process. Followup studies of partial tears demonstrate a substantial rate of incomplete or limited healing. Our review results show that partial-thickness tears should be repaired if clinical disabilities are present preoperatively and repair in situ will lead to predictably good results. However, to the best of our knowledge, no randomized studies have addressed the results of in situ repair versus tear completion followed by repair.

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. Due 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 our classification system.

Although the relationship between the types of tear and factors such as age and occupation was not truly evaluated in the study, a wide range of age distribution and the wide variety of tear pattern in this study suggest that the etiology of partial tears may be attributable to diverse biomechanical factors such as repetitive motion and tensile overloading applied in a varying fashion.

In the past, partial thickness tears were considered to be fiber disruption and not simply fraying or irregularity of the cuff surface. Some young active patients engaged in overhead activities showed not only anterior or superior labral lesions but also articular sided partial tears that, on further evaluation, were fraying of fibrillation of the tendon without involving significant thickness of the cuff. Undersurface cuff fraying is seen in internal impingement and may be a significant pain generator. We believe that partial tears with even minimal depth have clinical significance and deserve to be included in the classification scheme.

Our study does have several limitations. This classification system does not reflect intratendinous tears or delaminations which might coexist with articular or bursal sided tears because this design is based on arthroscopic inspection, and not cross-sectional imaging. Additionally, we do not have clinical outcome measures on patients who underwent debridement alone for Type I or II or completion and repair for Type V. Finally, this is not a prospective randomized study of repair technique, but rather a report of results of a single-surgeon series. Further the limitation of current study is that current classification was designed by author’s own experience and decision based on arthroscopic findings so that it did not reflect tendon quality such as mobility.

To conclude, various tear patterns can be detected in the evaluation of PTRCT. These are likely attributable to both histological and biomechanical factors of the rotator cuff tendon. A wide range of age distribution in partial tears suggests that varying mechanisms are involved in their pathogenesis. Based upon our results, favorable clinical results can be expected in midterm followup after arthroscopic repair of significant partial tears of the rotator cuff involving the footprint. Arthroscopic repair in situ (transtendon technique) is our preferred option in unstable partial thickness articular tears. Our classification system may assist decision making.
in the treatment of PTRCT. We introduce the concept of concomitant articular and bursal tearing (Type IV). However, a multicentric randomized controlled study is required to classify and treat partial thickness rotator cuff tears.

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