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ORIGINAL ARTICLE

Interstitial tears of the rotator cuff: difficulty in preoperative diagnosis

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Background: Few studies have investigated the characteristic findings of preoperative magnetic resonance imaging (MRI) and the clinical and radiologic outcomes of interstitial tear of the rotator cuff treated with arthroscopic repair after tear completion.
Methods: Forty-one patients (14 men and 27 women; mean age, 56.5 years) with arthroscopically confirmed interstitial tears underwent single-row repair after tear completion. The minimum follow-up period was 2 years.
Results: Twenty-eight patients (68.3%) were properly evaluated with MRI before surgery. Seven cases (17.1%) were misdiagnosed as bursal-sided tears and 5 cases (12.2%) were misdiagnosed as articular-sided tears on the basis of presurgical MRI findings. Arthroscopy revealed fibrillation and dimpling of the tendon surface in all cases and congestion within the defect in 36 cases (87.8%). At the final follow-up, the visual analog scale score for pain during motion decreased to 0.8 from a preoperative mean of 6.1 ($P < .001$). Moreover, at the final follow-up, the mean University of California–Los Angeles score and Constant score improved from 15.7 and 51.8 to 32.1 and 83.8, respectively ($P < .001$ for all). At 9 months after surgery, MRI revealed no cases of retear.
Conclusion: Interstitial tears are difficult to diagnose before surgery because MRI findings may lead to the misdiagnosis of interstitial tears as articular- or bursal-sided tears. If MRI-based diagnosis is indicative of articular- or bursal-sided tears but arthroscopy reveals fibrillation and dimpling of the tendon surface, interstitial tears should be suspected. The defective sites in interstitial tears are usually accompanied by congestion.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Shoulder; partial-thickness rotator cuff tear; interstitial tear; arthroscopy; rotator cuff repair; concealed lesion

Along with advancements in imaging modalities and arthroscopic techniques, the rate of diagnosis of partial-thickness rotator cuff tears has also increased and gained attention.[1,11,12,20,21,24,25] Ellman[6] presented a classification of partial-thickness rotator cuff tears based on location (articular, bursal, or interstitial). Despite various existing

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studies,[7,8,14,16,22,24,27] definitive incidence of partial-thickness rotator cuff tears remains unclear.

Some studies on the incidence of partial-thickness tears have been published.[7,8,14,16,24] Epidemiologic data from a cadaveric study showed a different result from the prevalence reported in a clinical study.[8,16,24] Fukuda[8] studied 249 cadaveric shoulders and found partial-thickness supraspinatus tears in 13%, with bursal-sided tears in 18%, interstitial tears in 55%, and articular-sided tears in 27%. However, clinical studies revealed lower rates of interstitial tears than those reported in the cadaveric study.[8,16,24] Park et al[16] explained that the prevalance of interstitial tears was only 4.7% among arthroscopically confirmed partial-thickness tears. As interstitial tears are more difficult to diagnose than articular- or bursal-sided tears, the incidence of interstitial tears differs between cadaveric and clinical studies. Therefore, the true incidence of partial-thickness tears may be higher than that currently documented in the literature.[14]

Interstitial tears are difficult to diagnose with magnetic resonance imaging (MRI) owing to their concealed nature. Uchiyama et al[24] suggested that no single imaging technique is ideal for diagnosis of interstitial tears, including ultrasound and MRI. Their study showed that only intraoperative findings could provide a definitive diagnosis of interstitial tears. The sensitivity of ultrasound and MRI for interstitial tears was 26.7% and 63.6%, respectively. Therefore, preoperative confirmation of interstitial lesions using MRI is still difficult because of the lack of connection between the articular and bursal spaces. Owing to these diagnostic challenges, little has been written about the clinical outcomes of interstitial tears.[24]

The purpose of this study was to evaluate the characteristic findings of preoperative MRI and the clinical and radiologic outcomes of interstitial tears treated with arthroscopic repair after tear completion. Our hypothesis was that interstitial tears could be misdiagnosed as articular- or bursal-sided tears when only MRI was used. Positive clinical and radiologic outcomes were expected after arthroscopic repair after tear completion.

Materials and methods

This study was retrospective in nature.

Patient selection

A total of 761 patients (769 shoulders) who underwent arthroscopic rotator cuff repair between June 2012 and December 2014 were evaluated. The inclusion criteria in this study were interstitial tears on arthroscopy, conservative management for >3 months, primary rotator cuff repair after tear completion, and minimum follow-up of at least 24 months (range, 24-55 months). The exclusion criteria included full-thickness rotator cuff tears; partial rotator cuff tears other than interstitial tears; and any associated lesions, such as subscapularis tear, acromioclavicular arthritis, Bankart lesion, or superior labral anterior-posterior lesion.

Arthroscopic diagnosis and surgical technique

All arthroscopic procedures were performed with the patient in the beach chair position and under general anesthesia. The procedure was performed by the senior author. The glenohumeral joint was evaluated through a standard posterior portal. A diagnostic intra-articular examination was performed. In all cases, there were no articular-sided rotator cuff tears. The arthroscope was then inserted into the subacromial space through the posterior portal. A lateral portal was created as a working portal, and a posterolateral portal was created just behind the posterolateral corner of the acromion to provide a Grand Canyon view. Although definitive tears of the rotator cuff tendon were not observed on arthroscopy, interstitial tears were suspected as follows: if fibrillation was present on the superficial layer of the tendon and the tendon was thin; if a slight dent was present; or if congestion around the lesion was observed on arthroscopy. The pinching test and ballooning test[13] were performed as diagnostic tests. Between June 2012 and March 2013, a pinching test was performed on 9 patients. Between April 2013 and December 2014, both the pinching test and the ballooning test were performed on 32 patients, based on the previous literature in which the ballooning test was introduced. The pinching test showed the presence of a weak area when the tendon was pinched with a retriever (Fig. 1). The ballooning test showed bloating of the tendon

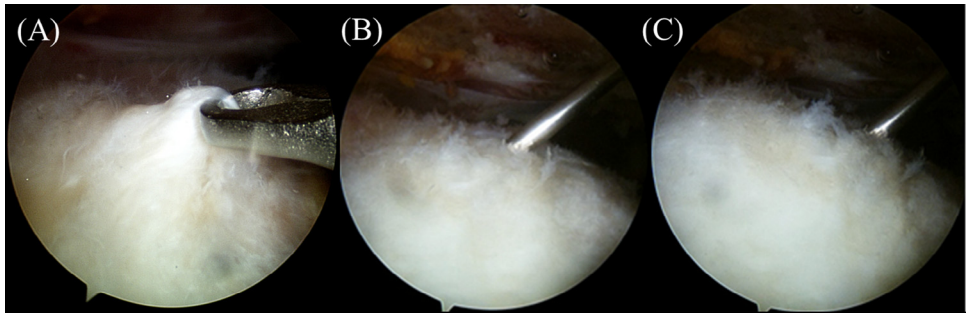

Figure 1 Pinching test (**A**) and ballooning test[13] (**B** and **C**). (**A**) The weak area of the tendon was pinched with a retriever. (**B**) Site of suspected lesion before the ballooning test. (**C**) Injection of saline caused the tendon to bloat at the site of the lesion.