SURGICAL TECHNIQUE

Arthroscopic Suture Bridge Technique for Intratendinous Tear of Rotator Cuff in Chronically Painful Calcific Tendinitis of the Shoulder

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Arthroscopic removal, now the main treatment option, has almost replaced open surgery for treatment of resistant calcific tendinitis. In some cases of chronic calcific tendinitis of the shoulder, the calcific materials are hard and adherent to the tendon. Removal of these materials can cause significant intratendinous tears between the superficial and deep layers of the degenerated rotator cuff. Thus far, there are no established surgical techniques for removing the calcific materials while ensuring cuff integrity. Good clinical results for rotator cuff repair were achieved by using an arthroscopic suture bridge technique in patients with long-standing calcific tendinitis. Intact rotator cuff integrity and recovery of signal change on follow-up magnetic resonance imaging scans were confirmed. This is a technical note about a surgical technique and its clinical results with a review of relevant published reports.

Key words: Calcific tendinitis; Intratendinous tear; Shoulder; Suture bridge technique

Introduction

Calcific tendinitis of the rotator cuff is a relatively common shoulder condition (some studies report a 2.5% incidence) of uncertain cause¹. Around 90% of cases are self-limiting and respond to a conservative regime of non-steroidal medication and physiotherapy¹. For the other 10%, there are wide ranges of treatment options². If conservative treatment fails, leading to symptom progression and constant pain that interferes with activities of daily life, the usual approach is surgical intervention. Arthroscopic removal, now the main treatment option, has almost replaced open surgery for treatment of resistant calcific tendinitis.

During arthroscopic debridement of chronic, hard, calcific materials that are adherent to the cuff, some patients develop significant (>2 cm) partial rotator cuff tears (intratendinous defect) which, if it not treated, may progress to the full thickness tears. Partial-thickness rotator cuff tears include articular side tears, bursal side tears and intratendinous tear^{3,4}. When there is a defect in a tendon after removal of calcific deposits, Gartsman recommends not repairing the tendon because of possible subsequent development of shoulder

stiffness. Fukuda pointed out that arthroscopy has technical limitations when there is a deep intratendinous extension³. We here describe our treatment technique for patients with chronic and persistent calcific tendinitis in which we use an arthroscopic suture bridge technique for repairing bursal side tears with deep intratendinous extensions that develop consequent on removal of calcific deposits.

Surgical Technique

Under general anesthesia, the patient is placed in a lateral position and lateral arm traction of approximately 4.5 kg applied using a traction device. The patient's systolic blood pressure is maintained at approximately 100–110 mm Hg. In order to prevent joint swelling and make it easy to change the arthroscopic portal from the articular side to the subacromial space, the pressure of the arthroscopic pump is maintained at 40–50 mm Hg. An arthroscope is inserted into the glenohumeral joint through a posterior portal and diagnostic arthroscopy performed. The arthroscope is then removed from the glenohumeral joint and redirected into the subacromial space. Following confirmation of calcific deposits, an 18-gauge spinal

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Fig. 1 Following confirmation of calcific materials, an 18-gauge spinal needle is percutaneously inserted just medial to the location of the calcific deposits.

needle is percutaneously inserted just medial to the location of those deposits (Fig. 1), after which the arthroscope is reintroduced into the glenohumeral joint. At this time, a suitable insertion site for anchor insertion is marked near the humeral head with a spinal needle, following which an anchor (TwinFix Ti, Smith and Nephew, Andover, MA, USA) is passed through the anterior portal or intact cuff depending on the location of the calcific materials.

Similar to the trans-tendon repair technique for partial articular supraspinatus tendon avulsion lesions, a suture anchor is inserted into the articular surface just below the rotator cuff insertion (Fig. 2A). Each monofilament suture (nylon no. 1-0) is passed to and then pulled through the anterior portal. Subsequently, each of the four strands inserted on the anchor are shuttled and repassed through the rotator cuff using a nylon suture. Next, the arthroscope is moved to the subacromial space and the location of the threads of the suture anchor confirmed. At this time, it is easy to exactly locate the calcific deposits, which are immediately lateral to the four strands. The anterior and posterior margins of the calcific deposits are located, after which a meniscus knife or arthroscopic scissor is used to remove the rotator cuff from the cuff insertion (Fig. 2B). The calcific deposits are palpated and evacuated under the cuff using a probe and shaver. Finally, a large intra-substance cuff defect is developed. After the medial row has been sutured, a suture bridge technique is used to repair the large intra substance cuff defect: this repair is performed in an X-shaped fashion (Fig. 2C). This is followed by sealing and compression of the intra-substance cuff defect, similarly to the repair procedure for intratendinous tear.

Fig. 2 Arthroscopic views and diagrams showing (A) the medial row is first sutured, (B) following which a large bursal side tear with a deep intratendinous extension is developed for removing the calcific deposits (C) A suture bridge technique is used to repair the large intrasubstance cuff defect after (D) repaired cuff defect with no damage to humeral head insertion and intact cuff.

Fig. 3 (A) Pre-operative MRI of the shoulder showing calcified thickening of supraspinatus tendon and focal subacromial and sub-deltoid bursal fluid on coronal T₂ fat-suppression image, suggesting calcific tendinitis and bursitis. (B) Post-operative MRI revealing no evidence of calcific materials in the supraspinatus tendon on coronal T₂ fat-suppression image and also showing fibrosis and some thickening of the rotator cuff tendon.

Following this, an arthroscope is again inserted into the glenohumeral joint and no further damage to the articular cartilage of the humeral head and articular side of the rotator cuff confirmed (Fig. 2D). Two days after surgery, passive range of motion (ROM) and pendulum exercises are started and, in the fourth postoperative week, full active ROM exercises are permitted.

Clinical Results

Inclusion criteria for this were calcific tendinopathy diagnosed on clinical grounds, duration of symptoms of at least 6 months, inadequate response to nonoperative management (including nonsteroidal anti-inflammatory drugs, physiotherapy and rest) and calcific tendinopathy of the rotator cuff found at the time of surgery. Patients with degenerative changes in the glenohumeral or acromioclavicular joint, sonographic evidence of a rotator cuff tear, acute sub-acromial bursitis or any neurogenic disorder were excluded. The only absolute contraindications to this surgical procedure are active infection and inflammatory arthropathy. Noncompliant patients who will not cooperate with the postoperative protocols of continuous passive ROM and dedicated rehabilitation should not be considered for this procedure. Our Institutional Review Board approved this study and all patients signed written informed consent agreements to participate.

The study consisted of 12 patients (eight women, four men), with an average age of 44 years (range, 34–60 years). The time between onset of symptoms and indications for surgery was 6–38 months (average, 13 months). Preoperative radiographs of the affected shoulders of all patients were taken in five positions: anteroposterior views in neutral, internal, and external rotation; a lateral view in the scapular plane; and an axillary view.

In the 12 cases the postoperative mean ROM was as follows: forward flexion 162.7°, abduction 157.4°, external

rotation at side 30.8° and internal rotation at back T₁₀ level. Postoperative radiography was performed to determine the amount of calcium removed surgically. Three months postoperatively, all patients underwent magnetic resonance imaging (MRI) of the affected shoulder to determine the status of rotator cuff repair. These postoperative MRIs showed fibrosis and some thickening of rotator cuff tendons in all patients with no evidence of calcific materials in the supraspinatus tendon on coronal T₂ fat-suppression images (Fig. 3). During follow-up, no complications, such as subcutaneous hematoma, infection or hyperesthesia, occurred, and no secondary surgery was required by any patient. However, two patients without any motion limitation prior to surgery developed stiffness that was relieved within 3–9 months of surgery with the assistance of subacromial or intra-articular steroid injections and non-steroidal anti-inflammatory drugs.

Discussion

Traditionally, it was thought that calcifying tendinitis progresses through distinct stages, as described by Uhthoff and Loehr⁵, and that the tendon always reconstitutes after calcium deposit removal. Neer and Marberrey recommended excision of the calcifying tendon as “a quarter orange” without performing complementary suturing⁶. Recent evidence, however, suggests that spontaneous healing of the tendon does not always occur and the cyclical natural history can be interrupted at any stage of the disease. Seil *et al.* found that 2 years following surgery 65% of patients had persistent discrete flattening of the tendon on ultrasound⁷. The incidence of persistent rotator cuff defects following surgery is reportedly 25%, 7% having persistent pain. This is more common following removal of large (>2 cm) deposits. Some surgeons therefore recommend a primary side-to-side repair of the rotator cuff defect if the residual defect following excision is large⁸. At present, there are no definitive surgical guidelines for

restoring and maintaining the integrity of the rotator cuff or treating newly developed large bursal side tears with deep intratendinous extensions after calcific deposit removal.

In our series, the average age was 44 years (range, 34–60 years) and there was a longer duration of painful shoulder associated with conventional calcific tendinitis in which conservative modes of treatment have failed. We treated 12 patients with calcific tendinitis and used an arthroscopic suture bridge technique for repairing the intra-tendinous tears of the rotator cuff tendons after calcific material removal. During arthroscopic debridement, needling on the cuff over the calcific materials can cause extrusion of calcific material as a paste, depending upon the consistency of that material. In some chronic cases, the calcific material is so hard that its removal requires excision of the rotator cuff. In older patients, we speculate that such damaged cuffs (bursal side tears with deep intratendinous extensions) can develop into more serious problems, such as full thickness tears.

No wisely-accepted suture techniques have been reported for surgical treatment of intratendinous tears after the calcific deposit removal, except for the suturing following conversion to a full-thickness tear and the intra-tendinous repair developed by Conway⁹. Suturing following conversion from a partial to a full-thickness tear is problematic because

it can damage the remaining fibers of the rotator cuff and reconstruction to a normal footprint is difficult. Some authors have described a technique using non-absorbable mattress sutures for percutaneous intratendinous repair of articular side delaminated partial thickness tears¹⁰. With this surgical technique, the cuff tendon substance cannot easily be sutured, footprint reconstruction is difficult and intratendinous tears of the rotator cuff after removal of calcific material cannot be repaired. Fukuda reported that the distal ends of a tear continue locally disrupt the normal four transitional layers of the tendon insertions³. Therefore, in our cases, after we had reconstructed the medial footprint using a trans-tendon repair technique, we attempted to reconstruct the anatomical footprint of the rotator cuff on the greater tuberosity by reconstructing a lateral row using a suture bridge technique. The advantages of this approach are that healing can be induced by compression as well as by sealing the large defect after the removal of calcific material: it does not excessively pull the tendon for the repair into the greater tuberosity and restores the anatomical footprint of the rotator cuff. We believe this arthroscopic suture-bridge fixation method can be used for successful treatment of rotator cuff tears in patients with chronic and persistent calcific tendinitis of the shoulder.

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