Suprascapular Neuropathy Associated with Massive Rotator Cuff Tears: A Rationale for Arthroscopic Rotator Cuff Repair

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INTRODUCTION

Massive rotator cuff tears may be present in patients with minimal pain and good function, or in patients with significant pain and disability. In the latter case, arthroscopic repair, either partial or complete, has been demonstrated to improve function. The mechanism of recovery is believed to be associated with an improved rotator cuff function due to at least partial healing of the posterior portion of the tendon repair. However, retear after repair of a massive tear has been shown to be common.

Recently, it has been suggested that a consequence of tendon tearing and retraction is traction on the suprascapular nerve (SSN) with the result being suprascapular nerve dysfunction (SSND) presenting as pain and weakness (Figs. 1A and B). The anatomy of the suprascapular nerve has been well described by others who have emphasized the relatively fixed position of the nerve as it passes beneath the transverse scapular ligament, thus making it especially prone to injury. In addition, previous studies have demonstrated the limits of lateral advancement of the rotator cuff before placing these neurovascular structures at risk during operative repair.

It has been suggested that improved pain and function despite radiographic evidence of a failed rotator cuff repair may be the result of complete or partial decompression of a tethered suprascapular nerve. In a prospective series of eight consecutive patients with massive rotator cuff tears, Albritton and coworkers reported that all patients had evidence of suprascapular nerve dysfunction with severe limitation of active motion and pain. Half of the patients elected for partial arthroscopic rotator cuff repair with significant improvement in function at an average sixteen month followup. Vad examined the prevalence of peripheral neurologic injuries in twenty-five patients with full-thickness tears of the rotator cuff associated with shoulder muscle atrophy. He noted a 28% prevalence of peripheral neuropathy, primarily involving the axillary and suprascapular nerves in patients with full-thickness rotator cuff tears.

The purpose of our study was to test two hypotheses:

Hypothesis #1: SSND is not uncommonly associated with massive rotator cuff tears.

Hypothesis #2: Arthroscopic repair of massive rotator cuff tear in patients with SSND will result in improved pain and function which will correlate with recovery of SSND.

Figure 1A. Suprascapular nerve traction at the suprascapular notch with medial retraction of supraspinatus tendon (From Albritton et al. J Shoulder and Elbow. 12:497-500, 2003).

Figure 1B. Suprascapular nerve traction around the base of the spine of the scapula occurring with medial and inferior retraction of a torn infraspinatus tendon.

Figure 2A. Magnetic resonance imaging of a massive rotator cuff tear in the coronal plane. There is superior displacement of the humeral head and medial tendon retraction.

Figure 2B. Magnetic resonance imaging in the oblique sagittal plane demonstrates moderate-severe fatty replacement of both the supraspinatus and infraspinatus muscles.
METHODS

STUDY COHORT

Over a thirteen-month period, twenty-six of two hundred sixteen patients with rotator cuff tears requiring surgery were identified to have massive tears in association with retraction and moderate to severe fatty muscle atrophy of the supraspinatus and infraspinatus (Figs. 2A and B). All patients had pain as well as marked abduction and external rotation weakness (Figs. 3A-D). This group of patients was consistent in that all demonstrated a significant lag between passive and active flexion and external rotation, which has been noted as the hallmark of a massive postero-superior rotator cuff tear.

Electrodiagnostic evaluation consisting of electromyography (EMG) and nerve conduction velocity (NCV) was performed on all twenty-six patients by one experienced neurologist blinded to clinical information about each patient. This included motor and sensory nerve studies of radial, median, and ulnar nerves as well as motor studies of the suprascapular and axillary nerves.

Demographic data were collected on patient history including mechanism of injury and duration of symptoms (Table I). Selection for surgical treatment was based on pain and or weakness and limited function. Patients analyzed in this study were those with weakness, pain, and electromyographic evidence of suprascapular nerve injury (Fig. 4). All patients completed standardized questionnaires and underwent physical examination with careful attention to active and passive motion and strength.

SURGICAL PROCEDURE AND REHABILITATION

Arthroscopic surgery was performed with the patient in a Beach-chair position (Tenet Tmax Beach Chair, Tenet Medical Engineering, Calgary, CN) following interscalene nerve block and administration of parenteral prophylactic antibiotics. An articulated hydraulic arm holder facilitated positioning of the arm for arthroscopy and arthroscopic rotator cuff repair (Spider Arm Holder, Tenet Medical Engineering, Calgary, CN). (Fig. 5).

Routine arthroscopic evaluation was performed in order to rule out comorbid pathology followed by a modified acromioplasty. Care was taken to preserve the coracoacromial liga- ment so as to prevent the risk of increased superior displacement of the humeral head by removal of this stabilizing barrier.

In all cases, a massive rotator cuff tear with marked medial and inferior retraction of the supraspinatus and infraspinatus
The seven patients with isolated suprascapular nerve injury consisted of six men and one woman. One patient was found to have an irreparable rotator cuff tear and was therefore not included in the analysis of this paper. This patient later underwent a latissimus dorsi transfer. The preoperative patient data on the remaining six patients is summarized in Table I. Preoperative and postoperative function are summarized in Table II.

In the six patients who underwent surgery, five were men and one was a woman; all sustained their injury from a traumatic fall. The average duration of time that elapsed from the date of injury to surgery was 8 months (range 2-12). There were three right and three left shoulders, and 83% affected the dominant extremity. One patient had undergone a prior failed open rotator cuff repair. The mean age was 57.3 years (range 41-73). All patients had pain as well as weakness and lag signs consistent with a massive rotator cuff tear. Average active flexion was 117° (range 70-140°) and active external rotation was 16° (range -20-50°). The average difference between passive and active external rotation with the arm at the side was 28° (range 15-50°). This constitutes the degree of external rotation lag (Table II).

In the six patients who had a tendon tear which could be partially or completely repaired, the tear involved the entire supraspinatus and infraspinatus and had a maximum diameter in the anterior-posterior dimension of greater than 5 cm. Tendon quality was such that repair of the posterior component, the infraspinatus, was possible after arthroscopic release. The infraspinatus tendon was then repaired to the superior and posterior greater tuberosity, thus transposing it superiorly and laterally. In one case, an associated margin-convergence closure was possible by repairing the infraspinatus to the supraspinatus.

In the six patients who underwent either partial or complete arthroscopic repair, follow-up EMG/NCV after six months demonstrated recovery of the suprascapular nerve palsy that correlated with complete pain relief and marked improvement in function at one year minimum follow-up (Figs. 8A-C).

**Table II. Patient function before and after surgical repair of tendon.**

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<th>PER</th>
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<th>ER STR.</th>
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26 (7%) had an associated upper trunk brachial plexus injury, and 1 of 26 (4%) had a cervical radiculopathy.
DISCUSSION

Although this is a retrospective study, we were able to identify a specific cohort of patients who had a massive rotator cuff tear in association with SSND. This association has been recognized previously by Albritton and coworkers; however, the incidence of this condition has not been clearly defined.\textsuperscript{1,2}

Our experience was that over a period of time slightly greater than one year, 7 of 216 patients (3\%) had this condition. If one further narrows this down to a cohort of patients with massive tendon tears and fatty muscle replacement, then the incidence is much higher (7 of 26 or 38\%). This would suggest that the degree of tendon retraction may be a cause of SSND through traction on the nerve either at the scapular notch or around the base of the spine of the scapula (Fig. 1). Albritton and coworkers suggested this phenomenon from their anatomic studies.\textsuperscript{1}

We also observed that all of our seven patients with a massive rotator cuff tear and SSND had in common a traumatic fall associated with the onset of symptoms. Therefore, it is possible that SSND occurs as a sudden event due to a traumatic tendon tear with marked retraction.

We also observed an association of other peripheral nerve lesions with massive rotator cuff tear including axillary neuropathy, brachial plexopathy, and cervical radiculopathy. Vad and coworkers\textsuperscript{37} had also observed this phenomenon.

Based on our observation of a high incidence of SSND with massive rotator cuff tears, we were able to validate our first hypothesis that SSND is associated with massive rotator cuff tears. Furthermore, it would seem that routine electrodiagnostic analysis is a reasonable component of preoperative evaluation in these patients.

We were also able to validate the second hypothesis in our study as arthroscopic repair of the massive rotator cuff tears significantly improved function and pain in our patients, and this correlated with electrical recovery of SSND after a minimum of four months following arthroscopic repair. We believe that this recovery principally occurred by relieving tension on the suprascapular nerve as it courses around the base of the spine of the scapula. Since the infraspinatus is repaired in a more superior and lateral position, the nerve is moved laterally away from the scapula spine around which is tethered (Fig. 9). We also believe this may be an explanation for the success of partial repair of a massive rotator cuff tear since the neurogenic cause of pain and weakness is relieved with the repair. This supports Burkhart’s concept of partial arthroscopic repair of massive rotator cuff tears.\textsuperscript{8,11}

From our observations we now recommend obtaining an electrodiagnostic study in all patients with a massive rotator cuff tear and marked weakness of abduction and external rotation, especially if this follows a known trauma such as a fall. If the EMG and NCV analysis shows SSND, we believe arthroscopic repair is indicated since all of our patients had marked improvement of pain and function and this correlated with reversal of SSND.

\textbf{Figure 8A.} Postoperative EMG and NCV study showing recovery of the suprascapular nerve four months after arthroscopic partial tendon repair.
\textbf{Figure 8B.} Postoperative flexion in a patient (EB).
\textbf{Figure 8C.} Postoperative flexion in the same patient.