Feature Article

Rotator Cuff Tears and Associated Nerve Injuries

Treg D. Brown, MD
Peter M. Newton, MD
Scott P. Steinmann, MD
William N. Levine, MD
Louis U. Bigliani, MD

ABSTRACT

A series of 15 patients with concomitant rotator cuff tears and infraclavicular brachial plexus injuries treated between 1980 and 1989 were reviewed. There were 6 men and 9 women with a mean age of 65 years. Seventeen nerve injuries were identified, including 12 axillary nerves, 4 suprascapular nerves, and 1 musculocutaneous nerve. One patient had an injury to all three nerves. Thirteen patients underwent operative repair of the torn rotator cuff, and 2 patients who refused surgery were treated conservatively. The average time from injury to surgery was 7.7 months.

Follow-up averaged 5.5 years (range: 2-10 years).

Isolated rotator cuff tear is a common cause of shoulder disability, especially in the elderly patient. Anterior shoulder dislocation is associated with a high percentage of rotator cuff tears in patients >40 years. Neuropathies associated with shoulder trauma are a relatively infrequent cause of shoulder disability. Shoulder trauma resulting in a simultaneous rotator cuff tear and brachial plexus injury is an even rarer entity.

Differentiating between a rotator cuff tear and a neuropathy as the cause of shoulder disability can be difficult by physical examination alone as either the rotator cuff tear or the nerve injury may go undetected. To recognize the concomitant lesion, additional testing with arthrography, magnetic resonance imaging (MRI), or electromyography (EMG) is essential to help make the diagnosis. Presently, there is little information in the literature on such concomitant injuries.

This article describes the clinical presentation and treatment results of such patients.

MATERIALS AND METHODS

Between 1980 and 1989, a total of 15 patients (6 men and 9 women) with a coexisting rotator cuff tear and a neuropathy were treated at the New York Orthopaedic Hospital. In patients who underwent surgery, all nerve injuries were diagnosed prior to surgical treatment of the rotator cuff tear. Average patient age was 65 years (range: 39-78 years).

Eleven patients had an episode of acute trauma to the shoulder without a history of previous pain or immobility. Anterior shoulder dislocation was documented in 5 of these patients, with 1 patient sustaining a humeral head fracture dislocation. The other 6 patients had various mechanisms of trauma, the most common being falls on an outstretched hand. Four of the 15 patients could not recall an incident of acute trauma but rather described an insidious onset of shoulder pain.

All patients were examined by the
TABLE
Average Preoperative and Postoperative Clinical Results

<table>
<thead>
<tr>
<th></th>
<th>Preop</th>
<th>Postop</th>
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</thead>
<tbody>
<tr>
<td>Pain (scale 0-10)</td>
<td>7</td>
<td>2</td>
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<tr>
<td>Range of motion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward elevation</td>
<td>40</td>
<td>151</td>
</tr>
<tr>
<td>External rotation</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Internal rotation</td>
<td>1.5</td>
<td>9.9</td>
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<tr>
<td>Strength (grade 0-5)</td>
<td></td>
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</tr>
<tr>
<td>Forward elevation</td>
<td>2</td>
<td>3.5</td>
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<tr>
<td>External rotation</td>
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<td>3.5</td>
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The time interval between injury and EMG evaluation averaged 3 months (range: 1-6 months). Electromyography results demonstrated evidence of partial (13 nerves) or complete (4 nerves) denervation with fibrillation potentials, polyphasic motor-unit potentials, and positive sharp waves in the denervated muscles. Overall, there were 17 nerve injuries in 15 patients including 12 axillary nerves, 4 suprascapular nerves, and 1 musculocutaneous nerve. One patient sustained an injury to all three nerves.

Each patient had single contrast arthrogram of the shoulder to confirm the diagnosis of full-thickness rotator cuff tear. After a failed trial of physical therapy, 13 patients elected to undergo surgical repair of the rotator cuff within an average of 7.7 months from the time of injury. Surgical exploration found massive tears (>5 cm) in 9 patients, a large tear (>3 cm) in 1 patient, medium tears (1-3 cm) in 2 patients, and a small tear (<1 cm) in 1 patient. Mobilization of the massive and large tears involved difficult and lengthy soft-tissue releases.

All tears were repaired primarily without the need for interposition grafts. Thirteen patients underwent an acromioplasty, and 9 patients also had a modified acromioclavicular joint arthroplasty. One patient with a 3-year history of EMG-documented complete deltoid denervation underwent neurolysis of the axillary nerve in addition to the rotator cuff repair. In the other patients, the neuropathy was more recent onset and the nerve was not explored.

The 2 patients who declined surgery had no history of acute trauma; however, they did have significant weakness and pain at the initial presentation. Both patients had a clinical examination and arthrography suggesting a rotator cuff tear with a positive fluid sign and biceps rupture.

Postoperatively, all patients participated in a closely monitored physical therapy program. Patients were started on passive range of motion (ROM) exercises and also received additional electrical stimulation to the denervated muscle groups. Exercises progressed to active assisted and then active ROM as tendon healing and nerve recovery progressed. The final patient outcome was graded when patients had reached full recovery or their improvement had plateaued. All patients were examined for pain relief, strength, and ROM.

RESULTS
Follow-up ranged from 2 to 11 years (average: 5.5 years). Significant pain relief was achieved in all 13 (87%) patients treated surgically (Table). The 2 patients who elected for nonoperative treatment required >1 year of therapy before achieving significant pain relief.

Overall ROM increased to an average of 151° active forward elevation (range: 85°-165°) and 40° active external rotation (range: 10°-60°) (Table). The 3 patients with axillary nerve lesions averaged 100° of forward elevation.

The time required for maximal return of strength (after which time no additional strength improvement was noted) averaged 20 months (range: 4-48 months). Improvement in strength required longer periods of time compared with ROM and pain relief. Average strength of forward elevation and external rotation was grade 3.5. Four patients achieved a normal rating of grade 5. Three patients with axillary nerve injuries were grade 3.

There was no correlation between the degree of trauma, the size of the rotator cuff tear, or the type of coexisting nerve lesion. Of the 4 patients with suprascapular nerve palsy, 2 patients were treated conservatively and 2 surgically. One of the surgically treated patients had a massive tear whereas the other had a small tear. All 4 patients had significant improvement in function, achieving grade 4 to 5 motor strength and lacking only 15°-20° of forward elevation. The patient who underwent axillary neurolysis via anterior and posterior surgical approaches in addition to rotator cuff repair did well, achieving 165° of active forward.

Senior author (L.U.B.) and underwent follow-up until the completion of therapy. The dominant arm was involved in 7 of the 15 patients. Preoperatively, all patients had moderate to severe pain including 9 with significant night pain.

Active forward elevation and external rotation averaged 50° and 7°, respectively. Passive forward elevation averaged 165° with full elevation limited by pain. Motor power was recorded as: grade 0—complete paralysis, grade 1—flicker of contraction, grade 2—movement with gravity eliminated, grade 3—movement against gravity, grade 4—movement against gravity and some resistance, and grade 5—movement against powerful resistance (normal power).

Strength testing revealed significant weakness in all 15 patients. Forward elevation and external rotation muscle testing averaged grade 2, with 1 patient graded at 4 and 3 patients achieving a grade 3. Eight patients had evidence of significant atrophy of the spinati, and 5 patients demonstrated significant deltoid atrophy. Decreased sensation over the involved shoulder was detected in only 2 patients. Two patients had type III acromions on outlet radiographs; otherwise, radiographs (excluding acute dislocations) were normal.

All 15 patients underwent EMG and arthrography, with 8 having an arthrogram ordered during the initial consultation. In 5 patients, a neuropathy was primarily suspected, and EMGs were obtained prior to arthrograms.
elevation and 85° of active external rotation with a strength grade of 5 at 2 years of follow-up.

Nine patients underwent repeat EMG studies during rehabilitation. Five patients demonstrated either normal or near-normal activity at an average of 21 months after the initial presentation. The other 4 patients showed only mild improvement on the EMG; however, their tests were performed early in the rehabilitation period (average 14 months) and all improved clinically with further follow-up. Of the 4 patients with EMG-documented complete denervation at initial examination (3 axillary and 1 suprascapular), 2 patients with axillary nerve lesions had a full recovery, whereas the other 2 patients had only fair results at the final follow-up.

When combining the three parameters of ROM, strength, and pain relief, there were 60% good to excellent results, 40% fair results, and no poor results (Table). There were no complications from either the surgery or the physical therapy protocol and no patient required a second surgical procedure.

**Discussion**

There are few reports in the literature discussing the coexistence of rotator cuff tears and neuropathy. Kay et al. discussed the first case report of a simultaneous axillary nerve palsy and a full-thickness rotator cuff tear. Their patient responded well once surgical repair of the cuff tear was undertaken and physical therapy instituted. Kaplan and Kernahan presented a series of surgically treated patients including five patients with suprascapular neuropathy and a partial tear of the rotator cuff and one patient with a complete tear. Guven et al. commented on the rarity of this combined injury and coined the term “unhappy triad” to describe a patient with a combined rotator cuff tear and brachial plexus injury following a shoulder dislocation.

Neviaser et al. demonstrated that rotator cuff tear, not axillary nerve injury, is the most common cause of weakness and pain following dislocation in patients > 40 years. Only 7.8% of these patients had an axillary nerve lesion, whereas 100% had rotator cuff tears.

Blom and Dahlback reported on 73 consecutive patients with a humeral fracture or glenohumeral dislocation, all of whom had EMG studies of the deltoid. Twenty-six patients > 50 years had evidence of a neuropathy. Arthrography and MRI were not performed in any of the 73 patients so rotator cuff integrity is not known.

With these studies in mind, it would seem prudent to be suspicious of a rotator cuff tear or neuropathy occurring alone or concomitantly in the patient with unrelenting pain and weakness after shoulder trauma. Additionally, Neer cautions that a large number of patients who failed surgery for suprascapular nerve entrapment were subsequently found to have rotator cuff tears.

The suprascapular nerve is most prone to injury during falls on an outstretched hand, as well as blunt trauma to the top of the shoulder, due to its high position on the brachial plexus. Drez described the nerve as having a relatively fixed position at its origin off the brachial plexus as it passes through the suprascapular notch. During cadaver motion studies, Thompson and Kopell noted that extremes of motion rendered the nerve relatively taut. Most studies favor a traction neuropathy or axonotmesis as the major mechanism of injury that if severe enough, can lead to an Erbs palsy-like presentation in adults. Only two of the four patients with suprascapular neuropathy in our series had a history of acute trauma. Thompson and Kopell believed that it was often difficult to ascertain the role of trauma in such injuries.

The axillary nerve seems to be less susceptible to injury from falls on the outstretched hand. Blom and Dahlback, however, noted anterior dislocation is a relatively common shoulder injury that puts the axillary nerve at a high risk, especially in older patients. In our study, all 5 patients with anterior dislocation had involvement of the axillary nerve, with 4 of the 5 patients being > 60 years. Of interest, similar to the findings of Blom and Dahlback, only 2 of the 12 patients with axillary neuropathy had decreased sensation over the lateral shoulder.

The recommended treatment for patients with confirmed rotator cuff tear and brachial plexus palsy is uncertain due to the small number of cases reported in the literature. Our protocol was to surgically repair the rotator cuff tear as soon as possible without exploring the nerve lesion. This approach was elected because the majority of nerve injuries are neurapraxic. Physical therapy was started immediately postoperatively, including passive ROM and electrical stimulation of the denervated muscle groups. This treatment protocol resulted in spontaneous recovery of nerve function and gradual return of strength, with 60% of patients having good to excellent function. In only one patient with a 3-year history of complete deltoid denervation was surgical exploration of the nerve undertaken. Nonoperative treatment of infraclavicular brachial plexus palsy yielded similar results in a study by Jeffert and Seddon who believed operative release was rarely justified.

Several authors advocate early operative treatment of nerve entrapment. Bateman proposed surgery if no improvement in suprascapular or axillary nerve function occurred in 6-8 weeks, whereas Klein and Yoon et al. prefer operative release only after several months of conservative measures failed. Drez likewise believes that a 4 to 6 month period of conservative treatment is needed prior to surgical intervention. Most authors believe that electrical stimulation is valuable in preserving muscle tone while awaiting nerve recovery.

With the presence of both a rotator cuff tear and neuropathy, it is often difficult to analyze a patient’s poor therapeutic progress. Prolonged therapy is required in the majority of patients.
with a combined lesion before optimal results can be expected or surgical exploration of the nerve contemplated. The overall time period for stabilization of the nerve recovery in our 15 patients was prolonged and similar to that reported by Leffert and Seddon.14

Because many of the patients in this study did not seek medical treatment immediately after the precipitating traumatic incident, it is still unclear whether the acute or chronic repetitive trauma caused simultaneous injuries to both the rotator cuff and infraclavicular plexus. The elderly patients sustaining anterior glenohumeral dislocations were subjected to forces sufficient to result in a combined injury. In addition, some of these patients may have experienced an extension of a preexisting rotator cuff tear.

The clinical presentation for a neuropathy or rotator cuff tear can appear quite similar. Therefore, the orthopedic surgeon should be suspicious of a combined lesion in patients with continued pain and poor function, particularly in those patients having undergone an appropriate rehabilitation program. Relying on specific clinical signs to make the diagnosis is not always helpful.

Deltoid or spinati atrophy can occur with either a nerve or a rotator cuff lesion but was present in only 65% of the patients in this study. Additionally, loss of sensation over the lateral shoulder was not a reliable sign in the majority of patients. Electromyography can reliably identify these nerve lesions, whereas arthrography and MRI are useful tools for the diagnosis of rotator cuff tears.

In this series, the coexistence of a brachial plexus neuropathy and a rotator cuff tear was rare and responded well to operative repair of the rotator cuff and expectant management of the nerve lesion. The results are inferior, however, compared to isolated rotator cuff repair. Careful preoperative evaluation should be performed in patients with continued disability following trauma to the upper extremity.

REFERENCES