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Rotator Cuff Tears in Polytrauma - A Hidden Lesion

Charles S. Grimshaw, Lisa K. Cannada* and Scott Kaar

Department of Orthopaedic Surgery, Saint Louis University School of Medicine,3635 Vista Avenue,7th Floor, Desloge Towers, St. Louis, Missouri 63110, USA

Abstract

A rotator cuff tear in a polytraumatized patient can be a devastating injury if not identified early. Traumatic rotator cuff tears are often massive, and generally retract within a short period of time. If the tear is missed, the consequences are profound especially if the tear becomes irreparable and especially in the younger, more active population. These consequences include pseudoparalysis, persistent pain, and rotator cuff tear arthropathy. Specific examination of the polytraumatized patient with shoulder pain on secondary/tertiary survey should include a detailed assessment of the rotator cuff. Ultrasound has been advocated as a potential adjunct to MRI but most surgeons would agree that MRI is imaging study of choice for evaluation of the rotator cuff. The treatment of acute or acute on chronic traumatic rotator cuff tear in the polytraumatized patient should be early rotator cuff repair when the patient's medical status allows.

Keywords: Rotator cuff tear; Polytrauma

Introduction

The evaluation and management of orthopaedic injuries in the multiply injured patient is challenging despite the ever improving diagnostic tools at an orthopaedic surgeon's disposal. Often polytraumatized patients are intubated, non or partially responsive or even in extremis at the time of initial evaluation [1]. Management of orthopaedic injuries can be of lesser priority. With systematic diagnostic and therapeutic evaluation occurring during the initial acute resuscitative phase, life threatening and then limb threatening injuries are sequentially managed in accordance with Advanced Trauma Life Support (ATLS) protocols. Once these critical injuries have been addressed, a secondary survey is performed which consists of a thorough physical examination of the patient. All extremities are inspected and joints examined to identify any injuries not identified on the initial survey. Frequently if ecchymosis or swelling is visualized, tenderness/crepitus is elicited by palpation, or pain is subjectively noted then an x-ray is obtained to identify a bony injury. If there is no evidence of fracture, subluxation, or dislocation on the x-rays, the patient is assumed to have a soft tissue injury, and often no further diagnostic workup is performed in the acute setting. This is especially true in the obtunded/intubated patient or the patient with multiple fractures [2-5].

The management of the multiply injured patient with only two surveys has been shown to be inadequate in detecting all trauma [3,4,6,7]. Thus, a tertiary survey was developed to better evaluate patients in a more awake and alert state and has been shown to decrease the risk of patients leaving the hospital with undiagnosed injuries [3,4]. The rate of missed injury, however, in polytraumatized patients is still relatively high and has been shown to range from 1.3 to 39 percent depending on the definition of "missed" and the type of injury [7-9]. The spine [10], pelvis [7,8], and extremities [11-14] have been shown to have a relative predilection for missed injury and frequently the majority of missed injuries are attributable to clinical error in patient assessment [3,4,6-8].

A rotator cuff tear in a polytraumatized patient can be a devastating injury if not identified early. Unfortunately shoulder pain with negative x-rays is generally disregarded in the evaluation of the polytraumatized patient, especially in the face of other upper extremity fractures. (Patient A Figure 1a-1f).

Figure 1 Patient A, a 51 year old male, was involved in a motorcycle accident, sustaining numerous traumatic injuries including liver and renal lacerations, a pneumothorax requiring a chest tube, rib fractures, and fractures of his left hand and **a)** left distal radius. The patient complained of pain in his right shoulder but **b)** radiographs were obtained and read as normal. Undiagnosed at the time of the patient's initial hospitalization was a rotator cuff injury. After healing of his fractures 2 months post injury, the patient was referred to our clinic for persistent right shoulder pain and decreased range of motion. An MRI was obtained which revealed **c-f)** a massive rotator cuff tear.

Sorensen et al. [15] evaluated 104 patients with a median age of 49 years (range, 19-75 years). The patients were evaluated clinically and with ultrasonography at a median of 13 days after acute soft tissue shoulder trauma. Fifty eight percent of the patients had some degree of cuff lesion. Of these patients, 32% had a full-thickness rotator cuff tears.

Polytraumatized patients are often young and have active lives to lead once they recover. According to the 2010 National Trauma Data Bank Annual Report 37.4% of nearly 682,000 traumatic incidents occurred in patients age 25-54 with a nearly 3:1 ratio of males:females. Over 40% of these incidents resulted in patients having injury severity scores (ISS) greater than 9 with nearly 20% involving ISS greater than 16 [16]. Traumatic rotator cuff tears are often massive, and generally retract within a short period of time. This is in contradistinction to degenerative tears seen in the elderly population which are usually chronic. (Patient B Figure 2a-2h)

Figure 2 Patient B, a 64 year old male, was involved in a motor vehicle accident and sustained **a)** right humerus and **b)** right radius and ulna fractures. He was treated with **c,d)** ORIF of these fractures.

***Corresponding author:** Lisa K. Cannada, Department of Orthopaedic Surgery, Saint Louis University, 3635 Vista Ave, 7th Floor-Desloge Tower, St. Louis, MO 63110, USA, Tel: 314-577-8850; Fax: 314-268-5121; E-mail: lcannada@slu.edu

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The patient complained of right shoulder pain but no fractures were seen on his injury films and the pain was believed to be referred from his humerus. After healing of his fractures 4 months post fixation, the patient was referred to our clinic for persistent right shoulder pain and decreased range of motion despite a trial of physical therapy. An MRI was unable to be obtained due to indwelling hardware so a diagnostic arthroscopy was performed. At the time of arthroscopy **e-h)** a massive, irreparable rotator cuff tear was visualized.

Sequelae of untreated rotator cuff tears include loss of musculotendinous elasticity [17], myotendinous retraction [18-20], fatty infiltration [21], superior migration of the humeral head [22-25], and ultimately, rotator cuff arthropathy [19]. Small tears with little or no retraction have a tendency to remain small [26]. Large, reparable tears, however, usually increase in size and often become irreparable with no further increase in disability or pain [19,27]. A recent study showed that 50% of full thickness rotator cuff tears in patients less than 60 years old tended to increase in size if treated non-operatively [28]. In a study of 37 patients with acute traumatic rotator cuff tears, Basset et al showed decreased range of motion and decreased shoulder function in patients who were repaired greater than 3 weeks post injury when compared to patients repaired within 3 weeks of injury [29]. In their study 81% of the patients with acute traumatic tears were diagnosed with massive or large tears. Another recent study of 39 patients with traumatic cuff tears showed better range of motion and shoulder function scores in patients treated with acute rotator cuff repair (within 3 weeks) when compared to those treated delayed (after 3 weeks) because of a missed diagnosis [30]. Eighty-eight percent of these rotator cuff tears were classified as massive or large.

It is therefore important to determine the existence of a rotator cuff tear as soon as possible as there is a limited window of opportunity for repair of these lesions. If the tear is missed, the consequences are profound especially if the tear becomes irreparable and especially in the younger, more active population. These consequences include pseudoparalysis, persistent pain, and rotator cuff tear arthropathy [19].

Evaluation

After the initial resuscitation of the patient using ATLS protocol a secondary survey should be performed. Those patients who have sustained blunt trauma require assessment of all musculoskeletal regions. This includes description of wounds and gross deformity, evidence of tenderness to palpation, crepitus on range of motion of joints, neurologic function, distal pulses and capillary refill. Those areas that have suspected injury should be evaluated further with imaging studies, plain radiographs and/or CT scans as indicated. In those patients with multiple injuries on presentation, a tertiary survey should be performed when the patients are alert/awake. This should include another complete examination of the musculoskeletal system with further radiographic imaging if indicated [3,4,6,7].

Specific examination of the polytraumatized patient with shoulder pain on secondary/tertiary survey should include a detailed assessment of the rotator cuff. A rotator cuff tear can usually be diagnosed by physical examination alone in the awake and alert patient, however,

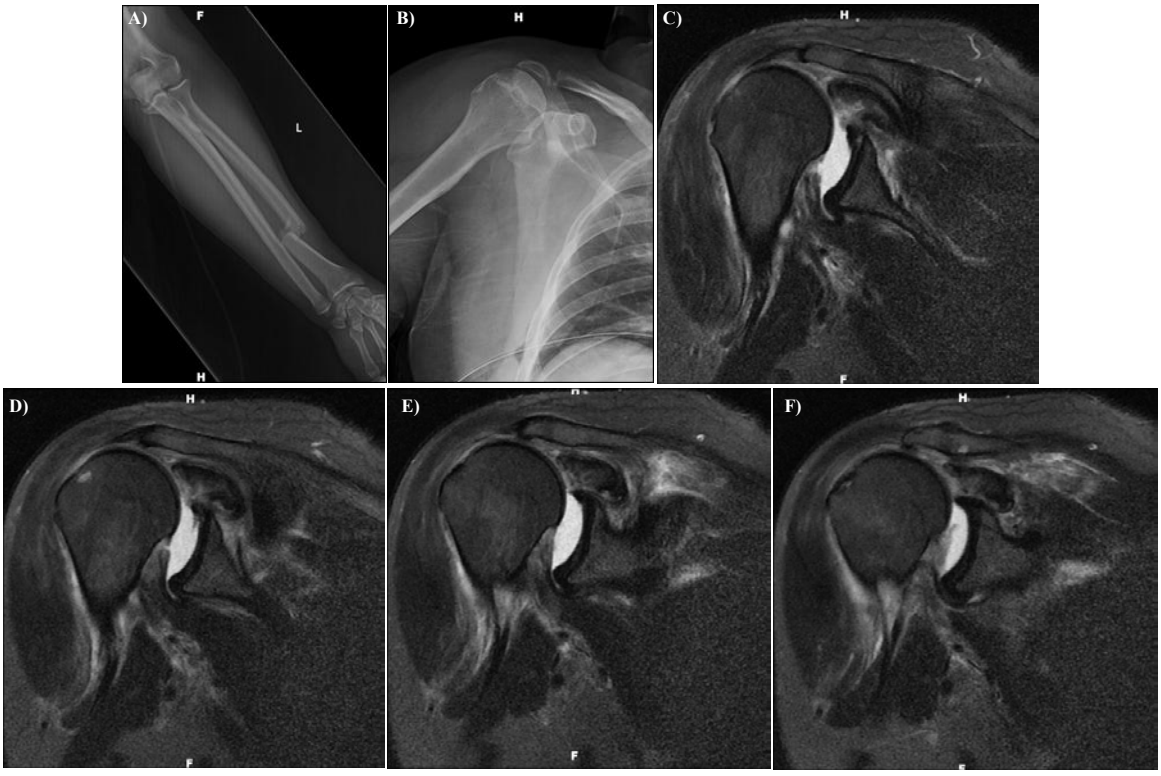

Figure 1: Patient A, a 51 year old male, was involved in a motorcycle accident, sustaining numerous traumatic injuries including liver and renal lacerations, a pneumothorax requiring a chest tube, rib fractures, and fractures of his left hand and **a)** left distal radius. The patient complained of pain in his right shoulder but **b)** radiographs were obtained and read as normal. Undiagnosed at the time of the patient's initial hospitalization was a rotator cuff injury. After healing of his fractures 2 months post injury, the patient was referred to our clinic for persistent right shoulder pain and decreased range of motion. An MRI was obtained which revealed **c-f)** a massive rotator cuff tear.

Figure 2: Patient B, a 64 year old male, was involved in a motor vehicle accident and sustained **a)** right humerus and **b)** right radius and ulna fractures. He was treated with **c,d)** ORIF of these fractures. The patient complained of right shoulder pain but no fractures were seen on his injury films and the pain was believed to be referred from his humerus. After healing of his fractures 4 months post fixation, the patient was referred to our clinic for persistent right shoulder pain and decreased range of motion despite a trial of physical therapy. An MRI was unable to be obtained due to indwelling hardware so a diagnostic arthroscopy was performed. At the time of arthroscopy **e-h)** a massive, irreparable rotator cuff tear was visualized.

this may not be possible in the obtunded/intubated patient. Traumatic injuries to the rotator cuff can present in the context of two settings. The first is acute traumatic rupture of the tendon. On inspection of the shoulder these patients will generally have evidence of ecchymosis and swelling of the anterior proximal arm with no evidence of muscular atrophy. The second setting is an acute on chronic tear. In addition to ecchymosis, inspection will often reveal evidence of supraspinatus with or without infraspinatus atrophy indicating chronic rotator cuff tearing. These patients may or may not detail a history of pain in the shoulder [31]. Codman's trauma theory postulates that trauma may rupture healthy tendons but that rupture from trauma occurs in the great majority of cases in aged tendons made weak by overuse, age, or toxic conditions [32].

A tear can occasionally be detected as a palpable defect in the supraspinatus tendon on the anterolateral aspect of the humeral head [33]. Strength testing is a key to the assessment and is usually diagnostic especially in the setting of a massive traumatic tear. As the multiply injured patient is usually lying supine on a bed when first evaluated, the Jobe empty can test, assessing shoulder abduction strength is not feasible. Testing of supraspinatus strength can be assessed by resisting the first 5 degrees of shoulder abduction from a position of full adduction or attempting to assess active elevation of the arm above 90 degrees. Often the patient with an acute massive tear will be unable to actively elevate the arm. Sorensen et al found that an inability to perform active abduction above 90° correlated with acute rotator cuff injury in over 50% of patients, one third of which involved a full thickness tear of one or more of the rotator cuff tendons [15]. The deltoid can occasionally mask supraspinatus weakness in abduction strength testing. Assessment of shoulder external and internal rotation weakness, however, is possible even in the face of other injuries in the upper extremity. An external rotation lag sign can be elicited by passively placing the arm in a position of maximal external rotation. When the patient is unable to hold the arm in this position and the hand/arm falls toward the abdomen this test is considered positive and the patient is assumed to have a massive rotator cuff tear involving the infraspinatus tendon. Another sign indicative of a massive tear is the hornblower's sign in which the patient is unable to externally rotate the shoulder and elevate the arm to touch his/her nose. While subscapularis tendon tears are less common, they can be identified by increased passive external rotation compared to the opposite extremity, and a positive lift off or belly press test [31].

A suprascapular nerve injury can also lead to the clinical picture of a massive acute rotator cuff injury [34,35] or be seen in conjunction with a massive rotator cuff tear [36,37]. In one report, 38% of 26 massive rotator cuff tears had evidence of suprascapular neuropathy [38]. In most cases the injury is a neuropraxia, however in the setting of penetrating trauma a laceration of the nerve is possible. Often, the patient has no or weak active abduction of the shoulder and MRI imaging is necessary to rule out a rotator cuff injury. Electromyographic and nerve conduction studies can be helpful in diagnosing a suprascapular nerve injury. Nerve compression or denervation should be suspected with increased fibrillation potentials, latency, and diminished amplitude [38,39]. Most of these patients recover their strength with physical therapy and observation [40]. In cases of delayed diagnosis and the presence of significant atrophy, however, motor strength may be irreversibly lost [41]. Thus, in a patient with structural compression

of the nerve associated with a massive rotator cuff tear or in a patient with a penetrating injury, operative treatment to decompress the nerve or repair a laceration is sometimes necessary [42].

A confounding factor in the evaluation of the rotator cuff in the setting of polytrauma is trauma of the cervical spine. Cervical spine trauma can present as pain in the shoulder and weakness of shoulder abduction, external, and internal rotation associated with spinal cord injury or injury to the C5 and C6 nerve roots. A complete neurologic examination must be performed to rule out cervical as well as other central nervous system causes of shoulder pain and weakness. Advanced imaging of the brain or cervical spine may be necessary in some cases during this evaluation.

Imaging

Radiographic evaluation of the shoulder in the polytraumatized patient should include a shoulder trauma series which consists of an AP, scapular Y, and axillary lateral images. While these are helpful in ruling out fracture or dislocation, in the setting of an acute traumatic rotator cuff tear these radiographs often demonstrate no abnormality except when a dislocation is noted on radiographs. Dislocation is associated with a more violent traumatic injury to the shoulder and massive rotator cuff tears can be seen in this setting, especially in patients of advanced age. Occasionally, radiographs in these cases will reveal evidence of a widened joint space due to interposition of the avulsed rotator cuff [43]. Berbig et al in a prospective evaluation found that 31% of 167 patients with primary traumatic anterior shoulder dislocations had full-thickness rotator cuff tears [44]. Another study showed a 35% rate of rotator cuff tear with anterior shoulder dislocation in skiers over 40 [45]. In addition, there is a case report in the literature describing a posterior dislocation associated with massive full thickness rotator cuff tear that required surgical repair [46].

Ultrasound has been advocated as a potential adjunct to MRI in the evaluation of rotator cuff tears. Many studies have validated the efficacy of ultrasound in the diagnosis of partial and full thickness tears of the rotator cuff [26,47-50]. Ultrasound accuracy in identifying and quantifying the size of partial thickness and full thickness cuff tears has been shown to be comparable to that of magnetic resonance imaging, with an overall reported accuracy of 87% at high volume institutions [47]. In one study Rutten et al used ultrasound to evaluate 50 patients referred for post-traumatic shoulder pain within a year of their injury and in whom no advanced imaging had been performed. 86% were found to have an associated rotator cuff tear, of which 54% had an undiagnosed proximal humerus fracture. Of these patients the ultrasound findings changed the working diagnosis in 74% and the therapeutic strategy in 52% [51]. Ultrasound can be especially useful in patients who for one reason or another (intubation, size, claustrophobia, metallic implant or foreign body, etc) are unable to obtain an MRI. It is easily performed in someone who is difficult to transport due to other injuries and there is the potential for it to be done at the bedside [47]. Another potential advantage when compared to MRI is that it can be reliably used with hardware in place in the proximal humerus. Limitations compared to MRI are in the definition of complex tear patterns, grading of fatty infiltration, user dependency, and identification of additional intra-articular pathology [48].

Most surgeons would agree that MRI is imaging study of choice for evaluation of the rotator cuff. MRI has been shown to be both highly sensitive and specific, with values ranging from 84% to 100% and 93% to 99% respectively, in various studies in the diagnosis of rotator cuff tears [29,47,52-57]. In addition MRI has been shown to be effective at defining tear characteristics like size [58] and amount of tendon retraction [59] muscle atrophy [60] degree fatty infiltration [61] and involvement of the biceps tendon [62]. It has been shown to be able to predict the reparability of massive tears [63]. Finally, MRI has been found to reliably predict rotator cuff tear pattern, thereby allowing surgeons to effectively prepare operative repair plans prior to entering into a surgical procedure [64].

Treatment

The treatment of acute or acute on chronic traumatic rotator cuff tear in the polytraumatized patient should be early rotator cuff repair when the patient's medical status allows. The timing of surgical repair must be coordinated with respect to the patient's associated injuries, and in many instances the priority of repair can be comparatively lower. Cooperating with the responsible general or trauma surgery service is essential to the effective management of the patient's injury. The primary goal for surgical intervention is to decrease pain and decrease the risk of the tear retraction. This leads to a tear becoming irreparable and eventual rotator cuff tear arthropathy. Surgery should repair the rotator cuff tendons to their anatomic proximal humeral insertion sites, thereby restoring function to the shoulder [65]. This is much easier to do if the tendons have not yet retracted and are easily mobilized. Early repair effectively prevents the late sequelae associated with chronic rotator cuff tears, namely atrophy, fatty infiltration, and tendon retraction that can make a tear irreparable. There is no definite evidence, however, as to when an acute rotator cuff tear must be repaired before it becomes irreparable. Peteresen et al. found no deficit in functional outcome regardless of tear size if the tear was repaired within four months of traumatic injury [66]. Similarly, Bjornsson et al. found no effect on outcome if the rotator cuff tear was repaired within 3 months of injury [67]. Studies by Basset et al. [29] and Hantes et al. [30] however, have shown decreased range of motion and decreased shoulder function in patients who are repaired greater than 3 weeks post injury when compared to patients repaired within 3 weeks of injury.

Repair can be undertaken in accordance with the surgeon's preference. Either an arthroscopic or open technique may be employed; there is no strong evidence that one technique is superior to the other [43]. With regards to fixation in the greater tuberosity, it is has been shown biomechanically that suture anchor fixation provides greater biomechanical strength than trans-osseous sutures [68,69] however clinical outcomes data does not mirror this biomechanical difference. Zumstein et al. prospectively evaluated twenty seven patients who underwent repair of a massive rotator cuff tear with transosseous sutures. Despite a retear rate of 37%, all patients reported good-to-excellent clinical result at mean 3 years follow up. At mean of nearly 10 years follow up the re-tear rate had risen to 57%, yet all but one patient remained satisfied with his/her outcome [70]. In direct comparison, at mean 3 year follow up, Galatz et al reported re-tear in 94% of 18 patients who underwent all arthroscopic massive rotator cuff tear repair with suture anchors. They also, however, reported improved functional outcome scores and 100% patient satisfaction [71].

The configuration of the suture anchors for repair is still debated and there are proponents of both single and double row fixation techniques [72]. While biomechanical studies of double row repair have shown increased load to failure, decreased gap formation, and improved contact area/pressures, clinical studies have not yet demonstrated a substantial improvement over single row repair with

either the degree of structural healing or functional outcomes [73-79]. Park et al. [80] showed that functional outcome scores following double-row repairs of tears greater than 3 cm were significantly better than those after single-row repairs. A randomized controlled trial of 60 patients by Franceschi et al. [81] showed no significant difference between double and single row repairs in range of motion or functional outcome at two years follow up. In a recent systematic review of the literature, however, analyzing 1252 repairs from 23 studies, retear rates for double-row repairs ranged from 7% for tears less than 1 cm to 41% for tears greater than 5 cm. In comparison, retear rates for single row and trans-osseous suture techniques were 17% to 69% respectively. No significant difference was found between trans-osseous suture repairs and single row suture anchor repair methods or between arthroscopic and non-arthroscopic approaches for any tear size [82]. There is, however, no clinical data that evaluates massive tears or those that are acute in the setting of a traumatic injury. Our preference in an early repair is to perform an arthroscopic repair with a double row suture anchor fixation technique.

If the injury is missed/discovered late, the tear should be treated similar to any other chronic rotator cuff tear. Status of the rotator cuff tear should be carried out with MRI evaluation to assess the reparability of the tear, the size of the tear and number of tendons involved, the amount of tendon retraction, and the associated atrophy and grade of fatty infiltration. If there is significant medial retraction present, the tear is of large or massive size and if there is any fatty infiltration present, patients should be counseled on how these risk factors might affect their potential outcome. Fatty infiltration beyond 50% [21] and/or superior migration of the humeral head resulting in an acromiohumeral distance of less than 7 mm [43], drastically lowers the probability that successful rotator cuff repair can be achieved as these tears are often irreparable. Aside from this, an attempt should be made to repair the tear coupled with subacromial decompression if there is evidence of outlet impingement. This may be carried out open or arthroscopically. An open technique may be preferred if the procedure is being done in conjunction with other procedures not involving the shoulder, if the amount of time the patient can tolerate anesthesia is limited, or if operating room positioning prohibits an arthroscopic technique. Also if the tear is chronic, retracted and requires significant mobilization, then some surgeons might prefer an open technique. (Patient A Figure 3)

Figure 3 Patient A underwent open rotator cuff repair at 4 months post injury. He was repaired using a double row suture anchor fixation technique.

Figure 3: Patient A underwent open rotator cuff repair at 4 months post injury. He was repaired using a double row suture anchor fixation technique.

Unlike in an early repair, mobilization of the rotator cuff tendon edges may be difficult and additional steps are needed to reduce the retracted tendons to their insertion site on the greater tuberosity. These additional steps may include lysis of subacromial adhesions [83-88], release of the rotator interval and coracohumeral ligament at the base of the coracoids [89-90], anterior and posterior interval slides [91-95], capsular release [90], and mobilization of the supraspinatus off the scapula which can allow for up to 3 cm of lateral advancement of the tendon [83,96].

In the event that the rotator cuff tear is not reparable in an elderly patient or one in which tendon transfers are not indicated, at the time of surgery a biceps tenotomy/tenodesis and a sub-acromial decompression or reverse decompression of the greater tuberosity should be considered for pain relief.

Walch et al. [97] reported on 307 patients who underwent biceps tenotomy for a massive rotator cuff tear and/or for refusal to participate in post repair rehabilitation. At mean 57 months follow up, functional outcome scores had significantly increased. While short term outcomes have been shown to be reasonable with arthroscopic debridement mainly due to relief from mechanical impingement pain rather than improved shoulder strength [98,99], long term outcomes have been mixed [99-105]. When performed, the integrity of the coracoacromial ligament must be preserved to prevent humeral head anterosuperior escape [106]. In an effort to maintain the coracoacromial arch, Fenlin et al. [107] described open debridement and tuberoplasty, reshaping the greater tuberosity and allowing it to smoothly articulate with the acromion. An alternative described by Scheibel et al. [106] involves debridement of the subacromial space and glenohumeral joint, with an associated arthroscopic tuberoplasty. Post-operatively rehab should focus on anterior deltoid strengthening exercises [109]. Patient B, who presented 4 months post injury with a massive irreparable rotator cuff tear, underwent subacromial decompression and biceps tenotomy.

The options in elderly patients who remain symptomatic despite failing less invasive procedures and adequate rehabilitation include arthroplasty options. For patients who can achieve 90° of forward elevation a hemiarthroplasty should be considered [110-115]. A glenoid component (total conventional shoulder arthroplasty) should not be implanted because of the high incidence of glenoid loosening by the "rocking horse phenomenon," which occurs with a deficient rotator cuff and relative loss of balanced forces in the coronal plane [110,116,117]. For the patient who cannot achieve 90° of forward elevation, a reverse total shoulder arthroplasty is considered [118-123]. When the teres minor is not intact, there may be persistent external rotation weakness following shoulder arthroplasty. Therefore a latissimus tendon transfer may be considered during the procedure to improve post-op external rotation [124-126]. (Patient A Figure 4a&4b)

Figure 4 Patient A continued to have significant pain despite his rotator cuff repair and gradually developed anterior superior escape. At four months post-op another MRI was obtained which demonstrated **a)** failure of his rotator cuff repair. The patient's pain and inability to use the shoulder persisted despite a deltoid strengthening physical therapy trial and at 1 year post-injury the patient underwent **b)** reverse total shoulder arthroplasty.

The surgical options for rotator cuff reconstruction are limited in the young, active patient. These include latissimus dorsi muscle transfer for posterior and superior rotator cuff deficiency (most commonly) [127-130], teres minor transfer [131], deltoid muscular

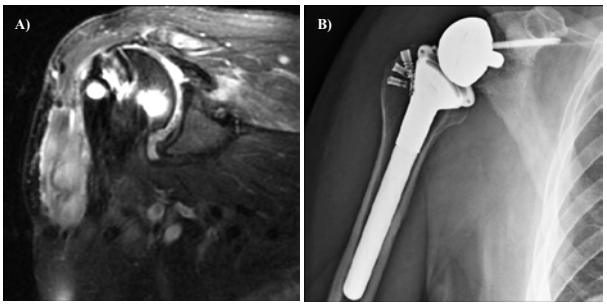

Figure 4: Patient A continued to have significant pain despite his rotator cuff repair and gradually developed anterior superior escape. At four months post-op another MRI was obtained which demonstrated **a)** failure of his rotator cuff repair. The patient's pain and inability to use the shoulder persisted despite a deltoid strengthening physical therapy trial and at 1 year post-injury the patient underwent **b)** reverse total shoulder arthroplasty.

flap transfer [131,132], and trapezius transfer [131,133]. In addition, pectoralis major tendon transfer may be indicated in the patient with a deficient subscapularis [131,134-138]. None of these options are ideal and despite a long post-op rehabilitation course, outcomes in terms of strength are unpredictable. The return of pre-injury strength and function is unlikely.

With all surgical treatment of rotator cuff injuries in the poly trauma patient, post-operative weight-bearing and rehabilitation is important. Standard post-operative rehabilitation protocols involve a period of sling immobilization and passive motion only [139]. Active motion is allowed followed by strengthening on a delayed basis [139-140]. The timing is dependent on the tear size, difficulty with tendon reapproximation and individual surgeon preference. Treatment of concomitant lower body injuries can have an effect on post-operative course. Although no specific guidelines exist, upper extremity weightbearing is discouraged in the acute healing phase of a rotator cuff repair. Patients may require an extended period of time in a wheelchair and with assistance for transfers in many cases to avoid rotator cuff repair site strain with crutch use.

Summary

Rotator cuff tears in multiply injured patients are easy to miss. Evaluation of the polytraumatized patient with shoulder pain should consist of radiographic imaging and a thorough physical examination. In the event that weakness is discovered with shoulder abduction or external rotation, the examiner should have a low threshold for advanced imaging with MRI or ultrasound. In the event that a tear is discovered, the rotator cuff should be repaired as soon as possible. Various open and arthroscopic repair techniques are acceptable. In these complex patients, there is no technique that can be universally used in all situations. Consequences of a missed untreated tear can be considerable and include an irreparable tear, pseudoparalysis and rotator cuff tear arthropathy. A symptomatic irreparable tear will lead to permanent disability with poorly tolerated functional deficits especially in the younger, active patient.

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