

# Rehabilitation of Acromioclavicular Joint Separations: Operative and Nonoperative Considerations

Mark P. Cote, PT, DPT<sup>a</sup>, Karen E. Wojcik, MSPT, ATC<sup>b</sup>,  
Gregg Gomlinski, MSPT, CSCS<sup>b</sup>, Augustus D. Mazzocca, MS, MD<sup>a,\*</sup>

## KEYWORDS

- Acromioclavicular joint • Acromioclavicular separation
- Rehabilitation approach

Acromioclavicular joint (AC) separations are one of the most common injuries seen in orthopedic and sports medicine practices, accounting for 9% of all injuries to the shoulder girdle.<sup>1-3</sup> Various operative and nonoperative treatment schemes have been described for the management of AC joint injuries.<sup>4-33</sup> Although considerable controversy exists over the efficacy of surgical reconstruction versus nonoperative intervention for grade III type injuries, grade I and II separations seem to respond favorably to conservative management. Conversely, grades IV, V, and VI often require surgical reconstruction. Regardless of the type of injury, rehabilitation as a part of conservative management and postoperative care plays an important role in the management of these injuries. This article presents the authors' rehabilitation approach to treatment of acromioclavicular separations pre- and postoperatively.

## CONCEPTUAL FRAMEWORK

To provide instruction and insight for rehabilitation clinicians, protocols are often provided for a specific injury or procedure. A protocol is a system of rules or procedures for a given situation. Although intended to be informative, protocols often result in a restrictive list of exercises and arbitrary time frames that a clinician is expected to

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<sup>a</sup> Department of Orthopaedic Surgery, University of Connecticut Health Center, Medical Arts & Research Building, Room 4017, 263 Farmington Avenue, Farmington, CT 06034, USA

<sup>b</sup> Department of Rehabilitation Services, University of Connecticut Health Center, Farmington, CT, USA

\* Corresponding author.

*E-mail address:* [admazzocca@yahoo.com](mailto:admazzocca@yahoo.com) (A.D. Mazzocca).

follow. It is the authors' experience that protocols tend to diminish a clinician's ability to provide quality patient care by discouraging critical thinking and clinical decision making by providing a predetermined set of care plans. Furthermore, protocols assume that each patient arrives at the same rehabilitation milestone at the same point in time.

When discussing the approach to rehabilitation the authors believe it is best to outline guidelines based on anatomy, pathoanatomy, and biologic healing for the progression of activities. Providing the rationale for rehabilitative services enables rehabilitation clinicians to use their entire skill set in a safe and efficient manner, thereby maximizing the quality of care provided to patients. Considering this conceptual approach to rehabilitation, the following rehabilitation guidelines are presented for the management of AC joint separations.

### **NONOPERATIVE MANAGEMENT**

Historically, grade I and II AC separations have been managed nonoperatively with periods of immobilization and rehabilitation.<sup>26-31</sup> Although nonoperative treatment is generally accepted as the treatment of choice for these injuries, evidence to support the efficacy of rehabilitation protocols is limited to case series (level IV) and expert opinion (level V). Mouhsine and colleagues<sup>27</sup> reported on 33 grade I and II AC separations treated conservatively with immobilization and physical therapy. At 6.3 years post treatment, the mean constant score was 82, with 17 of 33 subjects (52%) remaining asymptomatic. Of those patients with residual symptoms, 9 (27%) required surgical intervention to address continued pain and dysfunction.<sup>27</sup> Bergfeld and colleagues<sup>26</sup> examined the results of conservative treatment and the management of grade I and II AC separations in US Naval Academy shipmen. Their results demonstrated 30% of grade I and 42% of grade II separations presented with complaints of pain and clicking with push-ups and dips on follow-up. Furthermore, persistent pain and limitation of activities were present in 9% of type I and 23% of type II injuries.<sup>26</sup>

Literature to support the efficacy of specific rehabilitation protocols is also limited. Gladstone and colleagues<sup>28</sup> described a 4-part physical therapy protocol for the treatment of grade I, II, and III AC joint injuries in athletes. Phase 1 focuses on the elimination of pain and protection of the AC joint through sling immobilization (3–10 days), along with the prevention of muscular atrophy. Phase 2 consists of range of motion exercises to restore full mobility and a gradual progression of strengthening with the addition of isotonic exercise. Phase 3 involves advanced strengthening to enhance the dynamic stability of the AC joint. Phase 4 incorporates sport-specific training to prepare for a full return to prior level of activity.<sup>28</sup>

The guidelines set here follow those outlined by Gladstone and colleagues. The goal of rehabilitation is to return the patient to the previous level of activity. Return to full activity depends on how well the AC joint is able to function, which depends on the ability to maximize dynamic stability of the AC joint through strength training of the supporting muscles of the shoulder girdle and the avoidance of degenerative joint disease associated with these injuries. Advancements in rehabilitation programs are based on the reduction of pain and inflammation, restoration of range of motion, improvements in strength, and ability to perform sport-, work-, or function-specific tasks without limitations. These theoretic concepts form the basis of directing nonoperative care.

### **GRADE I**

A grade I separation involves a sprain of the AC ligaments without clavicle displacement, theoretically resulting in little insult to joint stability.<sup>1</sup> In this instance, the authors do not insist on a sling. If patients in the acute phases of injury are experiencing

significant pain and discomfort, a sling may be used to reduce stress on the AC joint to encourage cessation of pain and further inflammation. The criteria for discharge of the sling include the absence of pain with the arm at the side and during self-care activities. Early initiation of range of motion activities assists in reducing pain and inflammation and expedites discharge from the sling. Historically, a Kenny Howard sling has been advocated as an effective means of immobilizing the AC joint. However, problems associated with the device, specifically skin breakdown, have led many clinicians to discontinue its use.<sup>33,34</sup>

Mobility exercises are initiated within the first week of injury in an effort to decrease associated morbidity. Initial goals are to restore mobility by gradually progressing shoulder range of motion with supervised and home exercises and manual therapy techniques, specifically passive range of motion. Ranges of motion that may increase stress on the AC joint, specifically internal rotation (IR) behind the back, cross-body adduction, and end-range forward elevation, are approached cautiously and within a patient's own pain threshold; however, they are not expressly limited as stability is less of a concern than in higher-grade separations. Following a week of rehabilitation, restrictions in passive or active shoulder motion are uncommon. In patients with persistent limitations in shoulder mobility lasting greater than a week, concomitant or separate diagnoses should be considered.

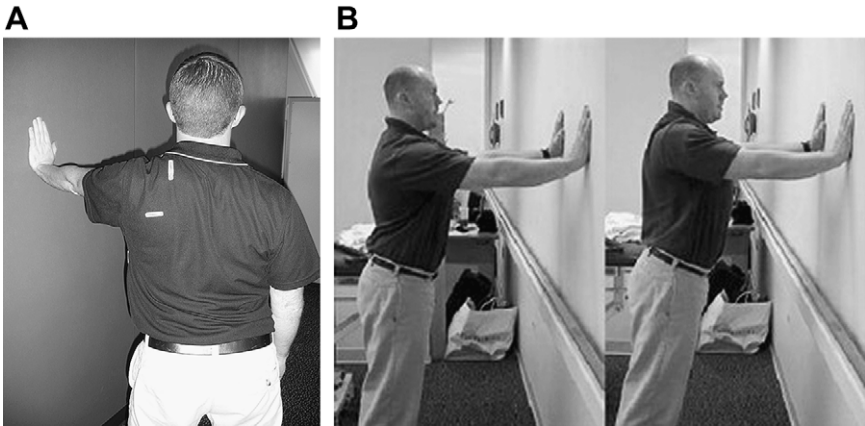
Strength exercise is begun immediately and progressed according to the patient's tolerance to activity. In the authors' experience, accelerating exercises by moving through acutely painful and stressful ranges of motions tends to encourage continued pain and inflammation, making it difficult if not impossible to maintain improvements in mobility or strength. By allowing exercises to be progressed within the guidelines of AC joint pain patients can maximize their own potential for progress.

Closed-chain scapular exercises similar to those described by Burkhart and colleagues<sup>35</sup> and McMullen and Uhl<sup>36</sup> are recommended as an introductory exercise to assist in isolating scapular movements. The term closed-chain refers to exercises in which the distal segment is fixed.<sup>37</sup> In shoulder rehabilitation, closed-chain exercises involve movements with the hand fixed to a wall, table, or floor. These exercises unload the weight of the arm, thereby minimizing the demand of the rotator cuff musculature to support the weight of the arm.<sup>36</sup> These exercises are adventitious as they allow patients to focus on quality, appropriate movements in a safe and pain-free manner. Examples of these exercises include scapular clocks (Fig. 1A) and scapular protraction and retraction on the wall (Fig. 1B).

The addition of isotonic and open-chain exercises can be made when the patient is able to maintain positions of forward elevation without pain or weakness. Exercise is progressed with isotonic strength exercises, focusing on the scapular and rotator cuff musculature, followed by sport-, work-, or function-specific training (Fig. 2). A return to sport or work activity that is dependent on symptom-free demonstration of task-specific activity can occur as early as 2 weeks.

## GRADE II

A grade II separation involves tearing of the AC ligaments, potentially resulting in anteroposterior movement of the clavicle.<sup>1</sup> Grade II separations do not involve the coracoclavicular ligaments and thus superior to inferior displacement of the clavicle is less of a concern. Similar to grade I separations, grade II separations are only immobilized acutely to manage pain and inflammation. During this period of immobilization, the authors allow pain to guide sling use. In grade II separations some healing of the AC ligaments may occur. In the early periods of tissue healing, active range of motion



**Fig. 1.** Closed-chain exercises. Scapular clocks (A) scapular protraction/retraction against wall (B).

and self-care activities may be accompanied by pain, indicating the need for further protection with continued use of a sling. Following the cessation of pain at rest with the arm at the side and with self-care activities, immobilization is discontinued.

Given the tearing of the AC ligaments and the potential for increases in posterior to anterior movement of the clavicle, the authors suggest immediate initiation of scapular exercises, emphasizing retraction to provide dynamic stability to the AC joint. Several exercises for scapular retraction have been described.<sup>38–42</sup> In the author's experience, rehabilitation clinicians prescribe exercises based on the amount of selective muscle activity they produce. From this perspective, horizontal abduction with external rotation and prone horizontal extension with the arm at 100°<sup>43</sup> (Blackburn exercises, or "Ts" and "Ys") would seem desirable as they have been shown to elicit high levels of muscle activity of the middle and lower trapezius<sup>40</sup> (see **Fig. 2C**). These exercises have also been shown to produce high amounts of electromyographic activity of the supraspinatus and infraspinatus.<sup>44–46</sup> In addition, the positioning of the upper extremity creates a long lever arm, producing high amounts of stress in the AC joint, which makes these exercises less tolerable in the acute and subacute phases of injury.

The authors prefer to start with closed-chain scapular activities that are easily tolerated early in the postinjury period, allowing the patient to work on scapular strength and motion without provoking undesirable increases in symptoms. These exercises unload the weight of the upper extremity, allowing the patient to focus on isolating scapular motion. For example, patients performing a scapular clock positioned with their hand on the wall are instructed to position the scapula in depression or somewhere between 6:00 and 7:30 for a right shoulder and between 6:00 and 4:30 for a left shoulder. This exercise can be treated as an isometric activity by instructing the patient to maintain the position through sustained muscle contraction for 10 seconds or more depending on tolerance to the activity (**Fig. 3**).

Continued attention is paid toward the patient's ability to maintain scapular retraction as symptoms continue to abate. To advance this, rowing exercises with tubing or cable resistance are initiated to integrate combined motions of the upper extremity. Early integration of kinetic chain exercises is also recommended to enhance recovery of shoulder function and improve the patient's ability to produce and maintain scapular retraction. Based on the kinetic link model, these exercises combine leg and trunk

A



B



C



D



**Fig. 2.** (A) Closed-chain activities: scapular clocks, isometric low row. (B) Isotonic 3-level rowing. (C) Horizontal abduction with external rotation (physiotherapy ball T [left]) and prone horizontal extension with the arm at 100° (physiotherapy ball Y [right]). (D) Sports-specific exercise: disco exercise that may mimic overhead sport activities.



**Fig. 3.** Scapular clock exercise.

activity with shoulder motions to reinforce normally occurring movement patterns of the upper extremity.<sup>36,47</sup> The lawn-mower and disco motions are examples of commonly prescribed kinetic chain exercises (Fig. 4).

As the patient demonstrates increases in strength and the ability to tolerate activities with the arm extended in front of the body, horizontal abduction with external rotation and prone horizontal extension with the arm at  $100^\circ$  can be introduced into the exercise program (see Fig. 2C). The authors prefer to start these exercises with no weight with sets performed to fatigue (defined as the inability to correctly perform the exercise motion; patients may interpret fatigue as muscle failure). As patients demonstrate the ability to perform these exercises correctly without symptom provocation, weight may be added. Return to full activity can occur once the patient can demonstrate the ability to perform task-specific activity related to his or her sport or work.

### GRADE III

In considering treatment options for patients who have sustained grade III AC separations, consulting the literature reveals a lack of publications supporting one approach over another. This finding is evident in Spencer's<sup>48</sup> systematic review of the literature, in which comprehensive search strategies revealed studies with only low levels of evidence appropriate for data analysis. The results of this review supported nonoperative management over surgical reconstruction based primarily on the lack of definitive data demonstrating improved outcomes with operative treatment. Furthermore, higher complication rates, longer recovery, and increased time away from work and sport associated with operative management were offered as a rationale for conservative rehabilitation versus surgical intervention.<sup>48</sup> A recent systematic review by Ceccarelli and colleagues<sup>49</sup> revealed 640 articles regarding AC dislocation, only 5 of which were appropriate for data analysis. The results of that review led the



**Fig. 4.** Double-limb stance initiating lawn mower exercises with an overhead follow-through for work- or sport-specific motions, (*bottom*) advanced to single leg. Note the arm in the bottom image is in a protected position, or a sling can also be used to protect the healing AC joint.

investigators to conclude that although operative and nonoperative management produced comparable results, surgery was associated with higher rates of complications.<sup>49</sup> Nissen and Chatterjee<sup>50</sup> surveyed the American Orthopaedic Society for Sports Medicine (AOSSM) and approved Accreditation Council for Graduate Medical Education (ACGME) orthopedic program residency directors to determine practice preferences in the management of uncomplicated grade III separations; they found that more than 80% opt for conservative management.<sup>50</sup>

Grade III AC separations involve complete disruption of the acromioclavicular and coracoclavicular ligaments, resulting in 100% superior displacement of the clavicle.<sup>1</sup> Complete ligament rupture offers little or no potential for healing and thus immobilization is strictly used to reduce initial pain and inflammation. The authors suggest minimal immobilization and immediate initiation of rehabilitation to decrease pain and inflammation. Although sling use up to 4 weeks following grade III AC separations has been previously reported, patients should be encouraged to cease sling use as soon as their symptoms allow. The AC joint functions primarily through movement of the acromion on the stable strut of the clavicle, producing motion that contributes to total shoulder mobility. In grade III separations the stability of the AC joint is

significantly compromised. The loss of the acromioclavicular ligaments allows unopposed anterior to posterior movement of the clavicle, although the loss of integrity of the coracoclavicular ligaments produces superior displacement of the clavicle, which results in significant alterations in the attachment of the scapula to the clavicle. Treatment directed toward scapular stabilization is essential for successful management of grade III AC injuries nonoperatively.

The authors' standard of care is to treat all grade III AC separations with a 6- to 12-week trial of rehabilitation to maximize functional recovery (Fig 5). A 6- to 12-week period of rehabilitation is a valuable prognostic indicator for predicting ability to return to sport or work activity. In the authors' experience, patients who go on to need operative intervention typically demonstrate little to no response after 6 weeks

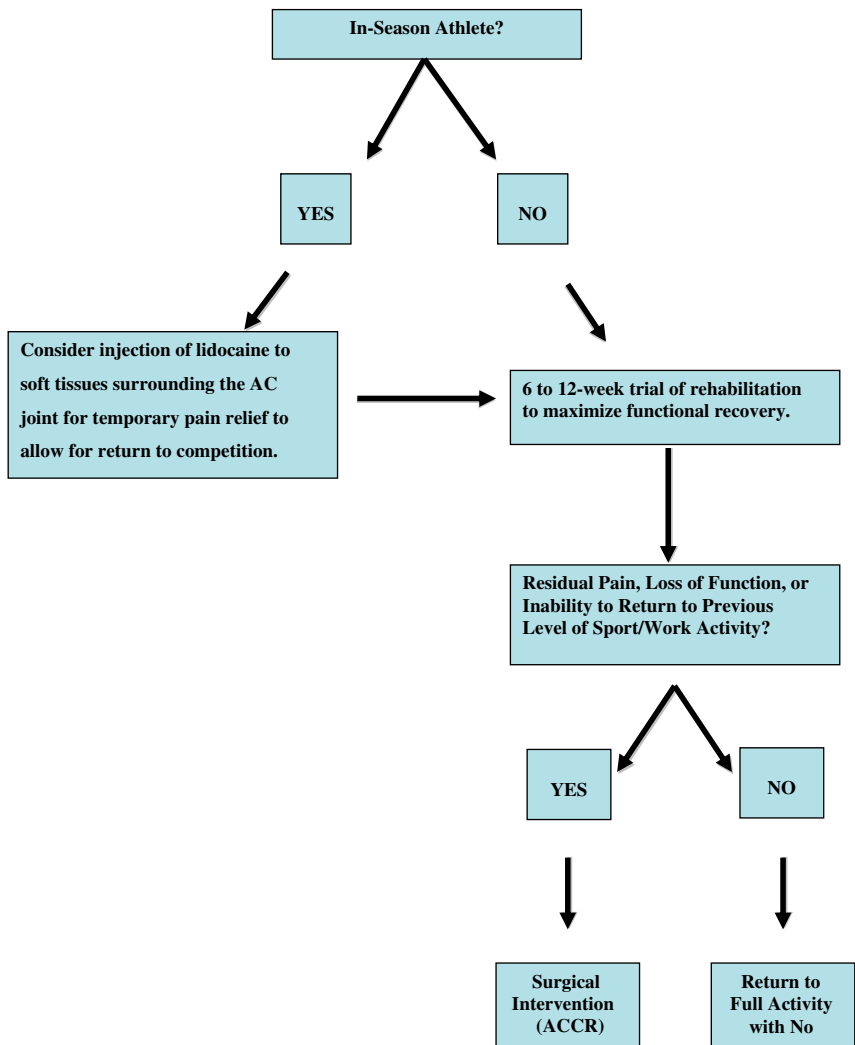


Fig. 5. Algorithmic approach to the management of grade III AC separations.



of rehabilitation. Conversely, those patients who have had a significant reduction in symptoms in the first 6 weeks are allowed to resume sport- or work-specific activities and are encouraged to continue rehabilitation up to 12 weeks. Provided a patient can safely perform required work or sport activity and has no activity-limiting pain, return to full activity is permitted. These patients, although successfully returning to their desired level of activity, require continued follow-up as functional decline may still occur. In these cases, rehabilitation is formally resumed and progressed accordingly. Those patients who are not responsive to rehabilitation either initially or as a result of continued relapse are offered operative intervention with anatomic coracoclavicular reconstruction (ACCR).

Those patients who continue with conservative care follow the same progression as described for grade II AC separations, starting with closed-chain exercises to improve scapular control, moving to combined motions with Thera-Band tubing (Hygenic Corporation, Akron, OH, USA) or cable resistance, and finally open-chain exercises and sport- or work-specific training. This progression is initiated immediately and progressed according to the patient's ability to tolerate exercise without provocation of symptoms. The amount of tissue trauma involved in grade III separations is greater than that associated with grades I and II, typically resulting in increased levels of pain and discomfort. In the acute and subacute phases of injury when these symptoms are typically present, lower extremity and core exercises focusing on kinetic chain strength and control are recommended as these exercises play a role in achieving scapular stabilization and can be performed with minimal or no use of the arm. These exercises can be later modified to incorporate the use of the shoulder as the patient's ability to tolerate upper extremity activities improve. As symptoms continue to subside and the ability to perform scapular exercise improves, advanced scapular exercises, such as Blackburn Ts and Ys can be initiated to maximize scapular strength.

Achieving and maintaining scapular control is imperative for successful nonoperative management. On physical examination, patients with grade III AC separations often present with alterations in scapula position and movement. Gumina and colleagues<sup>51</sup> evaluated scapular abnormalities in patients with chronic grade III AC separations. Scapular positioning statically and dynamically was assessed according to the Kibler rating system (scapular dyskinesis) and the Morgan grading scheme (SICK scapula [scapular malposition, inferior medial scapular winging, coracoid tenderness, and scapular dyskinesis]). Scapular dyskinesis was present in 70.6% of patients, of whom 58.3% had SICK scapula syndrome. Those patients with existing scapular dyskinesis demonstrated lower constant and simple shoulder scores. Similarly, in the authors' experience patients with persistent scapular abnormalities typically present with low outcome scores, having not responded to nonoperative rehabilitation.<sup>51</sup>

Several bracing options for facilitating and scapular retraction have been advocated. A clavicle or figure-of-eight brace has been used to retract the scapula manually. This brace can be useful for assisting in controlling excessive scapular protraction; however, assistance is typically required to don and doff it, often leading to poor tolerance. Newer options include the S3 brace, a shirtlike compression device that is secured with adjustable neoprene and Velcro straps designed in part to promote optimal scapular positioning. The S3 system can be a useful addition to a rehabilitation program, assisting patients in maintaining a retracted position of the scapula. Strapless posture apparel is also ideal for encouraging scapular retraction. IntelliSkin "proprio posture support" shirts use the same concepts as the S3 brace to promote posture and optimal scapular positioning.

## GRADES IV, V, VI

Grade IV, V, and VI AC separations are treated operatively with ACCR. The authors have had some incidental success with nonoperative management of grade V separations. Some patients who opt out of surgical reconstruction have followed the nonoperative guidelines with some success. There may be several reasons for this. First, these patients tend to be more than 55 years of age and are generally involved in activities that place low demand on the shoulder. Second, there may be some selection bias as these patients were resistant to operative intervention and self-selected a course of nonoperative management. The diagnostic criteria to distinguish between a grade III and grade V separation may inadvertently lead to a false-negative result. A grade V separation results in 300% displacement of the clavicle, whereas a grade III accounts for 100%.<sup>1</sup> In cases in which a clavicular displacement exceeds 100% the diagnosis of grade V may be made regardless of whether the displacement meets the 300% that defines a true grade V.

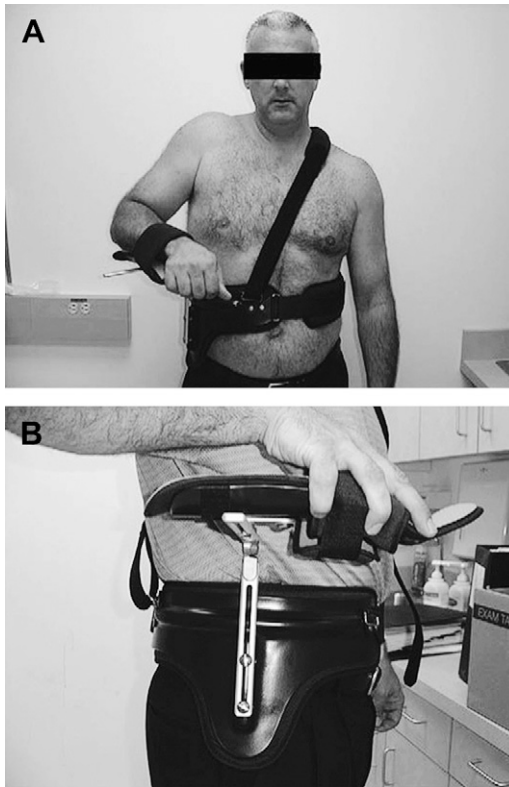
## POSTOPERATIVE REHABILITATION FOLLOWING ACCR

Patients with persistent symptoms and functional limitations recalcitrant to nonoperative rehabilitation are offered surgical intervention. Several operative procedures have been described for restoring stability to the AC joint, all of which require some form of biologic healing. Postoperative rehabilitation needs to be tailored according to tissue-healing time frames.

The senior author's preferred method of reconstruction is ACCR. The goal of this procedure is to restore the anatomy and return stability to the AC joint. This goal is accomplished by reconstructing the coracoclavicular ligaments with a soft-tissue allograft that is passed around the underside of the coracoid and up through 2 bone tunnels that have been drilled in the clavicle at the approximate insertion site of the native ligaments. Fixation is achieved using 2 interference anchors, 1 in each bone tunnel. By restoring the anatomy of the coracoclavicular ligaments the body is able to undergo the biologic healing process it was previously unable to achieve when the ligaments were completely torn. As patients enter the postoperative period, they are also just beginning the healing process.

The authors' guidelines for progression of activities following ACCR are based on the tissue-healing time frames on tendon healing in a bone tunnel. Rodeo and colleagues<sup>52</sup> examined healing response following the placement of a tendon graft in a bone tunnel in a canine model, and found construct failure through pull-out of the tendon from the tunnel on load-to-failure testing at 2, 4, and 8 weeks. At 12 weeks or more, failure occurred at the midsubstance of the tendon, indicating adequate healing at the bone-tendon interface.<sup>52</sup> Subsequent research has shown similar findings for tendon healing in a bone tunnel.<sup>53</sup>

Considering this research, guidelines have been developed for the progression of activities following ACCR. Preoperatively, patients are counseled in brace use and are taught a postoperative home program involving hand, wrist, and elbow exercise. Postoperatively patients are immobilized in a platform brace (Lerman Shoulder Orthosis, DonJoy Inc, Vista, CA, USA) for 6 to 8 weeks (Fig. 6). This brace allows for adequate unloading of the arm, thereby decreasing the amount of stress placed on the surgically reconstructed AC joint. This is an important facet of early postoperative management as the articulation between the clavicle and the acromion is the only link joining the upper extremity to the thorax. Patients are instructed to remain in the brace at all times other than during self-care and prescribed therapeutic activities. Following removal of the brace, patients are referred to rehabilitation for active

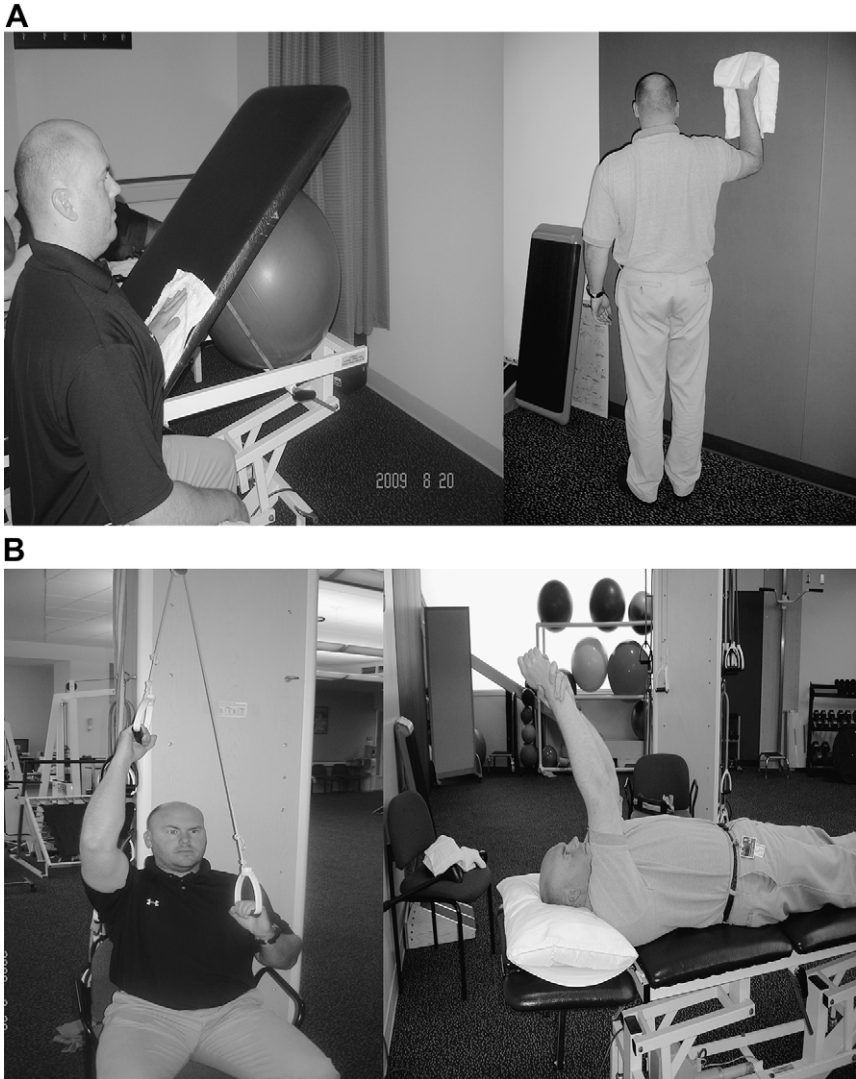


**Fig. 6.** Lerman brace (A, B).

assistive range of motion in all planes. The primary rationale for rehabilitation services is to manage the effects of 6 to 8 weeks of immobilization. Patients coming out of the brace tend to be stiff; however, because of the positioning of the Lerman device, which places the shoulder in external rotation, restrictions in mobility are not typically pronounced.

Similar to nonoperative management, motions that may increase stress on the AC joint, specifically IR behind the back, cross-body adduction, and end-range forward elevation, are approached cautiously and within a patient's own pain threshold. The authors prefer to initiate range of motion exercises with limb-supported activities like the table or wall slide. These closed-chain exercises have been shown to elicit low amounts of shoulder-muscle activity.<sup>54</sup> These exercises can be started on a flat surface and gradually progressed to inclined surfaces and finally a vertical surface. The addition of supine flexion and pulley exercises also assists in increasing forward elevation (**Fig. 7**). The authors' experience indicates patients respond favorably to this progression, as it allows the patient to increase the amount of muscle contribution gradually with each exercise.

In the authors' experience with ACCR procedure, mobility restrictions recalcitrant to rehabilitation have not been observed. At 10 weeks postoperatively, patients typically present with near full restoration of range of motion, lacking only the ability to perform IR behind the back. Stretching exercises behind the back like towel IR are allowed only if the patient can maintain scapular retraction while performing the exercise (**Fig. 8**).



**Fig. 7.** (A) A graduated table slide followed by a wall slide performed in the plane of the scapula. (B) Assisted forward elevation with a pulley and supine flexion.

This limitation in motion seems to be related to the mechanics of the AC joint rather than restrictions in glenohumeral joint mobility. Conventional capsular stretching of the glenohumeral joint is typically not needed.

All isotonic strength activities are withheld for 12 weeks because of concern about the ability of the surgical construct to tolerate a repetitively applied load. Closed-chain scapular exercises and kinetic chain activities are allowed starting at 8 weeks. These exercises are adventurous as they allow the patient to focus on scapular control and established movement patterns without creating excessive loads about the AC joint. They have also been shown to be effective in producing muscle activity in the scapular muscles in the early phases of shoulder rehabilitation.<sup>55</sup>



**Fig. 8.** Towel IR. (*Left*) Poor performance of the IR towel stretch and (*right*) good form (retracted scapula) during IR towel stretch.

From 12 to 18 weeks, exercise is progressed to include isotonic strength activities. The low row is an example of an exercise that transfers well from an isometric to an isotonic strength activity (**Fig. 9**). Multilevel rowing exercises focusing on combined motions with Thera-Band tubing or cable resistance are recommended (see **Fig. 2B**), in addition to continued integration of the legs and trunk, which improves function of the shoulder within the kinetic chain. Advanced strengthening such as



**Fig. 9.** Isometric low row followed by transition to isotonic low row.

Blackburn exercises can be integrated only after significant scapular control has been demonstrated.

## SUMMARY

Regardless of the grade of injury, rehabilitation plays an important role in the management of AC separations. Guidelines based on the anatomy, pathoanatomy, and potential for biologic healing enable rehabilitation clinicians to direct their services appropriately, resulting in optimal patient care. In nonoperative management the sequencing of exercise prescription should match the patient's ability to correctly perform and tolerate rehabilitation activities. Postoperatively, the biologic healing process involved in the surgical procedure needs to be considered with the time frames associated with healing to determine the appropriateness of various rehabilitation activities. With respect to the healing process, exercise can be progressed according to the same principles that guide nonoperative management to maximize patients' recovery from a significant AC joint injury.

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