The Unstable Shoulder,
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CHAPTER 11

Rehabilitation and Nonoperative Treatment

Joshua M. Zimmerman, John G. Skedros, Mark T. Dean, Peter O'Rourke, and Wayne Z. Burkhead, Jr.

The appropriate nonoperative treatment of the unstable shoulder has received considerable attention in the literature during the past 15 years. Until recently, the mainstay of nonoperative treatment of the unstable shoulder had consisted mainly of varying periods of immobilization. With the exception of an early report by Davis (1) in 1936, the concept of muscle rehabilitation as an adjunct to immobilization had been largely ignored. Refinements in our understanding of anterior shoulder instability now allow us to design patient-specific rehabilitation programs as well as to counsel patients on the likelihood of success of these programs (2–4).

Rehabilitation of the scapular stabilizing muscles, in addition to the dynamic glenohumeral stabilizers, is now recognized as an essential component in the management of the unstable shoulder (5,6). Electromyographic (EMG) studies have delineated which muscles and groups of muscles are activated during specific rehabilitative exercises (7–9). EMG analysis has also been instrumental in demonstrating muscle group imbalances in those patients with anterior instability (10). This information, in combination with a patient-specific diagnosis, can provide a rational basis for designing and implementing an effective rehabilitation program for shoulder instability.

The purpose of this chapter is to address the nonoperative management of anterior shoulder instability. The discussion focuses primarily on three entities: (a) first-time acute dislocators, (b) chronic anterior instability, and (c) anterior subluxation in the throwing athlete. Clinical evaluation and diagnostic imaging are discussed in Section 2 and are included in this chapter only as they pertain to rehabilitative recommendations.

J. M. Zimmerman, J. G. Skedros, M. T. Dean, P. O'Rourke: W. B. Carrell Memorial Clinic, Dallas, Texas 75204.

W. Z. Burkhead, Jr.: Department of Orthopaedics, University of Texas—Southwestern Medical School, and W. B. Carrell Memorial Clinic, Dallas, Texas 75204.

ACUTE FIRST-TIME DISLOCATORS

Immobilization

The appropriate length and value of immobilization after an initial episode of dislocation remain controversial. Most early studies recommend immobilization of 2 to 6 weeks duration, and little or no mention is made of a muscle strengthening program. In 1956, Rowe (2) reviewed 500 shoulder dislocations, 96% of which were traumatic in origin. Of those patients younger than 20 years of age at the time of dislocation, 83% experienced recurrent dislocations, compared with 63% of those aged 20 to 40 years and 16% of those older than 40 years of age. The nonoperative treatment of these patients consisted of varying periods of immobilization in a sling and swath. No correlation was noted between length of immobilization and recurrence. An earlier study conducted by McLaughlin and Cavallaro (11) noted recurrence rates of 90% in patients under 20 years using similar nonoperative methods. More recently, Henry and Genung (12) prospectively studied the recurrence rate in young athletes treated with immobilization for 2 to 6 weeks versus those treated with no immobilization. These investigators found an 85% to 90% recurrence rate in both groups. A 10-year prospective study by Hovelius et al. (13) noted somewhat lower redislocation rates in first time dislocators but also concluded that the type and duration of the initial treatment had no effect on the rate of recurrence. Simonet and Cofield (14) found a recurrence rate of 66% in patients less than 20 years of age, 40% in patients aged 20 to 40 years, and no recurrences in patients older than 40 years. The only treatment factor that significantly influenced recurrence in their study was a 6-week restriction on return to sports.

By contrast, two studies have demonstrated the efficacy of immobilization as a component of nonoperative treatment. In 1982, Yoneda et al. (15) reviewed the recurrence rate in young athletes treated with immobilization for 5 weeks, followed by a graduated exercise routine for 6 weeks. These investigators reported the recurrence rate with this program to be only 17%. Similarly, Aronen and Regan (16) reported a recurrence rate of 25% in Naval cadets treated with 3 weeks of immobilization followed by a specific rehabilitation program of isometric, isotonic, and isokinetic exercises.

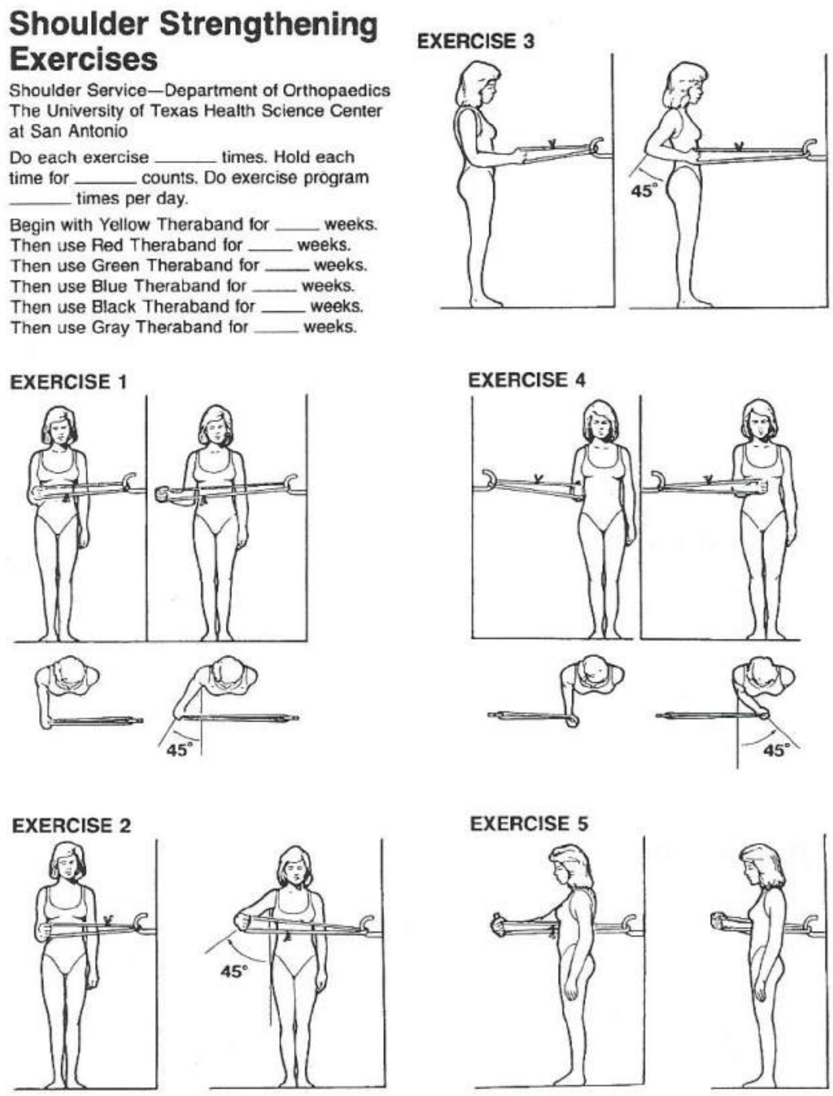
Although the literature remains controversial, our preference is for a 6-week period of immobilization in those patients who elect nonoperative treatment. Our rationale for this decision is based on the fact that a significant degree of capsular injury typically occurs before the traumatic detachment of the inferior glenohumeral ligament from the labrum (17). Also, cadaveric studies have demonstrated that a Bankart lesion alone, in the absence of capsular stretching or rupture, is *unlikely* to allow significant anterior translation of the humeral head in the glenoid fossa (18). The repair and regenerative phase of tendon and ligament healing occur between 72 hours and 6 weeks (19). Basic science studies evaluating tensile strength demonstrate that in this phase of healing, ligaments are relatively weak at 3 weeks with gradually increasing strength thereafter (20,21). Therefore, although immobilization in internal rotation may not result in anatomic healing of the inferior glenohumeral ligament to the glenoid labrum, our hope is that 6 weeks of immobilization will allow for the best nonoperative chance for optimizing healing of the static stabilizers of the shoulder.

Rehabilitation Protocol for First-Time Dislocators

After reduction of an acute first-time dislocation, as much information about the pathoanatomy of the patient's dislocation should be obtained as is safely and comfortably possible. Appropriate radiographs of the affected shoulder should be obtained, and include a Stryker notch, axillary lateral, true anteroposterior (AP), West Point axillary lateral, and apical oblique views as described by Garth et al. (22). These radiographs will define most of the bony defects in the humeral head and the glenoid, which have been noted in approximately 80% of patients with anterior dislocations (3). Several studies have noted a poorer prognosis in those patients with humeral head impression defects (Hill-Sachs lesion) compared with patients without other defects (3,13). Conversely, dislocations associated with a greater tuberosity fracture have a significantly better prognosis (23). In young patients at high risk of recurrence, computed tomography (CT), arthrography, or diagnostic arthroscopy should be considered to rule out a repairable Bankart lesion as well to document a chondral Hill-Sachs defect. The role of magnetic resonance imaging (MRI) continues to evolve in the evaluation of the unstable shoulder. Several recent studies comparing MR arthrography with CT arthrography in the detection of Bankart lesions and labral pathology have concluded that MRI is the superior modality (24,25). Rehabilitation recommendations are guided by patient age, history, and radiographic studies in most cases. MRI scanning is not routinely performed. We continue to reserve MR arthrography for the older first-time dislocator who is suspected of having rotator cuff pathology in addition to labral pathology.

The results of the imaging evaluation along with the patient's age and the magnitude of trauma causing the dislocation can be used to counsel the patient on the probable success of a nonoperative treatment program. If the patient, after being given this information, chooses nonoperative treatment, we insist on 6 weeks of immobilization. The patient is instructed to avoid exacerbating activities including overhead use of the involved extremity, as well as the abducted externally rotated "at-risk" position. The patient should also be informed that the period of immobilization will be followed by a long-term strengthening program that must be sustained to increase the probability of a successful outcome. Cessation of the rehabilitation protocol even in the remote future may increase the risk of recurrent symptoms.

After discharge from the hospital, the patient should use ice, nonsteroidal anti-inflammatory drugs (NSAIDs), and other modalities to control pain and reduce inflammation. As the pain subsides over the first few days, the patient begins isometric exercises in the sling with resisted contractions of 8 to 10 seconds with a 2-second intervening rest period. This consists primarily of deltoid isometric contractions. At 3 to 4 weeks postinjury, the patient is given instruction on isotonic rehabilitation exercises. These exercises are performed with a pulley, surgical tubing, weights, or Therabands (Hygienic, Akron, OH, U.S.A.). We prefer to use Therabands, as they facilitate both eccentric and concentric strengthening, are easy to use at home without expensive equipment and are not cumbersome. Therabands are available in six different thicknesses, providing progressive resistance from 1 to 6 lb in 1-lb increments. The initial program emphasizes isotonics with internal rotation and adduction, limiting external rotation to the neutral position. During the 5th and 6th weeks, the patient may progress to a comprehensive strengthening program emphasizing the three parts of the deltoid, the rotator cuff, and the scapular stabilizers (26) (Fig. 1A,B). Theraband exercises are performed two to three times per day. The exercises should be short arc, avoiding the end ranges of motion. Exercises are performed at low intensity and low speeds with high repetitions. Initially, five repetitions are performed holding each repetition isometrically for a 5-second count. The patient is advanced to 12 repetitions, with an isometric 10-second count, before advancing to the next level. After completion of the last level of a Theraband program, the patient performs the same exercises with either a pulley and weight kit or free weights. The weights are usually begun at 8 to 10 lb for an average patient, and



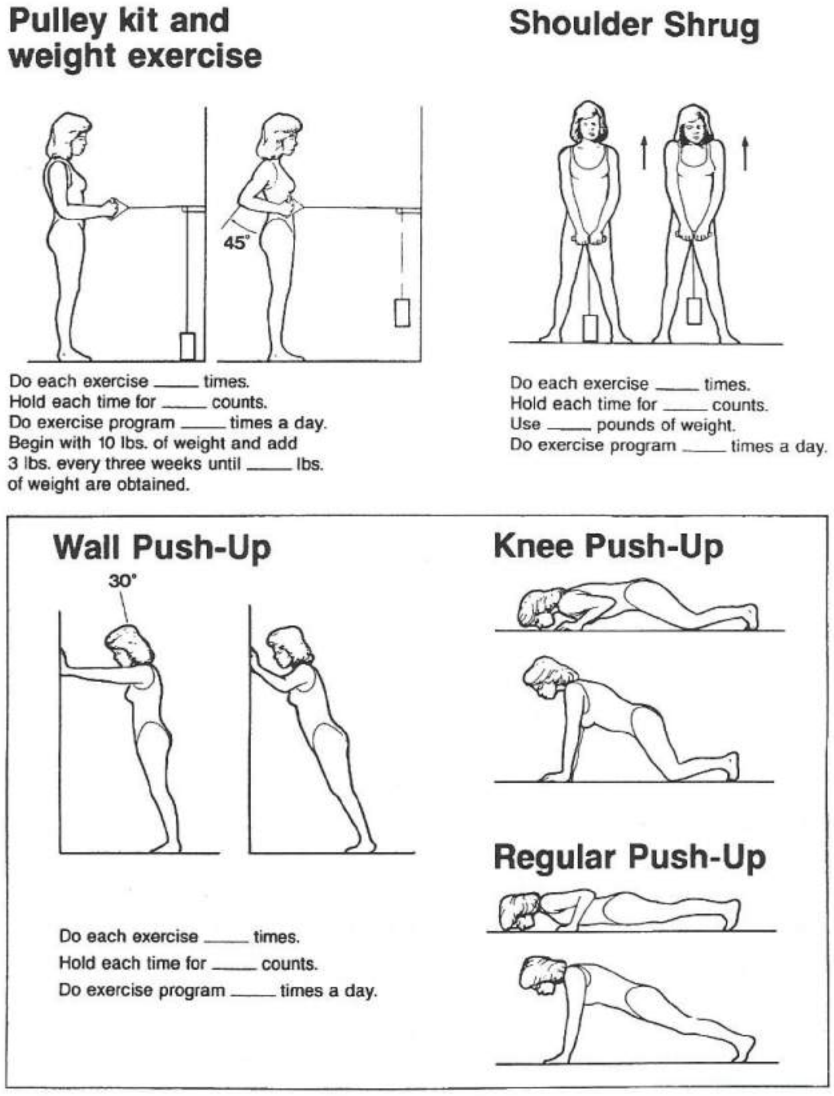
A

FIG. 1. Rehabilitation program to strengthen the deltoid, rotator cuff, and scapular stabilizer muscles. **A:** Initially, only internal rotation in adduction is performed. During the 5th or 6th week, the patient progresses to all five Theraband exercises. (*figure continues*)

then increased in 2-lb increments. The weights may be increased to as much as 20 to 25 lb for men and 15 lb for women. Patients are not progressed to the next level if they experience increasing exercise-related pain. When not performing exercises, the patient continues to wear the shoulder immobilizer. At 6 weeks, the immobilizer is discontinued, but the patient is restricted from returning to sports and is instructed to avoid at-risk positioning of the arm. A long-term rehabilitation program is instituted at this time. From a practical standpoint, rehabilitation is continued for 8 to 12 weeks after the immobilizer has been discontinued. Return to play is generally allowed at this point if full strength and range of motion are restored. Ideally, shoulder rehabilitation will be continued indefinitely, throughout the season and off-season.

When designing a program of specific exercises, it is extremely important to strengthen both the glenohumeral and scapular musculature. A broad rehabilitation protocol may include internal rotation, external rotation, flexion, extension, cross-body adduction, abduction, horizontal adduction, abduction in the plane of the scapula in both internal and external rotation, forward flexion, shoulder shrugs, press-ups, and rows. However, in acute first-time dislocators with no pre-existing muscle weakness, a simpler and more specific rehabilitation protocol may be designed.

Muscle-specific EMG studies have demonstrated core groups of exercises that effectively work the glenohumeral and the scapulothoracic musculature (10,27). For rehabilitation of the dynamic glenohumeral stabilizers, a set of four exercises has been shown to adequately address all of the involved muscles. These muscles include the four rotator cuff muscles, the three portions of the deltoid, the pectoralis major, and the latissimus dorsi. All nine of these muscles demonstrate adequate activity with a combination of scap-



B

FIG. 1. *Continued.* **B:** Strengthening of the scapular stabilizers is begun at the same time as the shoulder shrugs, wall push-ups, and the five Theraband exercises. Wall push-ups are then advanced to knee push-ups, then to modified regular push-ups (see Figs. 6 and 9). When the 5th Theraband level has been completed, a rope and pulley system is utilized for all five exercises, beginning initially with 5 to 10 lb. (From Young DC, Rockwood CA Jr. Complications of failed Bristow procedures and their management. *J Bone Joint Surg [Am]* 1991;73A:972–973, with permission.)

tion in internal rotation (Fig. 2), external rotation (Fig. 3), horizontal abduction with the arm externally rotated (Fig. 4), and press-ups (Fig. 5). Scaption in internal rotation resulted in the highest amount of EMG activity in the anterior deltoid, middle deltoid, subscapularis, and supraspinatus (27). External rotation produced the highest activity in the teres minor, infraspinatus, and the posterior deltoid (27). Later in the rehabilitation protocol, when the patient is able to abduct the arm without danger of instability, horizontal abduction in the prone position with external rotation may be performed. This has been shown to produce the highest EMG activity for the posterior deltoid, infraspinatus, and teres minor (27). This exercise has also shown to have very high EMG activity for the middle trapezius, upper trapezius, lower trapezius, and levator scapulae (27). The press-up (Fig. 5) has been shown to have the highest amount of EMG activity for the pectoralis major, pectoralis minor, and the latissimus dorsi; however, this exercise may be difficult to perform initially in the rehabilitation program for the

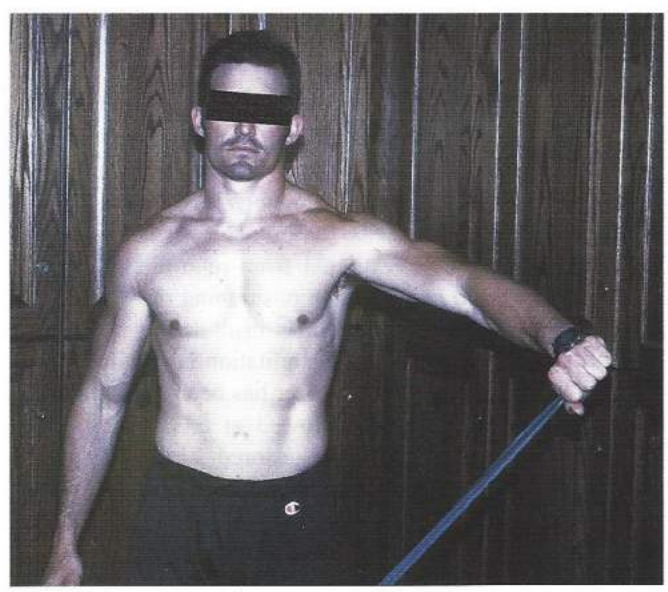


FIG. 2. Scaption in internal rotation.

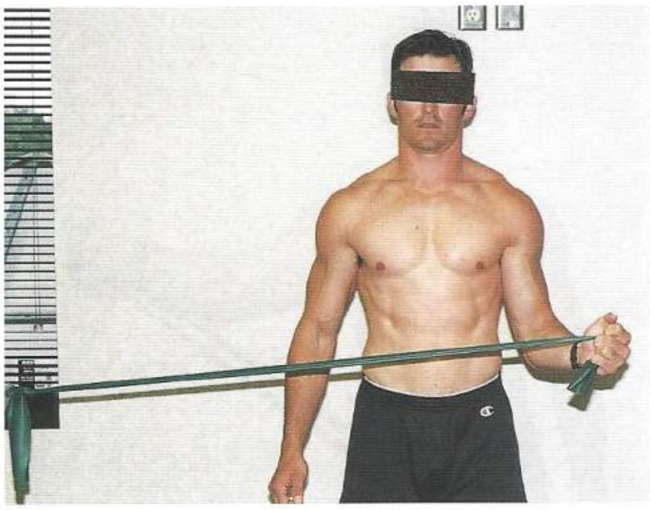


FIG. 3. External rotation.

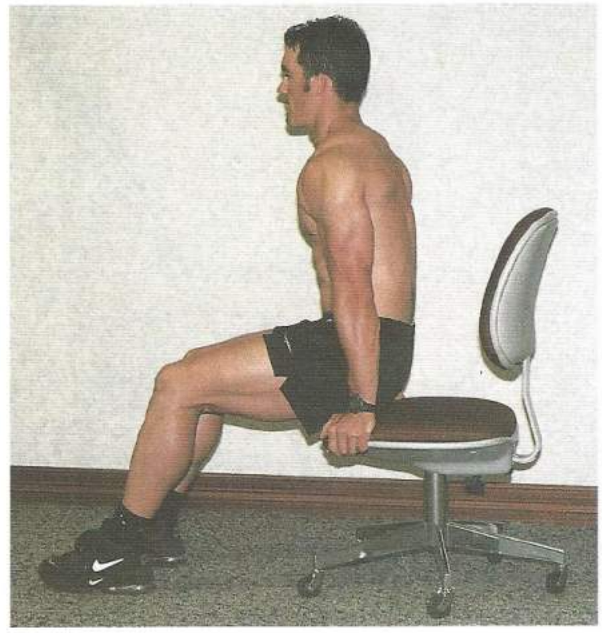


FIG. 5. The press-up.

acute dislocator. Push-ups against the wall followed by knee push-ups may be substituted initially for press-ups. The push-ups should be performed with the hands together to reduce the strain on the anterior capsule (Fig. 6). Interestingly, very limited subscapularis activity is produced with internal rotation of the shoulder with the arm in the adducted position, although this exercise has long been considered specific for maximally activating this muscle (9,27). High subscapularis activity is actually produced by internally rotating the arm in the 90-degree abducted position (9)(Fig. 7). Because of the degree of abduction required, this exercise should be instituted in the later stages of rehabilitation.

For rehabilitating the scapular stabilizers, EMG studies have demonstrated a core group of four exercises that effectively activate these muscles (10). These muscles include the upper, middle, and lower trapezius, the levator scapulae, the rhomboids, the pectoralis minor, and the middle and lower serratus anterior. All eight of these muscles demonstrate adequate EMG activity with a combination of scaption in external rotation (Fig. 8), rowing (Fig. 9A,B), press-ups, and push-ups with a plus (Fig. 10). We have included the first three of these exercises in our rehabilitation protocol. Scaption in external rotation has been shown to have the highest EMG activity for the lower serratus, as well as very high activity for the rhomboid and middle serratus (10). Rows exhibit high EMG

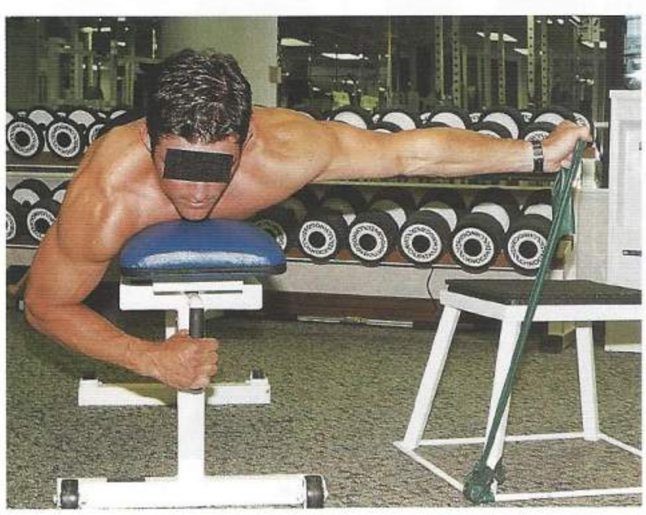


FIG. 4. Horizontal abduction with the arm externally rotated.

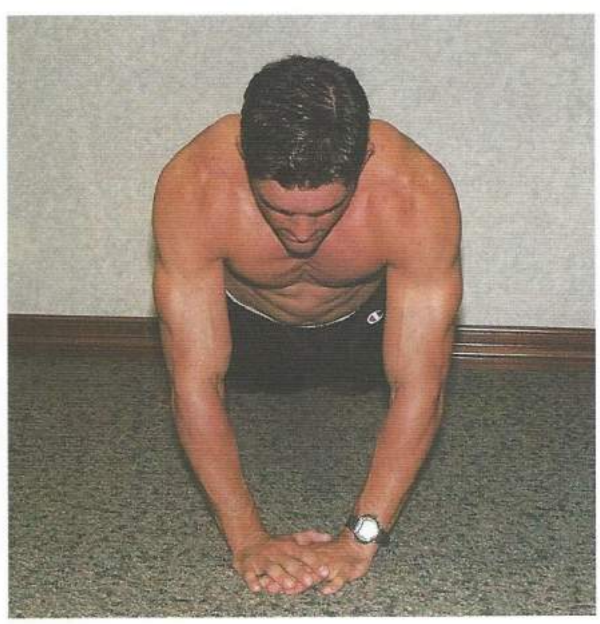


FIG. 6. Push-ups with hands together.

FIG. 7. Internal rotation with the arm in 90 degrees of abduction. This position is recommended in the later stages of rehabilitation for maximal subscapularis activity.

FIG. 8. Scaption in external rotation.

activity for the upper, middle, and lower trapezius, the rhomboids, and levator scapulae. Press-ups, as previously mentioned, demonstrate high activity in the pectoralis minor. Because of concerns that the push-up with a plus causes undue stress on the anterior capsule, we have excluded it from our rehabilitation protocol.

Isokinetic exercises (e.g., using Cybex or Biodex exercise machines), if available, may be added to the muscle-strengthening program. Initially, the isokinetic exercises should be performed with the elbow at the side. In the final stages of the rehabilitation program, these exercises may be performed with 90 degrees of shoulder flexion (Fig. 11).

The patient may return to full activity with no restrictions when there are no signs of apprehension and the upper extremity is approximately equal in strength to the opposite extremity. This generally does not occur before 3 months from the time of injury. Isokinetic strength testing is useful for assessing the strength of the extremity before return to full activities.

A

B

FIG. 9. A: Rowing using a Theraband. **B:** Rowing on a rowing machine.

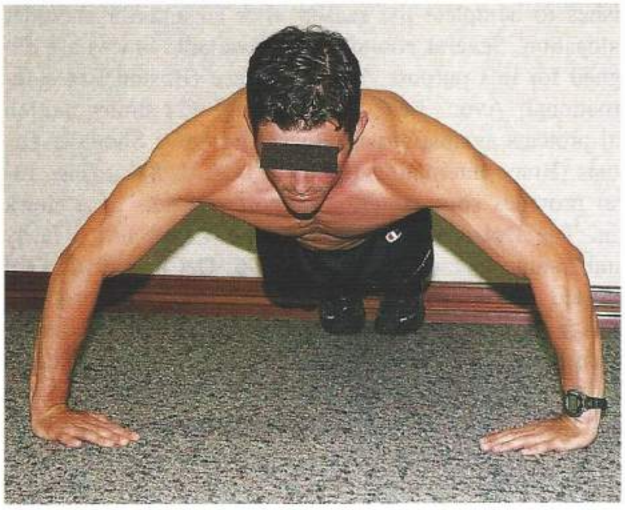


FIG. 10. Push-up with a plus.

Impact of Associated Injuries

As mentioned previously, fractures associated with acute dislocations have significant impact on prevalence of recurrent instability (13,23). Although no specific alterations in the rehabilitation protocol are recommended, this information is important to consider in counseling the patient on the probability of a nonoperative treatment program. A patient with a greater tuberosity fracture can be reassured of a low probability of redislocation. A patient with an associated Hill-Sachs defect, particularly in the young athlete, can be cautioned that nonoperative treatment will likely result in a high failure rate (3).

The frequency of an associated rotator cuff injury increases with age and may exceed 30% in patients older than 40 years of age (28). The diagnosis should be suspected in patients who are unable to abduct the arm after shoulder relocation (29). These patients are commonly misdiagnosed as having an axillary nerve injury, as an explanation for their continued weakness. We obtain an MRI with intra-articular contrast for those patients who exhibit continued abduction weakness at a 3-week follow-up. When a significant rotator cuff tear is confirmed by imaging studies, we recommend prompt surgical treatment. Hawkins and Koppert (30) noted that a low redislocation rate can be anticipated in these patients—only one redislocation occurred in 36 patients with this injury. Passive range-of-motion exercises, including pendulum, forward flexion with a pulley, and internal rotation, are permitted immediately after surgery. Passive external rotation is limited to neutral for 3 weeks. Depending on the strength of the rotator cuff and deltoid repairs, active range of motion is permitted at 4 to 6 weeks after surgery. Patients may begin Theraband exercises limited to internal and external rotation at 10 weeks. At 12 weeks, a full Theraband program may be instituted as described above. At the discretion of the surgeon, larger tears or tears with tenuous repairs, or both, may require a modified program.

Injuries to the axillary nerve are common after anterior shoulder dislocations and have been reported to occur in up to 25% of patients (31). Most of these are neuropraxic injuries, which typically recover spontaneously. Full recovery may take 3 to 5 months (32). We modify our rehabilitation protocol by the addition of an electrical muscle stimulating unit for rehabilitation of the deltoid. This is generally worn for 6 to 8 hours each day. These patients continue the regular rehabilitation protocol to the best of their abilities. If deltoid function fails to return by 3 months, surgical exploration of the nerve is recommended. Exploration is delayed if function is improving, but incomplete, at the 3-month mark.

Vascular injury after an anterior shoulder dislocation is relatively uncommon. Immediate surgical management is often necessary to restore circulation to the arm. The focus in these cases is on limb salvage, and we have no specific rehabilitation recommendations. When the vascular repair allows, a gradual rehabilitation program may be instituted.

FIG. 11. Isokinetic exercises using a Biodex machine.

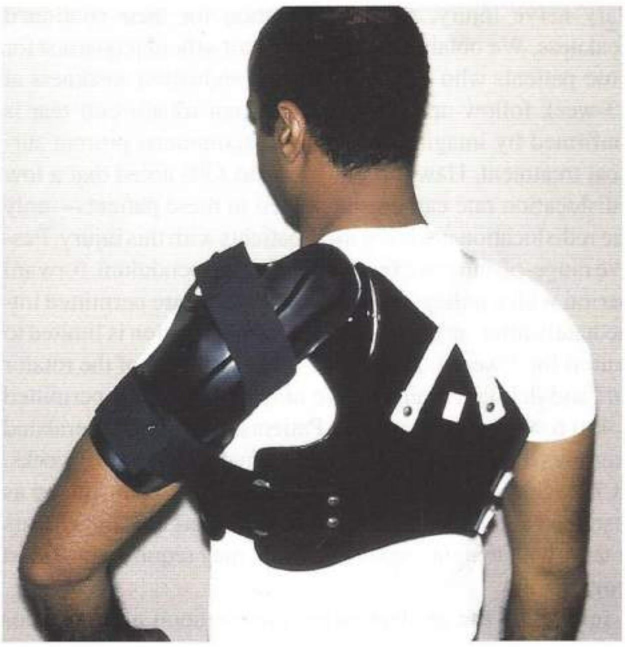


FIG. 12. SSI Shoulder Brace (Boston Brace International, Avon, MA, U.S.A.).

Bracing for Return to Sports

Shoulder braces are used to limit motion of the glenohumeral joint, specifically by limiting the ''at-risk'' position of abduction and external rotation. In selected patients, braces may be offered as a nonoperative alternative. This indication is typically for the athlete who wishes to complete the season after an anterior shoulder dislocation. Several commercially available braces are designed for this purpose. The SSI brace (Boston Brace International, Avon, MA, U.S.A.) (Fig. 12) limits motion and protects against direct blows. The Sawa Shoulder Orthosis (Brace International, Atlanta, GA, U.S.A.) (Fig. 13) also provides some anterior support and acts as a check rein. The Duke-Wire harness (not pictured) has a fairly cumbersome lace-up corset. In 1996, DeCarlo et al. (33) reported the results of a study that evaluated the ability of each of these braces to limit motion during isokinetic testing. Although test subjects considered the Sawa brace the most comfortable, the SSI brace was most effective in limiting motion likely to result in anterior instability.

In our practice, we have found that a simple and inexpensive shoulder strap can be made out of a football belt and is effective at limiting deleterious positions (Fig. 14). Of the commercially available braces, the Sawa Shoulder Orthosis is our preference for its ease of wear and effective check rein. Athletes involved in sports such as football, who sustain a shoulder dislocation during the season, may be offered a brace to wear during practice and games. The brace should be used in conjunction with ongoing shoulder rehabilitation. Brace wear is also recommended for contact athletes returning to sports after anterior shoulder reconstruction. Tackling athletes, in particular, are recommended to continue brace wear until they are 6 months postoperative and strength and confidence in the shoulder have been restored. A second group of patients who may be considered for bracing are recurrent dislocators who are nonoperative candidates for medical reasons. These patients generally must experience significant instability before a brace is recommended, as full-time brace wear is difficult.

FIG. 13. Sawa Shoulder Brace (Brace International, Atlanta, GA, U.S.A.).

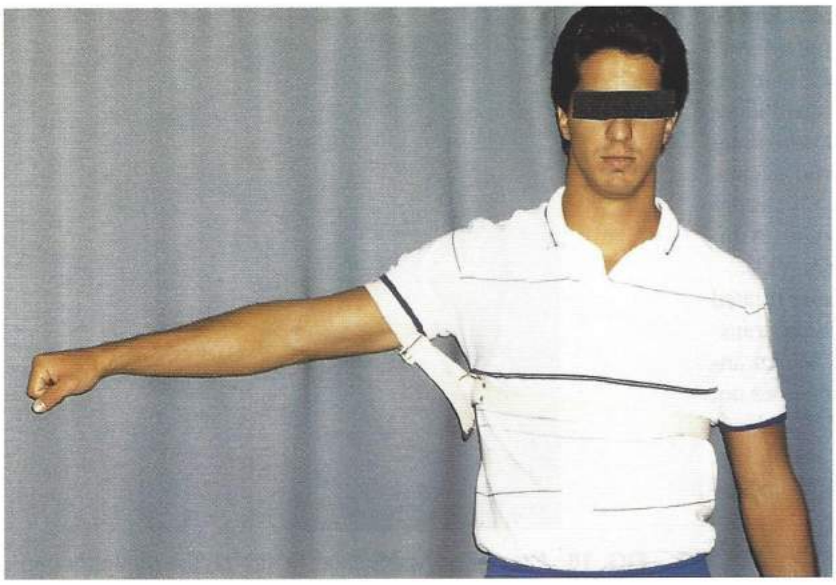


FIG. 14. Simple shoulder strap.

Rehabilitation for Atraumatic Recurrent Anterior Instability

The prognosis for successful rehabilitation in patients with recurrent atraumatic anterior subluxation, including those with multidirectional instability, appears to be much better as compared with that of patients with acute traumatic dislocations. A 1992 report by Burkhead and Rockwood (3) documented a 80% success rate in treatment of this group of patients when using a program of progressive resistance exercises. This represents a substantial improvement in comparison to the 16% success rate for those with traumatic subluxation.

In contrast to the patient with an acute traumatic dislocation, the patient with recurrent anterior instability may have developed chronic muscle imbalance. McMahon et al. (34) used EMG analysis to compare the rotator cuff and scapular muscles in normal shoulders *versus* shoulders of patients with anterior instability. The subscapularis, supraspinatus, infraspinatus, rhomboids, serratus anterior, and trapezius muscles were studied in three arcs of motion: scaption, flexion and abduction. Subjects with anterior shoulder instability consistently demonstrated relative deficiencies in the serratus anterior and the supraspinatus muscles. None of the other muscles tested demonstrated significant differences in activity between the two subject groups. This information suggests that additional emphasis should be spent on the rehabilitation of these muscles in a rehabilitation program designed for chronic anterior instability.

Careful manual muscle testing is performed on the initial evaluation of these patients. Particular attention is given to subtle winging of the scapula and asynchronous movements of the scapulothoracic and glenohumeral joints. Specific muscular imbalances are recorded and are addressed with a specific rehabilitation protocol.

Immobilization is avoided in these patients in order to avoid exacerbation of muscle weakness and imbalance. Physical examination often demonstrates significant tightness of the posterior capsule and deltoid, which can contribute to anterior subluxation (35). To address this problem, a stretching program emphasizing cross-body adduction and internal rotation is instituted early in the rehabilitation protocol.

A comprehensive Theraband program involving rehabilitation of the glenohumeral and scapulothoracic musculature (see also the section on acute dislocations) is instituted at the outset. Alterations in the basic rehabilitation protocol can be made if muscle imbalances are noted at the initial examination. This generally involves increased rehabilitative efforts directed toward the serratus anterior and supraspinatus by emphasizing scaption and push-ups with a plus (Fig. 12), which have been demonstrated to elicit high EMG activity in these muscles. Although scaption has traditionally been performed in an internally rotated (thumb-down) position (36), recent EMG analysis by Kelly et al. (9) suggests that optimal supraspinatus activity occurs with scaption in external rotation (palm up). In patients with a component of subacromial impingement, scaption in external rotation better avoids the position of impingement and is recommended in favor of scaption in internal rotation.

Rehabilitation of Throwing Athletes with Anterior Instability

The throwing athlete subjects the shoulder to repetitive high-energy forces. This may cause repetitive microtrauma that can lead to progressive damage to the anterior stabilizing structures of the shoulder (37). Kronberg et al. (38) demonstrated that coordinated muscle activity plays a significant role in stabilizing the shoulder. Initially, this coordinated muscular activity is able to compensate for the progressively attenuated anterior structures, allowing the shoulder to maintain stability. With continued throwing and continued damage, the muscular activity is unable to compensate and anterior translation of the humeral head in the glenoid occurs. With increased anterior translation, the humeral head can contact the coracoacromial arch or glenoid rim leading to an impingement syndrome and a painful throwing motion (37).

In the uninjured shoulder, the abducted externally rotated position of late cocking is accompanied by posterior translation of the humeral head in the glenoid fossa. When anterior instability develops, this posterior translation does not occur and anterior translation is observed. In EMG analyses of throwing shoulders in pitchers with anterior instability, Glousman et al. (37) demonstrated markedly diminished activity in the pectoralis major, subscapularis, serratus anterior, and the latissimus dorsi in the late cocking and acceleration phases. These investigators concluded that this imbalance contributes to, and propagates, the instability syndrome, whether this instability is a consequence of the primary pathology or a secondary effect.

The rehabilitation program for the throwing athlete begins with an initial period of rest. No throwing is allowed and inflammation is brought under control with an oral NSAID and physical therapy modalities. Most of these athletes demonstrate excessive external rotation on the dominant side with a reduction in internal rotation. This is usually accompanied by posterior capsular tightness, which can contribute to anterior subluxation (35,39) (Fig. 15). To manage this, a stretching program is instituted that includes cross-body adduction (Fig. 16) and abduction with internal rotation. Hancock and Hawkins have recommended a towel stretch with the athlete's hand behind her or his back to further address deficient internal rotation (7) (Fig. 17). A general rehabilitation program similar to that for anterior instability should be instituted along with the stretching exercises. Strengthening exercises for the entire upper extremity including the triceps, biceps, forearm, wrist, and hand are also instituted to improve overall fitness and endurance. The serratus anterior, pectoralis major, subscapularis, and latissimus dorsi are specifically emphasized, as they are important in the throwing motion. Scaption in external rotation and press-ups, or alternatively push-ups with a plus, are emphasized to strengthen these muscles. The forward

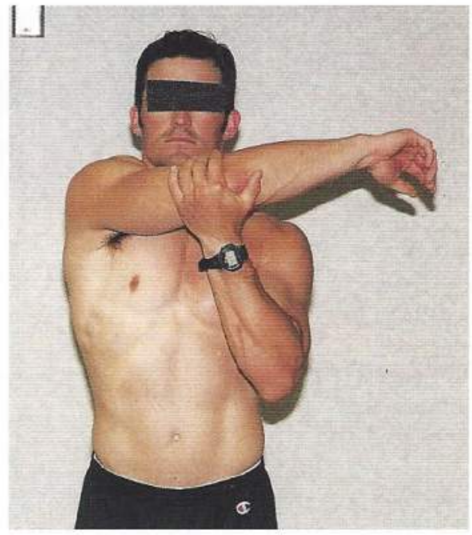


FIG. 16. Cross-body adduction to stretch the posterior capsule.

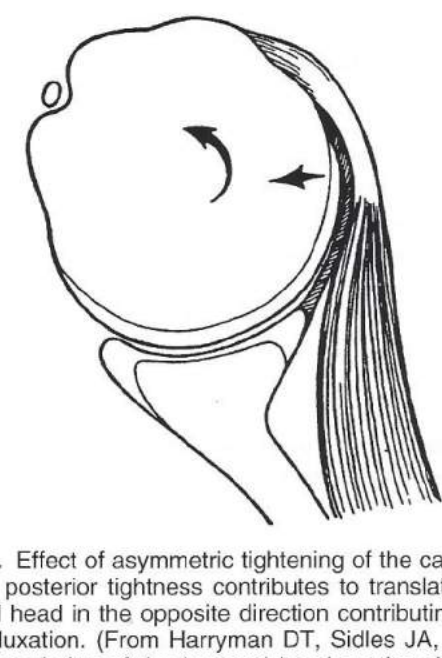


FIG. 15. Effect of asymmetric tightening of the capsule. Excessive posterior tightness contributes to translation of the humeral head in the opposite direction contributing to anterior subluxation. (From Harryman DT, Sidles JA, Clark JM, et al. Translation of the humeral head on the glenoid with passive motion. *J Bone Joint Surg [Am]* 1990;72A:1341, with permission.)

FIG. 17. Internal rotation stretching with a towel to address posterior capsular tightness.

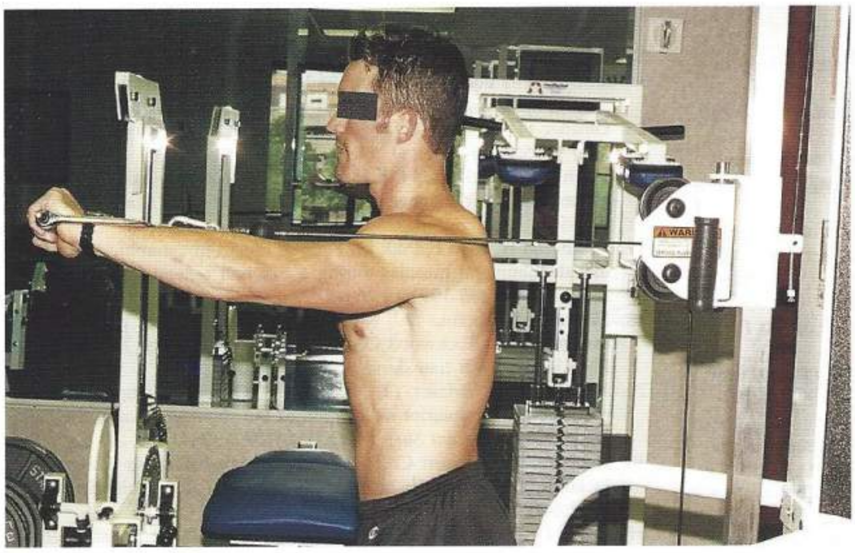


FIG. 18. Forward punch using a pulley to work the subscapularis further.

punch has been recommended by Hawkins et al. (7), which can also be added to work the subscapularis muscle further (Fig. 18). Eccentric contractions are emphasized in throwers to aid in strengthening for the deceleration phases of throwing. Isokinetic exercises can also be useful in improving the strength and endurance of the upper extremity. The athlete may return to throwing activities once there is full range of motion, no apprehension or impingement, and approximately equal strength to the contralateral extremity. Isokinetic testing is useful for determining when adequate strength has been achieved. The athlete is not immediately released to previous levels of throwing but, rather, is placed on a graduated throwing program. During the graduated program, the patient should continue strengthening exercises. When throwing activity is resumed, the strengthening program is performed later in the day, after the throwing program, to avoid reinjury secondary to fatigue.

FUTURE CONSIDERATIONS

Proprioception

A recent study conducted by Lephart et al. (40) demonstrated proprioceptive deficits in shoulders with anterior instability, as compared with stable shoulders. These investigators evaluated three groups of patients: a healthy group of normal volunteers, a group of patients with recurrent anterior instability at the completion of a rehabilitation program, and a group of patients who had a surgical reconstruction of the shoulder for anterior instability and had completed 6 months of postoperative rehabilitation. They were able to demonstrate significant proprioceptive deficits in the unstable shoulders, as compared with the healthy volunteers. No significant differences were demonstrated between the postsurgical group and the healthy volunteers. They concluded that reconstructive surgery appears to restore normal proprioceptive sensibility to the shoulder. In another study designed to evaluate proprioception, Wallace et al. (41) studied 12 subjects with anterior shoulder instability. The contralateral shoulder served as an internal control (41). A pneumatic cylinder was used to produce a sudden external rotation movement of the glenohumeral joint. The latency between the onset of movement and the detection of muscle contraction was used as an index of proprioception. These workers found no significant difference in muscular reflex activity between the stable and unstable shoulders and concluded that these results do not support the use of proprioception-enhancing physical therapy in the treatment of post-traumatic anterior shoulder instability.

Neural end organs in the form of Pacinian corpuscles and two types of Ruffini end organs are present in the ligamentous structures and connective tissues of the shoulder joint capsule (42). Disruption of these elements may interrupt the normal proprioceptive sensibility of the glenohumeral joint. Undoubtedly, normal proprioception is essential in providing the appropriate feedback to balance complex muscle-firing sequences as the joint position rapidly changes. Although it is clear that operative stabilization can improve proprioception, it has not been established whether a nonoperative rehabilitation protocol can have a significant impact on this parameter and thereby reduce the incidence of recurrent dislocation. For this reason, we do not currently include a specific proprioceptive program in our rehabilitation protocols.

Although the value of proprioceptive training remains to be verified in shoulder rehabilitation, several investigators have elected to include proprioceptive training in their rehabilitation protocol on an investigational basis (43). They recommend the following progression of activities to maximally restore proprioception and neuromuscular control: (a) joint position sense and kinesthesia, (b) dynamic joint stabilization, (c) reactive neuromuscular control, and (d) functionally specific activity. If these investigations and others are able to demonstrate improved stability with a proprioceptive program, this may prove to be an advance in our ability to understand and treat shoulder instability.

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