# Principles of Shoulder Rehabilitation

6

Gabriele Severini, Alessio Ricciardi,
and Angelo Cacchio

## Introduction

It is well known that the shoulder, by combining the actions across the glenohumeral, scapulothoracic, acromioclavicular, and sternoclavicular joints, provides a unique wide range of functional versatility to the upper extremity, making it prone to injuries and dysfunctions.

The strategies of shoulder rehabilitation have changed dramatically over the past two decades: thanks to a better knowledge of its complex arthrokinematics, as well as dealing with selective and well-known conditions (we are at last abandoning the term scapulohumeral periarthritis), physical therapy has reached elite standards in quality and effectiveness, thus allowing better, safer, and earlier restoring of function and painless motion. Nevertheless, all conservative and postsurgical approaches have been fine-tuned, and a good team approach is now a reality almost everywhere. For instance, physical management of shoulder pain has progressed from addressing single structures, such as the supraspinatus tendon with cross-frictions [1], to a multistructural approach, considering not only potential sources of symptoms but all possible contributing factors towards the etiology of injuries, maintenance of symptoms, and recurrence. So it is important to remember that, as experts at restoration, we need to be reminded of the importance of prevention: anticipated complications need to be expected and prevented. This is the golden concept of preventive rehabilitation. Never forget that we have to rehabilitate a patient, not her/his lesions, dysfunction, or MRI.

It is imperative to remember that all the guidelines and rehabilitative strategies have to be tailored to the single subject, taking into account a lot of variables such as age, gender, level of activity, pathoanatomy, and surgical procedures. A thorough knowledge of anatomy and biomechanics as well as the correct application of manual therapy, exercise, and modalities will lead to better outcomes.

In this chapter we decided to focus on those shoulder conditions more susceptible to arthroscopic treatment, such as conflicting and unstable shoulder, disorders of the acromioclavicular joint and long head of biceps, rotator cuff repair, and stiff and frozen shoulder.

## General Principles

Early motion, to the extent allowable, is crucial. Strengthening should be gradual and progressive. Repetitions should be increased first, followed by increases in resistance. Exercises for strength, endurance, and power must be balanced. Stabilization activities and exercises with weight bearing (closed kinetic chain) promote effective and functional strengthening (Fig. 6.1). The deltoid, scapular stabilizers, and rotator cuff muscles each have unique mechanisms, and the exercises designed to strengthen them must take these into account. Strengthening for the serratus anterior can be accomplished through many different techniques, each of which has a different impact on the scapula and the percent of maximal voluntary contraction of the muscle. Isometric exercises are usually tolerated better by arthritic joints. Age affects muscle and endurance. Aerobic exercise benefits nearly everyone recovering from shoulder surgery, and patients should be encouraged to be as active as possible. Exercises should be designed to address impairments and progressed to approximate closely the desired level of function.

G. Severini, PT, PhD (✉) • A. Ricciardi, PT
Private Practice, Via Andrea Baldi 2, Rome 00136 RM, Italy
e-mail: severini@artefisio.it; alerick@hotmail.it

A. Cacchio, MD, PhD
Department of Life and Environmental Sciences,
University of L'Aquila, P.zza Salvatore Tommasi 1,
L'Aquila 67100, Italy
e-mail: angelo.cacchio@univaq.it

G. Milano, A. Grasso (eds.), *Shoulder Arthroscopy*,
DOI 10.1007/978-1-4471-5427-3_6, © Springer-Verlag London 2014

**Fig. 6.1** Closed kinetic chain exercise on balance board

During an upper limb movement, corticospinal system generates a motor program that activates muscles in coordinated sequences to create joints motion. This motor program must create the optimal conditions of stability at the proximal joint of the upper limb aimed at generating and transferring forces to the distal segments in an efficient manner. If these stable conditions are achieved, the rapid upper limb movements will not disturb body equilibrium during overhead activities. The pathological conditions of the shoulder may impair this motor program producing subtle compensatory changes in the normal muscle activation patterns exerted during the upper limb movements, especially those rapid and overhead. Therefore, correction of abnormal motor control and restoration of correct muscle activation pattern is imperative in the functional reeducation of shoulder impairments. Setting goals and providing feedback on progress towards those goals assist with motivation and compliance with the exercise program. Graphs of range of motion and tracking repetitions are helpful, especially when targets for these relate to desired functions.

Small increments in flexibility may be difficult to appreciate functionally: goniometric measures provide feedback on those gains. Modalities may be helpful to deal with pain, inflammation, and swelling especially in the early phases of physical therapy. During the rehabilitation process, the patient should be instructed to produce and control the movement in a painless functional range, in which the motion is performed in a coordinated manner.

Many systems ore scores are available to measure outcome, but this topic will be discussed elsewhere in this book.

## Subacromial Impingement

Subacromial impingement is a common shoulder impairment. It occurs when the area between the superior humerus and inferior acromion process is diminished, resulting in compression of the interposed tissues including supraspinatus and long head of biceps (LHB) tendons, subacromial bursa, and shoulder capsule [2, 3]. This encroachment results in shoulder pain which is exacerbated by forward elevation and rotation of the upper extremity. Subacromial impingement can result in various stages of rotator cuff disease which range from mild tendon irritation to complete tendon tears. Causes can be subdivided into structural and functional mechanisms often referred to as primary or secondary impingement. Two primary mechanistic theories suggest specific fatigue-related kinematic changes that reduce the subacromial space: superior head migration and altered scapular kinematics [4, 5]. A poorly functioning rotator cuff, alterations in the position of the scapula due to weakness of scapular stabilizer muscles, impaired scapulothoracic mobility, and tight pectoralis minor may increase anterior tilting of the scapula leading to effectively reduce the subacromial space and so producing a functional impingement.

It is important to point out that shoulder impingement is not a sport-specific disease. Awkward working postures,

specifically working with the arms above shoulder level, can cause or worsen shoulder disorders. Indeed, working overhead has been linked to a lot of negative physiological and biomechanical consequences, with increased intramuscular pressure, impaired circulation, increased muscle activity, and fatigue development. So a good rehabilitation program has to reduce or modify those factors within overhead work which can enhance the risk of musculoskeletal injury.

## Nonoperative Treatment

### Acute Phase

The main goals of the acute phase of rehabilitation program are to relieve pain and inflammation, prevent muscle atrophy, reestablish painless range of motion, and normalize arthrokinematics of the shoulder complex. This phase may include a brief period of active rest, eliminating any activity that may cause increase in symptoms. Range of motion (ROM) exercises may include pendulum Codman's and active assisted exercises.

Relative rest may also be important in the reactive stage of rotator cuff tendinopathy [6]. Joint mobilization may be included with inferior, anterior, and posterior glides in the scapular plane. Neuromuscular control exercises are recommended with particular emphasis on scapular stabilizers, then isometric exercises for the external and internal rotators and biceps. Modalities such as cryotherapy, transcutaneous electrical nerve stimulation, and phonophoresis may be useful as adjunctive treatment. It is important to remember that use and diffusion of modalities may vary from country to country. To further reduce upward humeral head translation and tendon compression, avoidance of internal rotation in the early stages of rehabilitation may be appropriate. Patient education is particularly important in this acute phase: overhead activities, lifting, and reaching have to be avoided. Criteria for progression to the recovery phase are decreased pain or symptoms, increased ROM, and improved muscular function.

### Recovery Phase

The initial goals of this phase are to normalize ROM and shoulder arthrokinematics, perform pain-free activities of daily living, and improve neuromuscular control and muscle strength. ROM exercises should be progressed to active work in all planes and self-stretches focused on the posterior joint capsule.

Strengthening should include isotonic resistance exercises for the supraspinatus (dumbbell or tubing), internal and external rotators, prone extension, horizontal abduction, forward flexion to 90°, upright abduction to 90°, shoulder shrugs, rows, push-ups, and pull-downs to strengthen the scapular stabilizers. It may be possible to enhance the effect of exercise by including manual therapy in the treatment package [7].

Upper extremity ergometer exercises for endurance, trunk exercises, and general cardiovascular conditioning should be maintained. When full painless ROM is achieved and muscle strength is approximately 70 % of contralateral side, patient may progress to the next phase, whose goal is to get the athlete back to throwing and nonathletes back to overhead activities. This phase should include improving strength, power, and endurance and sport-specific neuromuscular control. Emphasis is placed on high-speed, high-energy strengthening exercises and eccentric work in diagonal patterns. Plyometric, sport-specific exercises and proprioceptive neuromuscular facilitation and isokinetic exercises are initiated.

### Maintenance Phase

The goal of this phase is to maintain a high level of training and prevent repeat injury. Emphasis is placed on intense workouts, proper arthrokinematics, and analysis and modification of techniques that may re-exacerbate symptoms. It is important for the patient to perform a home exercise program and clear understanding of the warning signs of impingement.

Generally, conservative treatment continues for 3–6 months. If the patient remains significantly disabled and has no improvement after 3 months of conservative treatment, the clinician must refer for surgical treatment (see Chap. 21).

## Postoperative Care

After subacromial decompression, the patient is placed in a sling for a very brief period and is encouraged to remove it when comfortable and begin active and passive ROM exercises. When pain has decreased significantly and ROM has returned near to normal, a program of strengthening similar to conservative management is instituted.

Reports of 80–90 % success following subacromial decompression for impingement have been published. When acromioplasty was compared with conservative care, surgery appeared to be no more beneficial clinically at 6, 12, or 48 months [8].

## Rotator Cuff Repair

Rotator cuff tears may result in significant shoulder dysfunction and functional impairments. Patients can have various clinical presentations due to different factors, including the characteristics of the rotator cuff defect.

The goal of rotator cuff repair is to restore the damaged tendon, eliminate pain, and improve function with increased

range of motion and shoulder strength. In addition to adequate surgical repair, outcomes are dependent on proper rehabilitation. Successful postoperative management following rotator cuff repair is dependent on several variables that have been shown to highly correlate with improved function, in particular integrity of the repaired rotator cuff and strength [9, 10].

The primary goal of the postoperative program is to protect the repair, promote healing, and gradually restore passive motion and muscular strength. It is imperative for the patient to be educated regarding protection of the repair site and the delayed nature of the healing process.

Thus, following rotator cuff repair, a postoperative abduction pillow brace supporting the shoulder at 30–45° of abduction may be necessary to decrease strain on the supraspinatus tendon repair site. It is important to underline that all rehabilitation professionals must be aware of the several factors that significantly affect the postoperative rehabilitation program. Two factors to consider are the surgical approach and the size of the tear. The rate of progression following rotator cuff repair is often determined by the amount of retraction present prior to repair, with the more retracted tendon requiring a slower rehabilitation course because of a higher postoperative failure rate. Tissue quality is also to be considered in determining the rate of postoperative progression, and another critical factor is the fixation method utilized.

Location and type of tear may require greater protection and slower progression depending on the tendon involved (infraspinatus and teres minor/subscapularis). The mechanism of failure of the rotator cuff and the timing of the repair have to be considered as well [11].

Another critical factor is the surrounding tissue quality. When it is fair to poor, the physical therapist should be cautious and more conservative postoperatively.

Nevertheless, the patient's characteristics, such as age, level of activity, lifestyle habits, and work situations, should be considered. The rehabilitation specialist should also consider the patient's goal for return to work and sport.

## Postoperative Rehabilitation

The rehabilitation program following rotator cuff repair may be broken down into three main phases: (1) maximum protection, (2) moderate protection, and (3) functional phase. The goal of the first phase for rotator cuff repair is to prevent postoperative stiffness and scar tissue adherence while allowing for tendon to bone healing [12].

### Maximum Protection Phase

Shoulder immobilization is recommended in this phase following rotator cuff repair regardless of the tear characteristics or method of surgical fixation. An abductor pillow brace with the shoulder supported between 30° and 45° of abduction in the scapular plane is recommended for about 3 weeks and then discontinued as determined by the surgeon or physical therapist. Active movements of the hand, wrist, and elbow are encouraged, and pendulum exercise, also known as Codman's pendulum exercise, is typically performed in this phase. Passive range of motion (PROM) and active assisted exercises are also prescribed during this phase. The use of a continuous passive motion (CPM) machine is not very frequent after this surgery and may complement the passive ROM by a therapist. Anyway, caution should be taken to avoid aggressive PROM into internal rotation with repairs of the infraspinatus and into external rotation with repairs of the subscapularis tendons.

Exercises for the scapular stabilizers may be initiated in this phase of rehabilitation as they have a synergistic relationship with the glenohumeral rotators. Early activation of the scapular stabilizers promotes improved scapulohumeral rhythm and functional use of the postsurgical shoulder [13].

Aquatic therapy is an appropriate option in the maximum protection phase, and it should begin as soon as the arthroscopic portals or surgical incisions are completely healed or otherwise covered with a waterproof bandage to allow for accelerated restoration of motion [14].

Closed chain activities are appropriate during this phase of rehabilitation as minimal activity of the rotator cuff and deltoid is exhibited.

### Moderate Protection Phase

Progression to the moderate protection phase involves several factors, as described above. Generally, the patient is ready for active exercises between the sixth and seventh postoperative week. Common exercises in this phase of rehabilitation include progression of scapular stabilizers, isometric exercises for the rotator cuff musculature, and active range of motion of the glenohumeral joint. Physical therapist needs to be aware, at this point of the healing process, of the importance of exercises at force couples rather than isolated muscle. Mirror feedback may be helpful in retraining the patients' proprioception with these exercises.

Isometrics of the shoulder musculature are commonly performed during this phase of rehabilitation. Submaximal isometric contractions should be supervised in repairs of the infraspinatus and subscapularis in external rotation and internal rotation, respectively.

Neuromuscular electrical stimulation (NMES) may be used as an adjunct treatment to enhance force production and muscle recruitment and improve muscle function, but it is not well accepted by patients. Physical modalities (laser therapy, diathermy, etc.) may be prescribed to deal with


**Fig. 6.2** Microwave diathermy for the treatment of pain and muscle spasm

pain or muscle spasm (Fig. 6.2). Active range of motion (AROM) exercises of the glenohumeral joint are typically performed during this phase of rehabilitation. It is suggested that upright elevation begins with elbow bent and then progressed to elbow straight as increased activity of the rotator cuff muscles is seen. Aquatic therapy can also be proposed, and exercises should include resisted forward flexion with paddles, ball proprioception exercises and resistance, and wall push-ups [15]. Closed chain activities are appropriate in this phase of rehabilitation (pointer and/or tripod positions).

### Minimum Protection Phase

Transition to the minimal protection phase typically occurs 12–14 weeks postoperatively. In this period, strengthening of the rotator cuff begins, and progression to functional lifting and sports activities is allowed.

Strengthening exercises may utilize elastic resistive bands (tubing) or dumbbells with the glenohumeral joint in various positions to strengthen the rotator cuff muscles. Plyometric and isokinetic exercises may be useful adjuncts for athletic population, and proprioception exercises should be increased as well.

It is important for rehabilitation professionals to recognize evidence-based tactics to restore the impairments after rotator cuff repair and utilize them properly with consideration of the numerous variables that can impact patient recovery.

## Disorders of the Long Head of the Biceps

The long head of the biceps (LHB) tendon has been recognized as a potential source of clinically significant pathology. When it is determined to be a significant contributor to patients' symptoms, the treatment options include different conservative interventions and various surgical procedures, such as tenotomy, transfer, or tenodesis. The ultimate management decision is based upon a variety of factors including the patient's overall medical condition, severity and duration of symptoms, expectations, associated shoulder pathology, and surgeon's preference.

The most important factors in selecting a surgical treatment are the primary cause of the condition, the integrity of the tendon, the extent of tendon involvement, and any related pathology that also needs to be addressed [16].

Due to the variety of surgical techniques proposed, it is imperative that the rehabilitation professionals communicate frequently with the physician to ascertain the type of surgery performed and fixation, the patient's tissue and repair quality, concomitant procedures performed, and any special instructions specific to the patients' rehabilitation. Successful biceps rehabilitation requires the therapist to create a good healing environment based on soft tissue healing properties. This concept involves controlling pain, swelling, irritation, and the load placed on the healing tissue.

Although little research specifically relating to the rehabilitation of LHB is present, therapists are aware that there

are differences in the management, for instance, of biceps tenotomy compared to tenodesis. Tenotomy rehabilitation will be more aggressive and advance more quickly. Conversely, rehabilitation following tenodesis will progress more slowly over the first 6 weeks to protect the healing biceps tendon.

## Postoperative Rehabilitation

The rehabilitation program following surgical management of LHB pathology may be divided into four phases.

### Immediate Postoperative Phase

Rehabilitation begins the day after surgery. A standard sling is used as needed. An elastic wrap is placed over the upper arm to provide support to the healing biceps. The goals are to decrease pain and swelling, initiate gentle rhythmic stabilization exercises and scapular control, and restore full PROM. Full passive motion is expected 1–2 weeks postoperatively with patients post-tenotomy typically achieving full motion slightly ahead of those post-tenodesis. Manual therapy treatments and modalities are prescribed as needed to decrease pain and improve ROM. Particular attention is placed on rhythmic stabilization and scapular exercises during this phase to improve neuromuscular control. As patient progresses, manual interventions subside in favor of active work.

### Moderate Protection Phase

In this phase patients are typically out of the sling and experiencing minimal or no pain or swelling. The goals in this phase are to increase AROM, activity tolerance, and muscle strength and endurance. A key rehabilitation regimen proposed in this phase is the "lawn chair progression," which involves transitioning from supine AROM to more functional active exercises sitting upright. This phase lasts approximately 2 weeks for tenotomy compared to 6 weeks for tenodesis.

### Functional Phase

The goals in this phase are increased endurance and strength. Biceps strengthening should include both supination and elbow flexion work. Exercise selection is based on patient goal and activity demands. Proprioception and neuromuscular reeducation exercise are crucial to counteract the inhibitory effects that pain and inflammation have on the rotator cuff and scapular stabilizers [17]. Bodyblade rhythmic stabilization exercises and multiplanar and multijoint patterns are important for a complete neuromuscular reeducation. Strengthening exercises focus on incorporation of the entire kinetic chain. Rotator cuff exercises begin with Thera-Band or tubing in external and internal rotation performed with the arm supported at 30° of abduction. Patients with tenotomy usually progress to the next phase from 4 to 6 weeks postoperatively, whereas those post-tenodesis wait until weeks 8–12.

### Return to Sport

The goals for this phase are to increase muscle strength and power, complete an interval throwing program, and return to previous level of sport participation. Plyometric exercises are appropriate to enhance dynamic stability and proprioception. A safe and effective progression for plyometrics could begin with a chest pass exercise and progress to a proprioceptive neuromuscular facilitation (PNF) D2 pattern exercise. Athletes are able to return to sport when painless full motion and full strength are regained.

# Disorders of the Acromioclavicular Joint

The acromioclavicular joint (ACJ) is a frequent source of shoulder pain. Its subcutaneous location makes it highly susceptible to trauma. Injuries such as AC separations are common in people who participate in contact sports. This joint is also predisposed to degenerative changes because of aging and the reliance on the arm for function. Another condition called "atraumatic osteolysis of the distal clavicle" has been recognized increasingly and coincides with the popularity of strength training. While dealing with any AC joint disorder, physical therapists must not forget that changes in structure and function of this joint because of injury or degeneration can result in a compromise to the "suprahumeral" space and that a high incidence of coexisting pathological conditions with symptomatic ACJ problems, such as biceps tendon pathology, full- or partial-thickness rotator cuff tears, and tears of the glenoid labrum, has been demonstrated.

## Acromioclavicular Separation

Sprains and dislocations of ACJ are seen commonly with contact and high velocity sports, but other common causes of AC injury include motor vehicle accidents and falls. AC injuries occur five to ten times more frequently in males compared with females and are seen most commonly in people in their teens through their 30s. Incomplete injuries are more common than complete dislocations. The mechanism for AC joint injury is generally represented by a fall on the point of the shoulder with the arm in an adducted position.

### Classification

The most commonly used grading system for AC injuries is the Rockwood classification [18]. This system consists of six different types of AC injuries. Types I and II are considered

incomplete injuries. Types III to VI are complete dislocations of the AC joint. By distinguishing the different types of complete dislocations, this system helps to determine the need for surgical intervention.

### Nonoperative Treatment

Type I AC injuries are treated with ice, nonsteroidal anti-inflammatory drugs (NSAIDs) or analgesic medications, and immobilization with a sling as needed for pain relief. ROM is advanced as tolerated. Pendulum exercises and gentle strengthening exercises may begin when pain-free and when ROM is near to normal. Return to sports can generally occur by 2 weeks. Cross chest adduction, wide-grip bench press, and dips should be avoided for 5–6 weeks.

Type II AC injuries are treated conservatively as well. Most patients have a full recovery. A sling is typically worn for 10–14 days or until symptoms are improved. Gentle early ROM can begin as tolerated. The arm can be used for activities of daily living when tolerated, which is typically by day 7. Gentle strengthening exercises may begin as described for type I injuries. Taping techniques may be proposed. No heavy lifting or contact sports should be undertaken for 5–7 weeks.

The treatment of type III AC injuries is controversial. Nonoperative and operative treatments have been used in the past with successful outcomes. More recently, conservative treatment has gained favor. Harnesses and braces such as the Kenny-Howard or "figure-8" brace are sometimes used to depress clavicle and reduce the dislocation. A sling should be worn for comfort for 4 weeks.

Gentle ROM activities can begin as the pain subsides and can advance as tolerated. Light strengthening exercises can start when ROM is near to normal and when the patient is not experiencing significant pain. Because the articular disc is so poorly developed and the surfaces of this joint have such poor congruency, it is difficult for the ACJ to dissipate forces in the manner seen in other joints.

Rehabilitation professionals must remember as well that a complete neurovascular examination is imperative because the brachial plexus and subclavian vessels traverse the area between the clavicle and the first rib. Grade III sprains of the ACJ can result in traction to the suprascapular nerve as a result of downward displacement of the scapula and the resultant compression and traction to the nerve by the overlying transverse scapular ligaments. Patients being treated conservatively should be made aware of the resultant cosmetic deformity that will be present. If the patient has persistent pain or functional deficits after conservative treatment, surgical options may be warranted and should be considered for those patients who participate in throwing or overhead sports, heavy laborers, or patients who are unwilling to accept cosmetic deformity.

Types IV to VI dislocations are generally treated surgically. Many surgical procedures have been proposed (Weaver-Dunn procedure, dynamic muscle transfer, etc.) (see Chap. 45). After these procedures, patients are kept in a sling for approximately 8 weeks. Codman's pendulum and gentle ROM exercises may begin in the early phase of rehabilitation. Modalities may be used to deal with pain and inflammation. After the sling is discontinued, the arm can be used actively without weights. Progressive resistance exercises can start at 11–12 weeks. Return to heavy labor and sport generally requires 4–6 months.

## Acromioclavicular Degenerative Arthritis

ACJ osteoarthritis is the most common cause of AC pain. This condition may be seen as a result of age or as a consequence of chronic overhead use of the extremity. Symptoms of degenerative changes of the ACJ include anterior and superior shoulder pain. Tenderness over the ACJ is also present. Treatment of ACJ osteoarthritis includes modifying activities, physical modalities, NSAIDs, and joint injection with steroids. If conservative treatment fails, surgery can be considered. The Mumford procedure, in which the distal clavicle is resected, has shown good result.

## Atraumatic Osteolysis of the Distal Clavicle

Osteolysis of the lateral end of the clavicle has been known to occur after trauma to the shoulder, but with the increasing popularity of weightlifting, this condition has become a more common occurrence. Although its etiology is not completely understood, osteolysis is seen more often in male athletes who have a long history of strength training. Treatment consists of activity modification. Eliminating the exacerbating activities and lifting exercises may prevent progression and alleviate symptoms. Failure of conservative treatment is an indication for surgery, consisting of resection of the distal clavicle.

## Glenohumeral Instability

Glenohumeral joint instability is a common disorder of the shoulder. There is a spectrum of presentation with shoulder instability. Traumatic anterior dislocation represents one end of this spectrum, while multidirectional instability would represent the other end. Variations in definition, such as voluntary or involuntary instability or traumatic versus atraumatic, make the diagnosis of this entity even more difficult. The treatment options for glenohumeral instability and dislocation include nonoperative and operative approaches. Patients with multidirectional instability generally refer satisfactory outcomes after a comprehensive rehabilitation program that addresses kinetic chain deficits, scapulothoracic

mechanics, shoulder girdle strength, flexibility, and neuromuscular control.

For patients who have a first time anterior dislocation, the decision between nonoperative approach and immediate surgical stabilization is more controversial.

## Nonoperative Treatment

Conservative treatment should include pain and swelling control, restoring shoulder girdle ROM, protection of the static glenohumeral joint stabilizers, obtaining full function of the dynamic stabilizers, restoring joint proprioception, and correcting associated kinetic chain deficits. The goal of this program should be the unrestricted return to preinjury activities.

Traditional nonoperative treatment after acute dislocation includes a period of immobilization with the arm in internal or external rotation [19]. Initially, treatment emphasizes controlling pain and inflammation, protecting healing tissues, and decreasing the deleterious effects of immobilization. Modalities may be useful also for promotion of tissue healing. Taping the unstable shoulder can help to improve joint biomechanics and enhance neuromuscular reeducation of the shoulder complex musculature.

The principles of glenohumeral joint protection include avoiding impingement positions, decreasing capsular stress, and preventing tendon overload. Exercises in the plane of the scapula are recommended. If posterior glenohumeral joint capsular tightness is present, mobilization using posterior glide techniques while horizontally adducting the internally rotated arm may be useful. Reestablishing appropriate force couples about the glenohumeral and scapulothoracic joints is crucial during rehabilitation.

When strengthening the rotator cuff for the treatment of specific instability pattern, it is important to remember Dempster's ring concept [20]. It has been found that any stress on the stabilizers of one side of the glenohumeral joint also places stress on the stabilizers of the opposite side of the joint. So it is important to strengthen anterior and posterior cuff and scapular muscles for the treatment of anterior and posterior unidirectional instability (Fig. 6.3). Multidirectional instability requires strengthening of all the rotator cuff muscles, long head of biceps, and deltoid. A comprehensive rehabilitation program needs to address the strength, endurance, and neuromuscular control of the rotator cuff and scapular stabilizers. Initial exercises should include multiangle, submaximal isometric contractions to activate neuromuscular control, develop strength, and improve local blood flow. Then rehabilitative exercises should progress to multiplanar activities in the full ROM, incorporating isotonic and isokinetic resistance at submaximal and maximal levels. The use of closed kinetic chain exercises is important for strengthening the unstable shoulder. Exercises with combined movement patterns (PNF) are important to reestablish function. Plyometric exercises are added in the last phases of rehabilitation.

Patients with shoulder instability frequently experience proprioceptive deficits, so rehabilitative exercise to enhance joint position sense and kinesthesia should include rhythmic

**Fig. 6.3** Exercise for rotator cuff with software providing feedback for strength and kinesthesia

stabilization and ball tossing activities in varying degrees of shoulder position and PNF drills using Bodyblade, tubing, and manual resistance.

### Postoperative Care

The biological healing response of the repaired and imbricated tissue must be respected. Although the specific postsurgical rehabilitation protocols vary according to the surgeon and type of surgery performed, the goals of rehabilitation are to regain full static and dynamic function of the shoulder and return to sports or activities of daily living in a reasonable amount of time. Many of the exercises used postoperatively are similar to those used for the standard conservative management of shoulder instabilities. However, postoperative ROM considerations are crucial in these patients, and specific rehabilitation protocols must be tailored based on surgical procedures (Bankart repair, Latarjet procedure, capsular shift, etc.) and quality of the tissues found at the time of surgery.

Initially, a period of immobilization in a sling is advocated. This must be worn from 2 to 4 weeks, including during sleep, in respect to the surgical procedure. ROM of the elbow, wrist, and hand is encouraged in the immediate postoperative period, and cryotherapy is recommended for 15 min three or four times a day. Gentle, small arc Codman's pendulum exercises are started in the early phase. Passive and active assisted ROM exercises start in the maximum protection phase, and it is imperative not to start strengthening or repetitive exercises until full ROM has been established. Early proprioception exercises are recommended. Strong resistance exercises with aggressive early postoperative rehabilitation do not appear to offer substantial advantages and could compromise the repair. In the minimum protection phase, exercises progress from isometrics for scapulothoracic and glenohumeral musculature, performed at submaximal intensity with no to minimal pain, to active concentric exercise, using Thera-Band or self-assisted closed kinetic chain patterns [21].

The goal is to achieve normal scapulothoracic and glenohumeral mechanics and good muscle endurance. Eccentric exercises should be performed in the functional phase, with continued progression of therapeutic exercise. Propedeutic to sport is gradually initiated, with plyometrics, isokinetics, and increasing difficult tasks aimed at restoring good balance and proprioception.

## Frozen Shoulder

Frozen shoulder, or adhesive capsulitis, describes a common shoulder condition characterized by painful and limited active and passive ROM. A common quandary with this set of complaints exists in determining the cause-and-effect cycle of the symptoms. Terminology and classification, as well as etiology, pathophysiology, epidemiology, natural history, and diagnostic evaluation, are explained elsewhere in this book (Chap. 28).

### Treatment Guidelines

Indications, technique, and effectiveness of corticosteroid injections will not be discussed in this chapter as far from the tasks of rehabilitation professionals. Identifying the stage of frozen shoulder in which a patient is presenting is important to determine the appropriate treatment regimen. Even though multiple interventions have been studied [22], the definitive treatment for frozen shoulder remains unclear. The overall goal of treatment is well accepted: relieve pain and restore motion and function.

Establishing treatment effectiveness is also difficult because the majority of patients significantly improve in approximately 1 year. Additionally, frequency and timing of visit and discharge criteria have not been established. Patient education about the natural history is probably an important treatment aspect.

#### Exercise, Modalities, and Manual Therapy

Exercise is the key to any treatment protocol for frozen shoulder. A typical exercise program is one of active and passive stretching with the goal of maintaining and regaining ROM. The basis of this program is the "four-quadrant stretching": forward flexion, internal rotation, external rotation, and cross body adduction and Codman's pendulum exercises. Stretching a frozen shoulder can be painful. Modalities are suggested to influence pain and muscle relaxation. Application of heat (microwave diathermy or moist heat) in conjunction of stretching has been shown to improve muscle extensibility [23]. This may occur by a reduction of muscle viscosity and neuromuscular-mediated relaxation. Transcutaneous electrical nerve stimulation (TENS), together with a prolonged low-load stretch, resulted in less pain and improved motion in patients with frozen shoulder. The basic strategy in treating structural stiffness is to apply appropriate tissue stress. The primary factors that guide this process are pain and ROM. Applying the correct tensile stress dose is based upon the patient's irritability (high – moderate – low). A pulley or a cane/stick may be used, depending on the patient's ability to tolerate the exercise. Many authors and clinicians advocate joint mobilization and aquatic therapy for pain reduction and improved ROM [24]. Finally, when functional ROM has been obtained and pain has improved, gentle strengthening and proprioception exercises can begin. There is no clear evidence to determine which patients may need formal supervised therapy rather

than a home program. Factors that may favor use of the former may be greater disability, more comorbidities, lower social support, lower education level, or high fear or anxiety. If the symptoms and motion are unresponsive to the different treatments over time (3–6 months) and quality of life is compromised, a manipulation under anesthesia or surgical capsular release should be considered. Postoperative protocols may vary from using a continuous passive motion device and exercise to a daily comprehensive physical therapy program as described before [25].

## References


1. Cyriax J. Textbook of orthopaedic medicine – diagnosis of soft tissue lesions, vol. I. 8th ed. London: Bailliere and Tindall; 1982.
2. Bey MJ, Brock SK, Beierwaltes WN, Zauel R, Kolowich P, Loch TR. In vivo measurement of subacromial space width during shoulder elevation: technique and preliminary results in patients following unilateral rotator cuff repair. Clin Biomech (Bristol, Avon). 2007;22:767–73.
3. Michener LA, McClure PW, Karduna AR. Anatomical and biomechanical mechanism of subacromial impingement syndrome. Clin Biomech (Bristol, Avon). 2003;18:369–79.
4. Grieve JR, Dickerson CR. Identification of evidence-based exposure guidelines. Occup Ergon. 2008;8:53–66.
5. Chopp JN, Fischer SL, Dickerson CR. The specificity of fatiguing protocols affects scapular orientation: implications for subacromial impingement. Clin Biomech (Bristol, Avon). 2011;26:40–5.
6. Lewis JS. Rotator cuff tendinopathy: a model for the continuum of pathology and related management. Br J Sports Med. 2010;44:918–23.
7. McClatchie L, Laprade J, Martin S, Jaglal SB, Richardson D, Agur A. Mobilizations of the asymptomatic cervical spine can reduce signs of shoulder dysfunctions in adults. Man Ther. 2009;14:369–74.
8. Lewis JS. Subacromial impingement syndrome: a musculoskeletal condition or a clinical illusion? Phys Ther Rev. 2011;16:388–98.
9. Harryman D, Mack L, Wang K, Jackins S, Richardson M, Matsen F. Repairs of the rotator cuff. Correlation of functional results with integrity of the cuff. J Bone Joint Surg Am. 1991;73A:982–9.
10. Gladstone J, Bishop J, Lo I, Flatow E. Fatty infiltration and atrophy of the rotator cuff do not improve after rotator cuff repair and correlate with poor functional outcome. Am J Sports Med. 2007;35:719–28.
11. Bassett RW, Cofield RH. Acute tears of the rotator cuff. The timing of surgical repair. Clin Orthop Relat Res. 1983;175:18–24.
12. Koo SS, Burkhart SS. Rehabilitation following arthroscopic rotator cuff repair. Clin Sports Med. 2010;29:203–11.
13. Schachter AK, Mchugh MP, Tyler TF, Kreminic IJ, Orishimo KF, Johnson C, et al. Electromyographic activity of selected scapular stabilizers during glenohumeral internal and external rotation contractions. J Shoulder Elbow Surg. 2010;19:884–90.
14. Brady B, Redfern J, MacDougal G, Williams J. The addition of aquatic therapy to rehabilitation following surgical rotator cuff repair: a feasibility study. Physiother Res Int. 2008;13:153–61.
15. Kelly BT, Roskin LA, Kirkendall DT, Speer KP. Shoulder muscle activation during aquatic and dry land exercises in nonimpaired subjects. J Orthop Sports Phys Ther. 2000;30:204–10.
16. Barber FA, Field LD, Ryu R. Biceps tendon and superior labrum injuries: decision making. J Bone Joint Surg Am. 2007;89A:1844–55.
17. Kibler WB, McMullen J. Scapular dyskinesis and its relation to shoulder pain. J Am Acad Orthop Surg. 2003;11:142–51.
18. Rockwood CA, Williams GR, Young DC. Disorders of the acromioclavicular joint. In: Rockwood CA, Matsen FA, editors. The shoulder. 2nd ed. Philadelphia: WB Saunders; 1998. p. 483–553.
19. Itoi E, Hatakeyama Y, Sato T, Kido T, Minagawa H, Yamamoto N, et al. Immobilization in external rotation after shoulder dislocation reduces the risk of recurrence. J Bone Joint Surg Am. 2007;89A:2124–31.
20. Dempster W. Mechanism of shoulder movement. Arch Phys Med Rehabil. 1965;46:49–70.
21. Wilk KE, Reinold MM, Andrews JR. Postoperative treatment principles in the throwing athlete. Sports Med Arthrosc. 2001;9:69–95.
22. Johnson AJ, Godges JJ, Zimmermann GJ, Ounanian LL. The effect of anterior versus posterior glide joint mobilization on external rotation range of motion in patients with shoulder adhesive capsulitis. J Orthop Sports Phys Ther. 2007;37:88–99.
23. Jarvinen TA, Jarvinen TL, Kaariainen M, Kalimo H, Jarvinen M. Muscle injuries: biology and treatment. Am J Sports Med. 2005;33:745–64.
24. Vermeulen HN, Rozing PM, Obermann WR, le Cessie S, Vliet Vlieland TP. Comparison of high-grade and low – grade mobilization techniques in the management of adhesive capsulitis of the shoulder: randomized controlled trial. Phys Ther. 2006;86:355–68.
25. Kelley MJ, McClure PW, Leggin BG. Frozen shoulder: evidence and a proposed model guiding rehabilitation. J Orthop Sports Phys Ther. 2009;2:135–48.