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SHOULDER IMPINGEMENT SYNDROME

Subacromial Impingement Syndrome

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The WSCC Care Pathways provide a standardized context for clinical decision making as well as a menu of possible interventions. These pathways are not intended to replace the clinical judgment of the individual physician. The needs of the individual patient may make it necessary to deviate from the recommendations contained in any given pathway.

Limitations

WSCC pathways are intended for use within our clinic system. They may be useful as a seed for regional guidelines or guidelines with wider application, but caution must be exercised. The following limitations would have to be addressed. 1) The literature searches employed would need to be more exhaustive; 2) inclusion criteria for published studies would need to be more stringent; 3) a wider pool of subject-matter experts must be tapped; 4) the participants of the consensus panel would need to be drawn from a broader cross-section of the profession and perhaps other health care providers as well. Although individual procedures and decision-making points within the Care Pathways have established validity or reliability, the pathways as a whole are untested.

ICD-9 Codes

718.81 Shoulder instability, excludes dislocation
719.61 Shoulder joint crepitus
726.0 Tendinitis or adhesive capsulitis of the shoulder
726.1 Supraspinatus syndrome
726.10 Bursitis in shoulder, unspecified
726.12 Biceps tenosynovitis

Sprains, strains, tears or ruptures:
840.3 Infraspinatus muscle or tendon
840.4 Rotator cuff or capsule
840.5 Subscapularis muscle
840.6 Supraspinatus muscle or tendon
840.8 Other unspecified sites of the shoulder or upper arm

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To the reader…

While the subject of this WSCC Care Pathway is shoulder impingement, the reader should bear in mind that some of the evaluation procedures and much of the rehabilitation and treatment pertain to other shoulder conditions.

You will see in the MANAGEMENT STRATEGY section of this document a series of sidebars in the left-hand column. These sidebars are a summary or overview of the office procedures and home care for the entire phase of treatment—not just those treatment goals discussed in the accompanying text.

You will notice on that we have chosen to adhere to a strict and limited definition of the terms “efficacy” and “effectiveness.” The term *efficacy* pertains to those studies whose outcome can be replicated only in a tightly controlled experimental setting but have yet to be borne out in a “real life” setting. *Effectiveness,* on the other hand, refers to studies whose results have been shown to have broad applicability in clinical practice but have not been subjected to examination in a more tightly controlled experimental setting.

BACKGROUND

Shoulder impingement syndrome can be defined as the encroachment of the acromion, coracoacromial ligament, coracoid process, and/or acromioclavicular joint on the structures that pass beneath them as the glenohumeral joint is moved, particularly in flexion and rotation.

Pathophysiology and Natural History

The clinical presentation in shoulder impingement most often results from accumulative and potentially degenerative[1,2,12] pathology that has progressed over months to years.[4]

Involvement is usually limited to the supraspinatus tendon and bursa,[3] and sometimes to the long head of the biceps. Less commonly, however, the infraspinatus and subscapularis tendons[7,11] may also be affected.

The condition often begins with minimal shoulder pain during activity, no weakness, and full glenohumeral range of motion.

The symptoms may progress over years to those of marked *tendinitis* with significant pain and decreased range of motion.[4] Tendon degeneration and bony changes in the coracoacromial arch may begin to occur. Repeated precipitous periods of shoulder pain at increasing frequency and severity are often seen. Eventually, pain with subsequent weakness may develop. Also, tears of the rotator cuff frequently occur. In severe cases, shoulder impingement may result in what is termed "frozen shoulder."[4]

NEER'S STAGES OF IMPINGEMENT

- Stage 1 is characterized by edema and tendinitis and is more typical in patients under 25 years old.
- Stage 2 is characterized by chronic inflammation, thickening and fibrosis of the impinged tendon due to repeated insults. This further decreases the size of the suprahumeral space. Stage 2 is more typical in patients between 25 and 40 years old and patients who have had a history of episodes of shoulder pain.
- Stage 3 is characterized by tendon degeneration, rupture, and arthritis. Patients with this stage of impingement are usually over 40 years old and have a prolonged history of shoulder problems. Often, at this stage, there will be radiographic evidence and a high likelihood of partial or full thickness rotator cuff tears.

Stage 1 and 2 are usually responsive to conservative management. Stage 3 is more resistant and a multidisciplinary approach may be necessary.

Predisposing Factors to Shoulder Impingement

I. Structural factors such as an abnormally shaped acromion, acromioclavicular (AC) degeneration,[3] altered vascularity of the supraspinatus or long head of the biceps tendons,[4] biceps tendon degeneration,[5] and a decrease in the subacromial outlet size due to inflammation or fibrosis.

II. Functional factors such as glenohumeral (GH) instability,[5,6] imbalance between the shoulder's internal rotators/adductors and external rotators/abductors,[7] dysfunction of the scapular stabilizers,[5,7-9] a tight posterior GH capsule,[10] tears or laxity of the glenoid labrum,[6] and congenital hyperelasticity.

Sports activities and occupations that often involve repetitive shoulder stress or microtrauma and may cause an increased incidence of impingement symptoms include: throwing,[6,11,12] swimming,[4,13] racquet sports, carpentry, welding, painting and plumbing. In addition, there is a significant incidence of shoulder pain in the general population.[14]

Epidemiology

Shoulder pain ranks third in frequency for conditions seen in general medical practice, behind headache and backache.[15]

In a Swedish study of middle-aged adults, 14% reported shoulder pain within the previous month lasting more than 24 hours.[14] The incidence of sick leave for shoulder pain within the previous year was 3% for the same population.[14]

The incidence of shoulder impingement as a cause of shoulder pain is unknown. However, Haig suggested that impingement (with or without rotator cuff tear) was the most common shoulder condition seen in one orthopedic surgeon's practice, making up an estimated 40% of referrals.[16]

EVALUATION

The following information summarizes the main symptoms and characteristics of patients with shoulder impingement syndrome. The characteristics of the two age groups have been placed side by side to facilitate comparison.

KEY SYMPTOMS OF IMPINGEMENT IN THE PATIENT UNDER 35[2]

- Toothache-like pain in the anterior acromion process (just inferior to the AC joint) or in the lateral shoulder, initially noticed after the provoking activity. Pain can also be referred into the lateral elbow, mimicking lateral epicondylitis.
- Pain that may progress and become present during the provoking activity and affect job or athletic performance.
- Avoidance of the provoking activity leads to relief of pain.
- Without activity modification or treatment, the discomfort can become worse at night and the patient often experiences inability to perform the activity that provoked the symptoms.
- Over months to years, the shoulder becomes stiffer and sometimes exhibits tenderness over the AC joint and painful “catching” when returning from an abducted or flexed position.

KEY SYMPTOMS OF IMPINGEMENT IN THE PATIENT OVER 35[2]

- A prolonged history of shoulder pain and refractory tendinitis.
- Toothache-like pain in the anterior acromion process (just inferior to the AC joint) or in the lateral shoulder that ranges from minimal to severe, is often worse at night, and often prevents athletic or job-related activities of the involved shoulder.
- Shoulder weakness due to pain (not true muscle weakness).
- Shoulder movement is often associated with crepitus.
- Minor trauma can result in a complete tear of a weakened rotator cuff tendon in this stage.

Physical Examination Summary

- Postural evaluation
- AROM of GH joint (include Apley's scratch tests and the unloaded empty can test).
- Palpation of joints and soft tissue of the shoulder girdle, cervical and thoracic spine, and upper ribs.
- Passive ROM and orthopedic procedures
    - *To screen for impingement:* Neer's impingement sign, Hawkins-Kennedy maneuver, compression of humerus up against the acromion
    - *To screen for instability:* supine apprehension test, load and shift maneuvers, relocation test
    - *To screen for labrum tears:* clunk test, crank test, "O'Brien's sign"
    - *To test for other specific structures:* horizontal adduction, biceps extension maneuvers, push-up test
- Muscle tests of the GH muscles (including the loaded empty-can test, and Speed's test) and scapular muscles.
- Motion palpation of the GH, AC, SC, upper ribs, and cervical and thoracic spine.
- Cervical ROM and orthopedic tests as needed.

Evaluation Strategy

Evaluation Steps

1. Establish the diagnosis of impingement syndrome.
2. Identify the soft tissue structures impinged.
3. Identify the etiologic and pre-disposing factors contributing to the impingement.

STEP 1: USE THE HISTORY AND OBJECTIVE FINDINGS TO ACCURATELY DIAGNOSE ANTERIOR IMPINGEMENT.

- Rule out diagnostic red flags for disease. Neoplasm and infection may cause erythema, swelling, or warmth over the area without trauma or significant injury. (See CSPE protocol, *Shoulder Pain: Red Flags for Disease*.) Visceral referred pain may cause shoulder pain not aggravated by mechanical means.
- Rule out significant injury (e.g., fracture, dislocation, tendon rupture) in cases with a traumatic onset. (See CSPE protocol, *Shoulder Diagnosis: An Aid to Pattern Recognition*.)
- As necessary, rule out common differential diagnoses in the exam such as cervical facet syndromes, cervical radiculopathy, thoracic outlet syndrome, suprascapular nerve injury, and phrenic nerve irritation.[17]
- Consider an impingement diagnosis if the pain was provoked with impingement maneuvers such as

Neer's impingement sign, the impingement test,[4] a painful arc with shoulder abduction, Hawkins-Kennedy maneuver,[4] or compression of the humerus toward the acromion.

Range of Motion Findings

Impingement is indicated when pain upon testing is located anterior and inferior to the acromion and the AC joint.

- A painful arc of GH motion may be present at 60-100 degrees[1,18] of abduction, possibly accompanied by GH catching or crepitus. The pain may be aggravated by adding resistance at 90 degrees of abduction. A positive "impingement sign" is anterior or lateral shoulder pain with active/passive forward flexion of the internally rotated humerus.[15]

- Apley's I (scratch), and Apley's II (also known as the "fasten the bra" test) may cause anterior or lateral shoulder pain or show the shoulder to be restricted.

General Impingement Tests

Note: Do not let the shoulder elevate or "shrug" as it is tested.

- *Neer's test (impingement sign).*[4,15] Passive forward flexion of the internally rotated humerus accompanied by extra pressure compresses the supra-spinatus tendon, causing anterior shoulder pain. This test is thought to have low specificity and will often cause pain in asymptomatic shoulders.[19]

- *Modified Neer's test.*[20] External rotation of the humerus, in the previous test, can cause compression and pain of the biceps tendon. *Relief* of painful catching with external rotation of the humerus suggests more supraspinatus tendon involvement than biceps. This maneuver can be further modified by applying downward pressure on the acromion, which should cause shoulder pain before end range in most impingement cases.[21]

- *Compression of the humerus upward* and *toward the acromion* can cause pain by impingement of the anterior tendons or the subacromial bursa. Again, the humerus can be internally or externally rotated to help differentiate the involved structures. This test may be the least sensitive but most specific test for impingement.[19]

- *Hawkins-Kennedy maneuver.*[2] The humerus is passively flexed forward to 90 degrees and internally rotated with elbow flexed to 90 degrees. This position increases impingement of anterior tendons by the greater tuberosity of the humerus, causing anterior or lateral shoulder pain.

- *Modified or 2-step Hawkins-Kennedy maneuver*. The humerus is abducted to 90 degrees. The examiner presses the acromion inferiorly while internally and externally rotating the humerus. A positive test elicits pain. Crepitus may also be elicited. Repeat the maneuver with the humerus horizontally adducted. This test may have good sensitivity and specificity for anterior impingement.[19]

STEP 2: IDENTIFY THE SOFT TISSUE STRUCTURES IMPINGED TO DETERMINE THE PAIN GENERATORS.

When impingement is present, use orthopedic tests, muscle strength tests, and palpation to help identify the structures most affected, which are commonly the supraspinatus, long head of the biceps, and/or the subdeltoid bursa.

Supraspinatus Tests

- Palpatory tenderness at the supraspinatus insertion (anterior and inferior to the AC joint) with the humerus extended and internally rotated.
- Anterior or lateral shoulder pain with the empty-can test.
- Weakness or pain with the supraspinatus muscle test[6] (good specificity and sensitivity).[19]
- Severe pain or inability to lower the arm slowly with the drop-arm test.[22]

Biceps Tests

- Palpatory tenderness over the tendon of the long head of the biceps.[23]
- Anterior shoulder pain with biceps extension or Speed's tests.[1]
- Modified or 3-step biceps extension can be done to increase the effectiveness of a simple biceps extension.[19]

  With the humerus at the side, the patient's elbow is passively flexed so the patient's fingers touch the ipsilateral shoulder, the examiner then passively extends the shoulder and the elbow, stretching the biceps tendon.

  A modified Speed's test can be done by providing resistance to shoulder flexion from this extended position. Anterior shoulder pain with elbow extension or resisted flexion suggests involvement of the tendon of the long head of the biceps.[19]
- Asymmetrical bulging of the biceps muscle with Popeye (Ludington's) test indicates likely biceps tendon rupture.[18]

Bursitis Tests

- Palpatory tenderness is found at the anterolateral acromion that reduces with passive abduction of the humerus, most likely due to retraction of the bursa under the acromion (Dawbarn's test). This test often has limited clinical usefulness. The acute patient often cannot perform the maneuver, which likely has low specificity.[19]

Palpatory tenderness or bogginess anterior to the AC joint with passive extension of the humerus.

STEP 3: IDENTIFY ETIOLOGIC OR PREDISPOSING FACTORS.

Summary of co-factors

- GH instability/hypermobility
- Glenoid labrum tears
- Rotator cuff considerations
- Joint restrictions in the shoulder girdle
- Aberrant scapulothoracic movements
- Postural and spinal factors
- Environmental and behavioral factors

GH Joint Considerations: Overview

- Identify those patients with labral tears or congenital hyperelasticity. Both are associated with shoulder impingement and adversely affect the patient's response to conservative care.

- Identification of GH instability/laxity is *crucial* when considering an impingement diagnosis. Instability is often a primary cause of impingement. GH instability/laxity is a possible contributor to impingement if pain is provoked with the supine shoulder apprehension test, the load and shift maneuvers, or other instability tests.

- Identify tightness of the posterior rotator cuff or joint capsule by testing GH internal rotation, horizontal adduction, and tests for posterior glide of the humerus. Tightness can cause forward migration of the humeral head and, therefore, impingement.

Tests for Low Grade Instability or Hypermobility*

- Increased GH external rotation may indicate subscapularis weakness and GH laxity.[10] This laxity/instability is often the primary problem, with the impingement and tendinitis a secondary result of the anterior subluxation of the humeral head.[1]

- The supine shoulder apprehension test indicates possible joint capsule instability/hypermobility when pain *without apprehension, shift,* or *clunk* results.[11,12] Relief of pain with the relocation test helps to confirm low grade anterior GH joint instability, an important secondary contributor to impingement.[1,12,24] In one study, 68% of patients with instability had significant impingement signs.[10]

- The load and shift maneuvers or anterior/posterior drawer tests may detect hypermobility due to microtrauma, subluxation, ligament damage, hyperelasticity, or tears of the glenoid labrum, which may be associated with a clunk or click.[6] GH instability in any direction can be a contributing factor to impingement.[10]

- The thumb-to-forearm test can be performed to screen for congenital hyperelasticity, a contributor to shoulder joint instability and impingement.[9]

* The literature is inconsistent when using the terms hypermobility and instability. Even the term instability represents various degrees of severity. For our purposes, instability will be considered on a continuum ranging from mild (as in cases when it is associated with impingement syndrome) to severe (as with labrum tears or a tendency toward dislocation).

Glenoid Labrum Signs and Tests

Objective instability (anterior or inferior) relieved by the relocation test, combined with clicking in one the following tests produced a sensitivity of 90% and a specificity of 85% for identifying labral tears in one retrospective study of 54 patients with shoulder pain.[25]

- *Clicking with internal and external rotation of the shoulder and with the load and shift test*. The patient's arm is in 20 degrees of flexion and abduction. The examiner stabilizes the scapula with one hand while the other hand grasps the proximal humerus and medially loads the humeral head into the glenoid while performing anterior-to-posterior translation.

- *The crank test*. The patient is supine. The examiner places the humerus in a position of maximum forward flexion and applies an axial load to the humerus. The test is performed in GH internal and external rotation.

Other Tests to Detect Labral Tears or Significant Instability

- *The "O'Brien sign."* The patient elevates the arm to 120 degrees of horizontal adduction, then resists a downward load with the arm completely internally rotated, then again with the arm completely rotated externally (i.e., palm up). A labrum tear is indicated if tests cause deep shoulder pain that is greater when the arm is pronated. In one prospective study, this test correctly predicted 53 of 56 patients who had surgically confirmed labrum tears. There were no false negatives.[26]

- *The Kocher maneuver*. Performed with the patient seated and the arm slightly abducted and externally rotated, the elbow is flexed to 90 degrees. The examiner distracts the arm, then passively adducts the arm, followed by internal rotation.

- *The clunk test*. Performed with the patient supine and the humerus maximally abducted, the examiner supplies anterior force to the humeral head while circumducting.

Note: These tests should be repeated several times. A clunk or click is positive and indicates the need for imaging, usually CT arthrography. A painful catch may also be a significant finding. Labral tears often do not respond to conservative therapy.

Rotator Cuff Considerations

- Decreased GH internal rotation[9] or horizontal adduction may indicate posterior rotator cuff or GH capsule tightness, possible causes of impingement.

- Test for infraspinatus, teres minor, and posterior capsule tightness in a position of internal rotation and cross-arm adduction. Tightness of these structures can cause superior migration of the humeral head.[1,9]

- Test for subscapularis (using the "lift-off" test†), infraspinatus, and teres minor strength and trigger points. These muscles (and the biceps tendon) normally function as humeral head depressers, preventing superior migration of the humeral head and impingement.[5,6]

- Significantly decreased unilateral GH active range of motion with fuller passive range of motion indicates possible rotator cuff tear. (See Prognostic Consideration, P. 15.)

†Considered the best test, patients place the back of hand on low back (not sacrum) and attempt to raise up against doctor's resistance.

Joint Restrictions in the Shoulder Girdle

- Joint restriction[7,9] or instability[5,6,11] may occur in any direction and contribute to shoulder impingement. Biomechanical faults of the shoulder girdle may include aberrant AC and sternoclavicular (SC) joint mobility, and restriction in GH glide.

- Posterior [7,9] and possibly inferior joint plays are most often restricted in anterior impingement. Tightness of the posterior GH capsule forces the humeral head anterior, possibly contributing to impingement. (For evaluation of the GH complex using static palpation, see Management Section, P. 41.)

Examination of Scapulothoracic Stabilizers

Dynamic problems in the key movement patterns of the scapulothoracic stabilizers, especially poor scapular motion with abduction or flexion, may cause or contribute to shoulder impingement. (See CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*.)

Scapulothoracic rhythm (during abduction)

- The scapula should not appreciably move during first 30 and last 30 degrees of abduction. The middle of the range should move at about a 1:1 relationship with the humerus. Abnormal movement can suggest scapular adhesions, capsular adhesions, or poor muscular control and coordination.

- Watch for stuttering during eccentric phase.

- Watch for early shoulder hiking (first 30 degrees), suggesting inhibited middle and lower trapezius, and/or overactive upper trapezius and levator scapula.

Push-up test

- Look for scapular winging (weak or inhibited serratus anterior).

- Approximation of medial border, cephalad movement.

Scapular coordination (side posture, active)

Instruct the patient to move the scapula in a variety of directions: protract, retract, and inferior (downward) displacement. See if the movement is occurring at the shoulder, entire upper extremity, or the trunk.

Scapular retraction (prone with arms externally rotated and thumbs out)

Look for superior elevation of the scapula, increased cervicothoracic kyphosis, or pushing off with the forehead. Note any shaking or rapid fatigue (inhibition caused by overactivity of pec girdle and suggesting lack of coordination).

Postural and Spinal Factors

- Static postural co-factors include rounded shoulders (e.g., consider hypertonic pectoralis and/or weak rhomboid/middle trapezius muscles), thoracic hyperkyphosis,[27,28] and thoraco-lumbar flexion bias (may be associated with hypertonic rectus abdominis muscles).

- Spinal joint dysfunction in the cervical, thoracic, and lumbar regions can contribute to altered biomechanics of the shoulder in the throwing motion and other overhead activities.

- Upper thoracic and lower cervical extension and lateral flexion are required for the final 20 degrees of shoulder abduction.[27]

- Cervical rotation and extension are necessary for "targeting" in the throwing athlete.[29]

- Lateral trunk flexion is necessary for arm abduction in throwing.[29]

- Weak thigh and abdominal muscles may contribute to shoulder pain in throwing athletes.

Environmental and Behavioral Considerations

Review the history and physical exam for key information indicating a poor prognosis for recovery from shoulder impingement. (See Prognostic Considerations, P. 15.) Analyze the patient's ergonomic, work, and sports requirements to recommend corrective strategies. (See Management section.)

- Assess the patient for repetitive or sustained use of arms above the horizontal (e.g., in a sports context, swimming, tennis, and throwing can be particularly aggravating); previous shoulder dislocation or other trauma; and for strenuous occupation (especially in older patients.)[14]

Key Ancillary Studies

The Impingement Test. For patients with a positive Neer's impingement sign, a confirmation test can be performed in which 10 ml of 1% lidocaine hydrochloride is injected into the subacromial space. The Neer's maneuver is repeated. Relief of pain confirms the diagnosis. If muscle strength is also restored, then a complete tear is very unlikely. In most cases, this invasive test is not necessary before initiating a conservative care program.[30]

DIAGNOSTIC IMAGING OPTIONS [3]

Indicators for imaging studies include localized swelling, history of significant trauma, pain and limitation of motion with shoulder movement in all directions, and significant shoulder pain in those patients over 40 years of age.

- Diagnostic imaging is indicated to rule out structural causes if approximately six to eight weeks of conservative treatment fails to adequately improve the patient's pain and function.

- Plain Film Radiography. X-ray views of the shoulder should include internal and external rotation and axillary views to look for calcific bursitis, cystic changes in the greater tuberosity, congenital abnor-malities in the shape of the acromion, or superior migration of the humerus, (indicates rotator cuff tear). Consider a variation to the AP external view

with a 30 degree caudal projection. This view will more clearly show the anterior acromion.

Consider an AP acromioclavicular view, a scapular Y-view, or the supraspinatus outlet view. Look for degenerative changes, osteophytes, or an os acromiale.

- Ultrasound. This is most useful in patients over 50 who are suspected of having complete tears.

- MRI. Indicators include a strong suspicion of rotator cuff tear, large spurs on X-rays, or failure to respond to six to eight weeks of conservative care. MRI of the shoulder will detect or rule out bony or soft tissue pathologies of the coracoacromial arch including rotator cuff tear, any impingement of the tendon(s) by spurs, and avascular necrosis.

- Computed Tomography. When combined with arthrography, this is the most sensitive technique to evaluate the glenoid labrum and joint capsule in suspected secondary impingement.

Lab Tests. If there is suspicion of a disease process, an ESR/CRP and CBC can be ordered. In cases where an inflammatory process is suspected, consider an arthritis screening panel that includes uric acid level.

Prognostic Considerations

- A history of recalcitrant shoulder pain, pre-treatment symptoms lasting longer than one year, and significant functional impairment can all indicate a poorer prognosis.

- Patients over 40 years of age have an increased incidence of the impingement becoming chronic and often are unable to resume work or athletic activities associated with the symptoms.

- “Catching” with shoulder abduction and/or pain and limitation in all directions of shoulder motion in the chronic stage indicate probable arthritis or degenerative changes. Rehabilitation will be slower. Surgery may be required if conservative treatment fails.

- Significant instability suggests a more difficult case. A labrum tear has a much poorer prognosis for non-surgical care.

- A significant decrease in abduction and external rotation following the capsular pattern suggests adhesive capsulitis, which has a longer recovery.

- A combination of significant shoulder muscle weakness; infraspinatus and supraspinatus wasting; palpatory tenderness over the greater tuberosity, anterior acromion, and AC joint; decreased active range of motion with fuller passive range of motion; and superior migration of the humerus on X-ray indicate possible rotator cuff tear and the need for further evaluation. (See Key Ancillary Studies, P. 14.)

- X-ray findings of degenerative changes in the coracoacromial arch, an abnormally shaped acromion, and cystic changes of the greater tuberosity all indicate a poorer prognosis and the possible need for additional studies if the condition is not improved with six to eight weeks of conservative care. (See Key Ancillary Studies, P. 14.)

See CSPE protocol, *Shoulder Pain/Impairment: Red Flags for Disease*.

Outcome Measures

A number of functional questionnaires can be used to track progress. These include the University of Washington Simple Shoulder Test,[31] the Shoulder Rating Questionnaire,[32] and the DASH Patient Questionnaire.[33]

The clinician may also choose from the following.

- m-Vas for pain (at rest or with specific movements or activities)
- Active, passive and/or resisted range of motion
- Palpatory tenderness
- Muscle strength as compared to the uninvolved shoulder
- Scapular motion in various movement patterns or ADLs
- Restoration of ADLs

MANAGEMENT: STRATEGY

Please Note: The boxed information that you will see on the following pages is a summary of the office and home treatment for the <u>entire phase</u> of treatment—not just for the goal(s) that may be described on the same page. Where possible, we have tried to highlight the goal appropriate for that section.

The management strategy has been divided into several phases of intervention. Time periods for any phase are approximate and will vary from patient to patient. Moving from phase to phase is more dependent on the operational end points (listed at the end of each section) than on the time periods suggested on this page. For the reader's convenience, a general treatment summary for home and office care appears in the left column throughout the sections describing treatment during the Acute and Rehabilitative phases.

Patients may enter care at any of the phases listed below. However, the practitioner should review the acute care recommendations to see if any would still be applicable, while at the same time moving the patient into the appropriate phase of management. For a summary of Operational End Points, see P. 60.

Acute Inflammatory Phase Intervention: Usually 1-3 days from time of onset or whenever the patient relapses into an acute phase.

Phase 1 Rehabilitation: When the acute phase ends, usually from day 3 to two weeks.

Phase 2 Rehabilitation: Approximately week 2 to week 4.

Phase 3 Rehabilitation: Approximately week 4 to week 6.

Phase 4 Rehabilitation: Approximately week 6 to week 8.[34]

Authors suggest that a conservative, non-operative approach can range from six weeks to six months of care.[1,16,30] Neer's Stages 1 and 2 are usually responsive to conservative management. Stage 3 is more resistant; a multidisciplinary approach may be necessary. (This stage is characterized by arthritis, rupture, and degeneration in patients over 40 with a prolonged history of shoulder problems).[21, 35-38]

Acute Inflammatory Phase

Acute stage healing is characterized by the inflammatory process. The main goal is to control pain and limit the amount of inflammation and further tissue damage, which will speed the healing process and thus allow a faster transition into rehabilitation.

Initial treatment also emphasizes maintaining range of motion (to prevent adhesions and capsular creep) and muscle tone. It is important to keep the shoulder as mobile as possible while protecting the area from further microtrauma.

Note: Treatment procedures should not provoke or aggravate patient's shoulder pain.[39,40]

Recommended treatment frequency: Daily or every other day, depending on severity.

TREATMENT GOALS

1. Reduce pain and inflammation.
2. Maintain pain-free range of motion (ROM) and proprioceptive awareness.
3. Prevent muscular atrophy.
4. Normalize the biomechanics of the shoulder girdle complex, the costovertebral articulations, and the cervical and thoracic spinal joints.
5. Teach postural awareness specific to shoulder girdle complex (e.g., relax shoulder, postural awareness of rounded shoulders and increased kyphosis, and "sternal lift").
6. Protect the injured tissue from further trauma.[39]

TREATMENT GOAL: REDUCE PAIN AND INFLAMMATION.

The clinician may choose from any of the following treatment options to help reduce pain and inflammation.

Office treatment

✓ *Electromodalities/ice.* Choose from the following options based on presentation and severity: ice with compression (sometimes not well tolerated by older patients); phonophoresis with hydrocortisone,[41] lidocaine, salicylate, or arnica; interferential; low volt galvanic (+); iontophoresis (+) polarity (magnesium sulfate 2%, hydrocortisone 0.5%, xylocaine 5%); sine wave; high volt galvanic (+); microcurrent; pulsed ultrasound (US).[42,43] (See Physical Therapy Modalities P. 47 and CSPE protocol, *Physical Therapy Modalities*.)

✓ *Gentle massage techniques*. Gentle effleurage will help relax muscles and move inflammatory fluids.

✓ *Treat myofascial trigger points*. This can be done for early pain control or can be delayed until the subacute phase of treatment. Choose from or combine the following techniques: post-isometric relaxation, Nimmo, ischemic compression.[2,44]

(See Pp. 44-45.)

Home care and patient education

✓ *Botanicals, supplements, and over-the-counter (OTC) medications.* For inflammation, consider proteolytic enzymes (e.g., bromelain) 3-4 tablets per day. (See Botanical and Nutritional Supplements, P. 58, as well as the CSPE protocol, *Trauma: Diet, Nutritional Supplements, and Botanical Considerations*.) Another option is OTC medications at pain or anti-inflammatory dosages (see CSPE protocol, *NSAIDs*).[4,6,45]

✓ *Ice therapy* with compression[6,45] (15 minutes every hour).

✓ *TENS and microcurrent*. A home TENS unit (conventional mode) or microcurrent unit may be given if necessary (for example, in cases with severe or recalcitrant pain).[37,38,42,46]

Summary of Office Treatment: Acute Phase

- **Electromodlities/ice**
- Passive ROM/mobilization
- Gentle mobilization/ manipulation of GH
- Teach isometrics
- Adjust AC, SC, spine, etc. (now or in next phase)
- Teach postural first aid

Other Options

- **Gentle massage**
- **MFTP therapy**
- Bracing (if necessary)

Summary of Home Care: Acute Phase

- **OTC/botanicals/ice therapy**
- Codman pendulum/wand
- AROM: IR and ER
- Isometrics/ball squeeze
- Aerobic activity
- Activity modification (2-6 weeks)
- Avoid impingement positions

Other Options

- **Home TENS or microcurrent**

Summary of Office Treatment: Acute Phase

- Electrom odlities/ice
- **Passive ROM/ mobilization**
- **Gentle mobilization/ manipulation of GH**
- Teach isometrics
- Adjust AC, SC, spine, etc. (now or in next phase)
- Teach postural first aid

Other Options

- **Gentle massage**
- **MFTP therapy**
- Bracing (if necessary)

Summary of Home Care: Acute Phase

- OTC /botanicals/ice therapy
- **Codman pendulum/wand**
- **AROM: IR and ER**
- Isometri cs/ball squeeze
- Aerobic activity
- Activity modification (2-6 weeks)
- Avoid impingement positions

Other Options

- Home TENS or microcurrent

TREATMENT GOAL: MAINTAIN PAIN-FREE RANGE OF MOTION AND PROPRIOCEPTIVE AWARENESS.

The clinician may use generalized passive range of motion procedures and/or mobilization into specific directions.[2,5,47]

Office treatment

✓ *Generalized passive-ROM therapy*. The clinician passively moves the GH joint in broad painless directions, using circumduction and general ROM (with[48] or without traction).

✓ *Specific graded mobilization* to GH joint within the pain-free, non-impingement ranges.[39]

Home care and patient education

A key part of home care is to immediately get the patient started with passive and some active-assisted range of motion activities. Choose some combination of the following:

✓ *Codman's exercises/passive range of motion (PROM)*. Pendulum arm swings (without weights initially). Begin with a one-inch diameter circular motion. Increasing the diameter and adding alphabet exercises may be useful as patient's tolerance allows. Begin passively and work up to active arm swings.[6,39,45]

✓ *Wand (PROM)*. Use the wand for passive or, if tolerable, active assisted range of motion. Patient may try to work through painful arc.[39] (See Special Appendix, Figures I a-b.)

✓ *Active internal and external rotation* with the arm in the dependent position. All motions should be pain-free.[39]

Summary of Office Treatment: Acute Phase

- Electrom odlities/ice
- P assive ROM/ mobilization
- Gentle mobilization/ manipulation of GH
- **Teach isometrics**
- Adjust AC, SC, spine, etc. (now or in next phase)
- Teach postural first aid

Other Options

- Gentle massage
- MFTP therapy
- Bracing (if necessary)

Summary of Home Care: Acute Phase

- OTC /botanicals/ice therapy
- Codm an pendulum/wand
- AROM: IR and ER
- **Isometrics/ball squeeze**
- **Aerobic activity**
- Activity modification (2-6 weeks)
- Avoid impingement positions

Other Options

- Home TENS or microcurrent

TREATMENT GOAL: PREVENT MUSCULAR ATROPHY.

It is important that the patient begin isometric contractions as soon as possible. Doctor-assisted isometrics are optional, but the patient should be taught the exercises for home care.

Office treatment

✓ *Doctor-assisted isometrics*. Begin with submaximal isometrics (65% maximum)[49] and work up to maximum effort as pain allows. Focus on the humeral head depressors, which include the rotator cuff muscles and the long head of the biceps. Initially, perform these with the arm in the dependent position. Work up to multiangle isometrics (MAI) as pain allows. Avoid impingement positions.[39,50] (See Special Appendix, Figures II a-d.)

Home care and patient education

✓ *Isometrics*. These exercises can be performed against a wall, physioball, or the patient's free hand. Perform 6 times a day, at 6 repetitions, with a holding of 6 seconds each to patient tolerance (65% to maximum effort). Include internal and external rotation, and shoulder and elbow flexion (supinated), with the arm in the dependent position.[39] (See Special Appendix, Figures III a-d.)

✓ *Handball squeezes.* If unable to do active isometrics, consider asking the patient to perform handball squeezes to tolerance. These can also be done at multiple angles (20-degree intervals in scaption and/or flexion), staying below the impingement range.

✓ *Cross-train*. Encourage the patient to cross-train the well shoulder and the other joints of the kinetic chain of the injured shoulder. This is especially important for athletes who cannot do the isometric exercises with the symptomatic shoulder. Progressive resistance exercise (PRE) of the uninjured large muscle groups may also aid healing and reduce muscle atrophy.[51]

✓ *Aerobic activity*. Also encourage the patient to perform aerobic exercise to maintain cardiovascular function and general muscle tone (e.g., stationary bike, walking, pool walking, and swimming with kickboard or with an altered stroke*).*[47]

Summary of Office Treatment: Acute Phase

- Electrom odlities/ice
- P assive ROM/ mobilization
- Gentle mobilization/ manipulation of GH
- Teach isometrics
- **Adjust AC, SC, spine, etc. (now or in next phase)**
- **Teach postural first aid**

Other Options
- Gentle massage
- MFTP therapy
- Bracing (if necessary)

Summary of Home Care: Acute Phase

- OTC /botanicals/ice therapy
- Codm an pendulum/wand
- AROM: IR and ER
- Isometri cs/ball squeeze
- Aerobic activity
- Activity modification (2-6 weeks)
- Avoid impingement positions

Other Options
- Home TENS or microcurrent

TREATMENT GOAL: NORMALIZE BIOMECHANICS OF RELATED JOINTS.

The joints of the shoulder girdle complex as well as the cervical, thoracic, and costovertebral articulations should be assessed.

Mobilization of related joints can be done during the acute phase of treatment or later in the subacute phases. Although these joints are not likely to be the major pain generators, restoration of their function is important to the overall function of the shoulder.[52]

Office treatment

✓ *Manipulate or mobilize restrictions of the AC, SC, or scapulothoracic articulation* to restore normal function to the girdle as a whole.

✓ *Adjust related joints of the ribs, cervical and thoracic spine*.[2] Restore restricted intersegmental motion to the thoracic and cervical spine and ribs using chiropractic manipulative techniques. Restrictions in these spinal joints may affect the biomechanics of the shoulder girdle.[40,53,54]

TREATMENT GOAL: TEACH POSTURAL "FIRST AID."

Office, self-care, and patient education

The patient should be taught strategies to prevent inappropriately elevating or "hiking" the shoulder when raising the arm.[55] Rounded or anteriorly rolled shoulders and forward head carriage can be corrected by "lifting" the sternum. Patients should be instructed to monitor and modify poor posture throughout the day, especially when they are in the acute phase.

Summary of Office Treatment: Acute Phase

- Electrom odlities/ice
- P assive ROM/ mobilization
- Gentle mobilization/ manipulation of GH
- Teach isometrics
- Adjust AC, SC, spine, etc. (now or in next phase)
- Teach postural first aid

Other Options
- Gentle massage
- MFTP therapy
- **Bracing (if necessary)**

Summary of Home Care: Acute Phase

- OTC /botanicals/ice therapy
- Codm an pendulum/wand
- AROM: IR and ER
- Isometri cs/ball squeeze
- Aerobic activity
- **Activity modification (2-6 weeks)**
- **Avoid impingement**
- **positions**

Other Options
- Home TENS or microcurrent

TREATMENT GOAL: PROTECT THE INJURED TISSUE FROM FURTHER MICROTRAUMA.

Office treatment

✓ *Bracing*. Typically bracing is not appropriate for impingement syndrome. However, in cases with severe pain, immobilization may be helpful to reduce arm use and pain. An ace wrap, tape, or a sling can be used for up to 3 days.[16] Patients over 60 years old have an increased risk of developing adhesive capsulitis following immobilization. Therefore, keeping the shoulder as mobile as pain allows is extremely important.[40]

Home care and patient education

✓ *Teach patient to avoid impingement positions*. Any elevation above 60 degrees in abduction or 90 degrees flexion tends to impinge the suprahumeral structures. Humeral internal and external rotation in these positions may further irritate the structures and should be avoided. In addition, inferior loading should be avoided (e.g., carrying a briefcase or shoulder bag).[40]

✓ *Activity modification*. The patient must discontinue any aggravating activity. No overhead activity should be performed for 3-6 weeks, as appropriate (based on patient's progress).[37,40] Work and sports activities will need to be examined. Necessary modifications and/or restrictions should be discussed at this time.[4,18,37,38,40,56] Athletes may need to refrain from the aggravating sport for 2-6 weeks.

OPERATIONAL END POINTS: ACUTE PHASE

Indicators for moving to the next phase of treatment:

- **Patient can tolerate acute phase home exercises with little or no discomfort.**
- **As inflammation clears, severity of pain is reduced.**
- **No visible signs of swelling or bogginess (compared with well shoulder).**
- **Pain at rest (if present) is decreased.**

The Warm-up

When patients do their rehab exercises, whether in the clinic, at home or in a health club, they should begin with a warm-up session.

In this phase, a warm-up session could consist of any upper-body aerobic activity, such as hand-peddling an upper-body ergometer (UBE). If available, have the patient use an aerodyne bicycle—progress from passive to moderately active, to active for 5-15 minutes daily.

Rehabilitation: Phase 1

During the first phase of rehabilitation, improve pain-free range of motion while beginning to work on strength and endurance of the rotator cuff and biceps muscles. *In general, external rotators usually require more strengthening than the internal rotators*.[16] In addition, the scapula often requires training, beginning with patients becoming proprioceptively aware of the scapular stabilizers, especially the lower trapezius. Once this awareness has been achieved, begin exercises to strengthen the mid- and lower trapezius and serratus anterior.

Note: During rehabilitation—and all subacute stages of healing—procedures should be *pain-free* in order to minimize microtrauma and promote maximum collagen repair and flexibility.

Recommended Treatment Frequency: 2-3 times per week
Home exercise schedule: Daily

TREATMENT GOALS

1. Promote collagen repair. Prevent or reduce adhesions.
2. Improve pain-free range of motion and proprioceptive awareness.
3. Prevent atrophy. Strengthen GH stabilizers and humeral head depressors.
4. Improve scapulothoracic stabilization.
5. Normalize joint mechanics of spine and shoulder girdle.
6. Continue postural education.
7. Continue control of pain and inflammation.[39]

Summary of Office Treatment: Phase 1 (Week 1-2)

- **Transverse friction massage**
- Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine
- Stretching techniques (e.g., PIR)
- Stretch post. capsule (if nec.)
- Doctor-assist ed ROM (flx/ext/scap)
- T each MAI
- Teach scapular and serratus awareness
- Postural education
- PT for pain (as needed)

Other Options

- **Contrast therapy**
- **Massage (e.g., effleurage)**
- **PT**
- Russia n stimulation
- Teach short arch

Summary of Home Care: Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- PROM (or assisted): pendulum/ wand/wall walk
- AROM in flexion, extension, scapular elevation
- MAI: IR, ER, flexion, extension, scaption, elbow flexion
- Begin scapula track exercises
- Sternal lifts; chin tucks
- OTC/botanicals (as needed)
- Maintain aerobic activity

Other Options

- **Contrast therapy**
- **Nutritional supports**

TREATMENT GOAL: PROMOTE COLLAGEN REPAIR. PREVENT OR REDUCE ADHESIONS.

Choose from the following procedures. *These interventions may not be necessary in mild cases*.

Office treatment

✓ *Transverse friction massage* can be performed to patient tolerance. A common treatment schedule would be 3 times per week for 2-4 weeks.[2] The most common structures to be impinged are the supraspinatus tendon and the biceps tendon. Occasionally treatment can be directed to the coracoacromial ligament and the external rotators.[27,57,58] (See Transverse Friction Massage, Pp. 41-42, for more details.)

✓ *Contrast therapy*. Alternating heat and ice for a total of 20 minutes; end with ice. (For more information, see the CSPE protocol, *Physical Therapy Modalities*.)

✓ *Massage* such as effleurage can be used to facilitate flushing of debris in the injured site.[42,43]

✓ *Physical Therapy*. Treatment options include phonophoresis, TENS,[2] IFC, EMS, microcurrent,[42,43] and US[4,18,37] (pulsed and continuous).[48] Any heat therapy may be helpful as well. (See the CSPE protocol, *Physical Therapy Modalities*.)

Home care and patient education

✓ *Contrast therapy* at home.[42] (See the CSPE protocol, *Physical Therapy Modalities.*)

✓ *Nutritional support to aid healing*. (See CSPE protocol, *Trauma: Diet, Nutritional Supplements, and Botanical Considerations*, as well as P. 59.)

Summary of Office Treatment: Phase 1 (Week 1-2)

- Transverse friction massage
- **Stretching techniques (e.g., PIR)**
- **Stretch posterior capsule (if necessary)**
- **Doctor-assisted ROM (flx/ext/scap)**
- Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine
- T each MAI
- Teach scapular and serratus awareness
- Postural education
- PT for pain (as needed)

Other Options

- Contrast therapy
- Massage (e.g., effleurage)
- PT
- Russia n stimulation
- Teach short arch

Summary of Home Care: Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- **PROM (or assisted): pendulum/ wand/wall, walk**
- **AROM in flexion, extension, scapular elevation**
- MAI: IR, ER, flexion, extension, scaption, elbow flexion
- Begin scapula track exercises
- Sternal lifts; chin tucks
- OTC/botanicals (as needed)
- Maintain aerobic activity

Other Options

- Contrast therapy
- Nutritio nal supports

TREATMENT GOAL: IMPROVE PAIN-FREE ROM AND PROPRIOCEPTIVE AWARENESS.

Office treatment

✓ *Elongate and relax muscles*. Choose any combination of post-isometric relaxation (PIR), contract-relax, hold-relax, reciprocal inhibition, cool and stretch, and myofascial release technique. Muscles affecting the GH joint that are prone to tightness include supraspinatus, external rotators, and the subscapularis affecting the GH joint. Muscles affecting the scapula that are prone to tightness include the upper trapezius and levator scapula.[57]

✓ *Stretch posterior capsule*. Posterior capsule tightness is sometimes implicated in impingement syndromes.[2,10,40,47,59] (See Special Appendix, Figure I c.)

✓ *Increase range of motion*. The clinician may continue general passive ROM with traction through the painful arc of abduction and external rotation.[48] Doctor-assisted ROM exercises can be followed by prescribing pulley exercises, if available, or other home ROM activities to improve all motions within pain-free limits. Emphasize flexion, extension, and scaption.[39,56,58]

Home care and patient education

✓ *Range of motion activities*. Continue with the Codman arm swings with and without weights. Choose from the following:

- wand exercises (moving from passive to active-assisted)
- wall walking
- auto-mobilization techniques
- physioball ROM activities
- pulley (if available at home)

As pain allows, patients should progress from passive to active-assisted to active range of motion—especially in flexion, extension, and scaption.[16] Active ROM in abduction, flexion, horizontal adduction, and external rotation may be performed supine at first, with arm above 120 degrees abduction.[48] (See Special Appendix, Figures V a-c.)

Summary of Office Treatment:
Phase 1 (Week 1-2)

- Transverse friction massage
- Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine
- Stretching techniques (e.g., PIR)
- Stretch post. capsule (if nec.)
- Doctor-assist ed ROM (flx/ext/scap)
- **Teach MAI**
- Teach scapular and serratus awareness
- Postural education
- PT for pain (as needed)

Other Options

- Contrast therapy
- Massage (e.g., effleurage)
- PT
- Russia n stimulation
- Teach short arch

Summary of Home Care:
Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- PROM (or assisted): pendulum/ wand/wall, walk
- AROM in flexion, extension, scapular elevation
- MAI: IR, ER, flexion, extension, scaption, elbow flexion
- Begin scapula track exercises
- Sternal lifts; chin tucks
- OTC/botanicals (as needed)
- Maintain aerobic activity

Other Options

- Contrast therapy
- Nutritio nal supports

TREATMENT GOAL: PREVENT ATROPHY. STRENGTHEN GH STABILIZERS AND HUMERAL HEAD DEPRESSORS.

These muscles include the rotator cuff muscles and the long head of the biceps and the scapular stabilizers.

Office treatment

✓ *Add new isometrics*. Continue doctor-assisted submaximal (65%) to maximum effort isometrics. Include shoulder flexion (Flx), extension (Ext), scaption, internal rotation (IR), and external rotation (ER). Work up to multiangle isometrics (MAI). The patient may perform MAI in the flexion and/or scaption plane, staying below 45 degrees of elevation or above the arc of pain (about 120 degrees). Continue to avoid impingement ranges. Office time can be used for doctor-assisted isometrics over a number of visits and/or to teach home exercises.[2]

Emphasize internal and external rotation of the glenohumeral joint and shoulder flexion with the forearm supinated.[60] Typically, the external rotators are weak compared with the internal rotators. This weakness may contribute to anterosuperior subluxation of the humeral head. Therefore, strong emphasis is placed on strengthening the external rotators in shoulder impingement.[2]

General Rule

If patients have less than 20 degrees of pain-free ROM, they should stay with isometric muscle work.

If more than 20 degrees, move to isotonics within a pain-free range.

For example, isotonic band short-arc exercises in the impingement-free ranges may be started once the patient has achieved greater than 20-30 degrees of pain-free motion in flexion, abduction, and scaption.

Summary of Office Treatment:
Phase 1 (Week 1-2)

- Transverse friction massage
- Stretching techniques (e.g., PIR)
- Stretch post. capsule (if nec.)
- Doctor-assist ed ROM (flx/ext/scap)
- T each MAI
- **Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine**
- **Teach scapular and serratus awareness**
- Postural education
- PT for pain (as needed)

Other Options

- Contrast therapy
- Massage (e.g., effleurage)
- PT
- **Russian stimulation**
- Teach short arch

Summary of Home Care:
Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- PROM (or assisted): pendulum/ wand/wall, walk
- AROM in flexion, extension, scapular elevation
- **MAI: IR, ER, flexion, extension, scaption, elbow flexion**
- Begin scapula track exercises
- Sternal lifts; chin tucks
- OTC/botanicals (as needed)
- Maintain aerobic activity

Other Options

- Contrast therapy
- Nutritional supports

✓ *Russian muscle stimulation* may be used in *select* cases to immediately begin muscle conditioning. Examples would be high performance athletes or patients whose pain lasts longer than expected and *prevents* muscle strengthening exercises.[42,43]

Home care

✓ *MAI exercises for cuff* are done to patient tolerance at the level achieved during office rehabilitation. The motions to include are shoulder flexion, extension, scaption, internal and external rotation. Isometric chair press-ups can be included. (See Special Appendix, Figure VII b.)

TREATMENT GOAL: IMPROVE SCAPULOTHORACIC STABILIZATION.

It is *critica*l that patients have a properly functioning scapular base from which the GH joint can operate.[5,6] The strategy here is to adjust or normalize joints related to scapular motion, make patients aware of the lower trapezius and the serratus anterior, and place them on exercise tracks that train them to gain subcortical (unconscious) control.[6,47,56]

Office treatment

✓ *Teach scapular and serratus awareness.* Focus on the weak scapular stabilizers: most commonly the serratus anterior and middle and lower trapezius.[2,54,58] If the scapular protractors are weak, the acromion may not elevate high enough, which may cause impingement of the suprahumeral structures. Begin with isometrics and work up to MAI. Work the scapular protractors and retractors.[8]

With the patient in prone or side position, help the patient gain awareness of proper scapular movements by using rhythmic initiation† and active-assisted scapular activities. This can usually be accomplished in one or two treatments but will have to be periodically rechecked. The shoulder abduction test can be used to monitor response. Place the patient on an exercise track that initially trains control then endurance of the middle and lower stabilizers. (See CSPE protocol, *Scapular Training Track*.)

†Rhythmic initiation is a series of isometric contractions in alternating directions to help patients gain conscious control of a particular joint, in this case, the scapula.

Summary of Office Treatment: Phase 1 (Week 1-2)

- Transverse friction massage
- Stretching techniques (e.g., PIR)
- Stretch post. capsule (if nec.)
- Doctor-assisted ROM (flx/ext/scap)
- Teach MAI
- **Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine**
- **Teach scapular and serratus awareness**
- **Postural education**
- PT for pain (as needed)

Other Options

- Contrast therapy
- Massage (e.g., effleurage)
- PT
- Russian stimulation
- Teach short arch

Summary of Home Care: Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- PROM (or assisted): pendulum/ wand/wall, walk
- AROM in flexion, extension, scapular elevation
- MAI: IR, ER, flexion, extension, scaption, elbow flexion
- **Begin scapula track exercises**
- Sternal lifts; chin tucks
- OTC/botanicals (as needed)
- Maintain aerobic activity

Other Options

- Contrast therapy
- Nutritional supports

To teach serratus anterior awareness, the clinician may use the push-up test to evaluate the serratus. Use doctor-assisted protraction against resistance to train the patient, which is usually accomplished in one or two visits. Then place the patient on a push-up track. (See CSPE protocol, *Serratus Anterior Training Track*.)

Home care

✓ *Scapular exercises.* The patient should be taught side-posture scapular coordination exercises and scapular isometrics to do at home. (See CSPE protocol, *Scapular Training Track*.)

TREATMENT GOAL: NORMALIZE JOINT MECHANICS OF SPINE AND SHOULDER GIRDLE.

Office treatment

✓ *Chiropractic manipulative therapy as indicated*.[40,53,54]

Manipulate/mobilize GH joint. Provide manual therapy in directions of restriction (*especially* restore inferior [2] and posterior glide). If the joint is too painful, consider adjusting/mobilizing into pain-free directions.

Note: Manipulating and mobilizing into hypermobile joint play is contraindicated. Anterior GH hypermobility is common in secondary impingement.[39,58] (See Special Appendix, Figures IV a-f.)

Manipulate/mobilize the scapulothoracic articulation; the cervical, thoracic, and costotransverse joints; the glenohumeral joint complex; and the AC and SC joints, as indicated. Check for humeral head depression, proper roll and glide; tight posterior GH capsule; rotation around the SC pivot with humeral abduction or rotation around the long axis of the clavicle.

TREATMENT GOAL: POSTURAL EDUCATION.

Office treatment

✓ *Continue to reinforce postural awareness*.

Summary of Office Treatment:
Phase 1 (Week 1-2)

- Transverse friction massage
- Manipulate GH, shoulder girdle, ribs, and cervical/thoracic spine
- Stretching techniques (e.g., PIR)
- Stretch post. capsule (if nec.)
- Doctor-assisted ROM (flx/ext/scap)
- Teach MAI
- Teach scapular and serratus awareness
- Postural education
- **PT for pain (as needed)**

Other Options

- Contrast therapy
- Massage (e.g., effleurage)
- PT
- Russian stimulation
- **Teach short arch**

Summary of Home Care:
Phase 1 (Week 1-2)

- Warm-up: (UBE, if available)
- PROM (or assisted): pendulum/ wand/wall, walk
- AROM in flexion, extension, scapular elevation
- MAI: IR, ER, flexion, extension, scaption, elbow flexion
- Begin scapula track exercises
- **Sternal lifts; chin tucks**
- **OTC/botanicals (as needed)**
- Maintain aerobic activity

Other Options

- Contrast therapy
- Nutritional supports

✓ *If pectoralis muscles are tight*, do in-office stretching and give patient home pec stretches and/or Brüegger's relief position. (See Special Appendix, Figures VI a-b.) If forward head carriage is noted, consider teaching the patient chin tucks and awareness of chin position during work or exercise activities. Deep neck flexors may need to be evaluated (Jull or Janda test);[55] suboccipital muscles may need to be stretched.[2,28,34] In preparation for sensory-motor training, patients can be taught the "small foot" (short arch) exercise described in the CSPE protocol, *Low Back Rehabilitation*.

Home care

✓ *Stress postural awareness* (sternal lifts; perhaps chin tucks). Pectoralis muscle stretches may be added and/or Brüegger's relief position.[55] (See Figure VI.)

TREATMENT GOAL: CONTINUE CONTROL OF PAIN AND INFLAMMATION.

Office treatment

✓ *Use electromodalities as necessary if further pain control is needed.* (See PT Modalities on P. 47 and CSPE protocol, *Physical Therapy Modalities*.)

Home care

✓ *Continue OTCs and botanicals as needed to reduce pain and inflammation.*

OPERATIONAL END POINTS: PHASE 1 REHABILITATION

Indicators for moving to the next phase of treatment:

- **Painless AROM of approximately 45-60 degrees in flexion and scaption plane.**
- **Isometric exercises can be performed to maximum effort without pain in all motions including IR, ER, flexion, extension, and scaption. Multiangle isometrics (MAI) are begun in pain-free limits.**
- **The patient can demonstrate good scapular awareness, sternal lift, and neutral cervical posturing.**

Rehabilitation: Phase 2

The Warm-up

When patients do their rehab exercises, whether in the clinic, at home or in a health club, they should begin with a warm-up session.

In this phase, a suggested warm-up would be 3-5 minutes of exercise with upper body ergometer (UBE) and MAI for rotator cuff muscles (IR, ER).

Phase 2 rehabilitation shifts the focus to muscle strengthening while continuing to improve full pain-free ROM. Proprioceptive training is also emphasized. Transverse friction massage or myofascial release therapy to improve flexibility is continued, as are any of the goals of Phase 1 rehabilitation that are appropriate.

Recommended Treatment Frequency: 2-3 times per week.

Home care schedule: daily

TREATMENT GOALS

1. Continue goals of Phase 1: Aid collagen repair, reduce non-mobile adhesion formation, improve soft tissue flexibility, restore full pain-free ROM, normalize joint mechanics, and improve scapulothoracic stability.
2. Gradually increase muscle strength to aid GH and scapulothoracic stability.
3. Promote local proprioceptive retraining.

TREATMENT GOAL: CONTINUE GOALS FROM PHASE 1.

Continue procedures that aid collagen repair, improve soft tissue flexibility, mobilize joint mechanics, and improve scapulothoracic stability. Soft tissue therapy begun during the first phase may need to be continued. The clinician should use the independent indicators for each therapy to determine when it can be discontinued. If electromodalities are used, choose settings that will promote tissue healing. Many of the treatment and exercise tracks begun in Phase 1 will be continued in this phase, especially those that increase the patient's pain-free range of motion.

Summary of Office Tx: Phase 2 (Week 2-4)

- **Continue transverse friction and other soft-tissue therapy**
- **Continue to adjust shoulder and spinal joints as needed**
- **Continue ROM, stretching, myofascial release**
- Teach strengthening exercises: rotator cuff, biceps, scapular stabilizers
- PN F cross-patterns

Other Options

- **PT**
- May begin BOING™ and rockerboard now or in next phase

Summary of Home Care: Phase 2 (Week 2-4)

- Warm-up: UBE (if available), MAI for cuff (IR, ER)
- **Continue AROM and stretching**
- **Continue serratus and scap track (wall angels)**
- Strengthening exercises for cuff and biceps
  - Prone horizontal abduction (with ER)
  - Isotonics: flx/scap, IR & ER, biceps (palm up/down)
  - MAI abduction/adduction
  - Chair press-up/Lat pull down (if available)
- Begin BOING™ and rockerboard activities (optional)

Office treatment

✓ *Continue soft tissue therapy*. The following should be continued, *as needed:* transverse friction massage, therapeutic muscle stretch techniques, muscle energy techniques, deep tissue massage, trigger point therapy, and/or myofascial release.

✓ *Manipulate as needed to normalize joint biomechanics*. Check cervical, thoracic, costotransverse, and shoulder girdle complex for normal motion, adequate joint play, and end feel.

✓ *Continue doctor-assisted ROM and/or check wand ROM activities or auto-mobilization home exercises*. It is important to periodically check patient compliance as well as the quality of home exercises.

✓ *Continue stretching activities for the GH muscles and posterior capsule as appropriate*. (See Special Appendix, Figure I c.)

✓ *Continue scapular stabilization track.*

✓ *Continue serratus anterior track.*

✓ *Physical therapy*. Choose from the following electromodalities: diathermy, heat, iontophoresis with potassium iodide, interferential, microcurrent, US (continuous or combo), or phonophoresis. (See PT section on P. 47 and CSPE protocol, *Physical Therapy Modalities*.)

Home care and patient education

✓ *Active and active-assisted range of motion*. Work in the pain-free ranges is continued until full and pain-free active and passive ROM is achieved.

✓ *Continue home stretching activities for GH muscles and capsule*. Stretch only in directions of stability. The posterior capsule is often an important structure to target.

✓ *Continue home activities promoting scapulothoracic stability and control*. (See CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*.)

Summary of Office Treatment: Phase 2 (Week 2-4)

- Contin ue transverse friction & other soft-tissue therapy
- Continue to adjust shoulder and spinal joints as needed
- Continue ROM, stretching, myofascial release
- **Teach strengthening exercises rotator cuff, biceps, scapular stabilizers**
- PN F cross-patterns

Other Options

- PT
- May begin BOING™ and rockerboard now or in next phase

Summary of Home Care: Phase 2 (Week 2-4)

- Warm-up: UBE (if available), MAI for cuff (IR, ER)
- Continue AROM and stretching
- Continue serratus and scap track (wall angels)
- **Strengthening exercises for cuff and biceps**
- Prone horizontal abduction (with ER)
- Isotonics: flx/scap, IR & ER, biceps (palm up/down)
- MAI abduction/adduction
- Chair press-up/Lat pull down (if available)
- Begin BOING™ and rockerboard activities (optional)

TREATMENT GOAL: GRADUALLY INCREASE MUSCLE STRENGTH TO AID GH AND SCAPULOTHORACIC STABILIZATION.

Office treatment and home care

✓ *Teach strengthening exercises*. In general, local proprioceptive postural training should precede strength training.[61] Focus on the humeral head depressors (rotator cuff and biceps), the dynamic GH stabilizers, and the scapulothoracic stabilizers.[10,39,40,47,59] The patient can move from isometric to isotonic strengthening, using tubing or free weights. (See Isometric exercises, P. 45.) If Russian stimulation-assisted exercises were begun in an earlier phase, continue as needed.

Note: Because of the potential for re-injury, the eccentric phase of isotonic exercises should not be emphasized during this phase, especially as resistance is increased. Therefore, instruct the patient to move rapidly through the eccentric cycle, allowing gravity or other muscles to help.

Two exercises that best stimulate the shoulder muscle are prone horizontal abduction with external rotation and scaption or flexion.[2]

- With the patient lying prone, use horizontal abduction with external rotation to activate and train proximal scapular stabilizers. (See Special Appendix, Figure VII a.) If lower and middle trapezius will not engage, see CSPE protocol, *Scapular Training Track*.
- Add isotonic exercises in flexion and scaption plane, as well as in IR and ER. Begin biceps curls, palm up and palm down.[16]
- Add MAI abduction and adduction exercises.
- Chair press-ups (see Special Appendix, Figure VIII b) and, if available, lat pull downs can also be done.

Summary of Office Treatment: Phase 2 (Week 2-4)

- Contin ue transverse friction & other soft-tissue therapy
- Continue to adjust shoulder and spinal joints as needed
- Continue ROM, stretching, myofascial release
- Teach strengthening exercises rotator cuff, biceps, scapular stabilizers
- **PNF cross-patterns**

Other Options

- PT
- May begin BOING™ and rockerboard now or in next phase

Summary of Home Care: Phase 2 (Week 2-4)

- Warm-up: UBE (if available), MAI for cuff (IR, ER)
- Continue AROM and stretching
- Continue serratus and scap track (wall angels)
- Strengthe ning exercises for cuff and biceps
- Prone horizontal abduction (with ER)
- Isotonics: flx/scap, IR & ER, biceps (palm up/down)
- MAI abduction/adduction
- Chair press-up/Lat pull down (if available)
- **Begin BOING™ and rockerboard activities (optional)**

TREATMENT GOAL: PROMOTE LOCAL PROPRIOCEPTIVE RETRAINING.

Office treatment

✓ *Proprioceptive Neuromuscular Facilitation (PNF) cross-patterns*. Begin by teaching doctor-assisted/resisted diagonals called "sword and seat belt" cross-patterns. Emphasize smooth, coordinated actions. (See Special Appendix, Figures VIII a-l.) If the patient cannot tolerate motions above 90 degrees of elevation, perform the patterns below the arc of pain and work up to full motion. Again, if necessary, the progression can start with doctor-assisted ROM and MAI isometrics. The clinician may gradually introduce resistance through an isotonic range. Eventually tubing may be given for resistance during home care.

Additional options include teaching the patient BOING™ exercises and/or rockerboard activities. (See Special Appendix, Figures XIV.)

Home care

- Home PNF exercise, as described above
- Home activities using BOING™ if possible
- Rockerboard activities

OPERATIONAL END POINT: PHASE 2 REHABILITATION

Indicators for moving to the next phase of treatment:

- **The patient has achieved full pain-free AROM without recruitment.**
- **Progressive gains in muscle strength are evidenced by upgrades in band resistance or weights.**
- **Good scapulothoracic control is displayed (e.g., no unnecessary winging or shoulder hiking, good engagement of the lower and middle trapezius).**

Rehabilitation: Phase 3

During this phase, the patient has achieved full pain-free ROM, and muscle strengthening activities have been introduced. The emphasis shifts to building more muscular strength and endurance. *The rehabilitation program should include activities that mimic normal function and the demands of the patient's work and recreational activities.* More demanding proprioceptive training can also be introduced. Continue with appropriate goals from Phase 1 and 2 rehabilitation.

Note: In Phases 3 and 4, office treatment procedures and home care summaries will be presented under a combined heading, which reflects the natural blending that occurs at this point in rehabilitation.

The Warm-up

When patients do their rehab exercises, whether in the clinic, at home or in a health club, they should begin with a warm-up session.

In this phase, a warm up session could consist of UBE (upper body ergometer), and PNF diagonals with tubing and wall angels.

TREATMENT GOALS

1. Continue to build strength and endurance.
2. Begin functional-demand training and return-to-work strategy.
3. Continue proprioceptive coordination and retraining.

TREATMENT GOAL: CONTINUE TO BUILD STRENGTH AND ENDURANCE.

By this phase, patients have achieved full pain-free ROM and have gained muscle strength; they are ready to perform the exercises introduced in Phase 2 rehab through a full range of motion and up to the point of fatigue.

Eccentric contractions can be emphasized. Before beginning these contractions, the muscles should be reasonably well conditioned and have progressed through concentric resistance exercises with bands or weights.[16] Have the patient move slowly through the eccentric phase with no recruitment of other muscles. In addition, specific muscles should receive emphasis for certain sports. (See Rehabilitation—Active Care on P. 50.) To build endurance, increase sets and repetitions (1 set of 10 a day working up to, ideally, 3 sets a day. For athletes, work toward 5 sets of 15).

Summary of Office Tx and Home Care: Phase 3
(Week 4-6)

- **Strengthen GH and biceps muscles(emphasize eccentric contractions)**
- **Build scapular muscle endurance**
  - Push-ups with a plus; serratus punch
  - Scapular retraction; wall angels
- **Give functional exercises that mimic sports or occupational activities**
- Adjust, stretch only if necessary

Other Options

- **Continue BOING™ and PNF diagonals**
- **Continue rockerboard activities**

✓ *Strengthen GH and biceps muscles*. To build strength, increase resistance with bands/tubing or weights. Add biceps curls (with the shoulder in neutral, palm-up and palm-down positions)[16] to the exercises prescribed for strengthening the GH muscles.

✓ *Build scapular muscle endurance*. Serratus can be conditioned by doing push-ups with a plus on the floor or against a wall, or by doing serratus punches with a hand weight or tubing.

Scapular retraction and "wall angel" exercises will target the middle and lower trapezius. (See strengthening section of the CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*.)

TREATMENT GOAL: FUNCTIONAL-DEMAND TRAINING; RETURN-TO-WORK STRATEGIES.

✓ *Functional exercises and return-to-work advice*. Prescribe exercise that mimics the demands placed on the shoulder—and the body as a whole—by the patient's occupation, sports, or household chores.[62] Light resistance can be provided by tubing, bands, or free weights. These exercises should be introduced gradually and performed at slow speed to prevent re-injury. Emphasize good control and body mechanics.[47,56,62] Workers should be taught to use ladders or chairs to minimize overhead reaching and to prevent shoulder hiking. Specific advice can be given to athletes depending on the sports in which they are participating. (See Home-Care Advice, P. 57.)

TREATMENT GOAL: CONTINUE PROPRIOCEPTIVE COORDINATION AND RETRAINING.

✓ *Continue exercises for proprioception.* Exercises continue to place a proprioceptive demand on the shoulder. Two examples are the use of the BOING™ and PNF diagonals, which can be done with increased resistance. These, and other appropriate exercises, can be done while standing on a rockerboard.

OPERATIONAL END POINT: PHASE 3 REHABILITATION

Indicator for moving to next phase:

Patient can perform strengthening program to fatigue and to full range of motion.

Rehabilitation: Phase 4

Not all patients will reach this stage of rehabilitation. This phase is particularly important for chronic and/or chronic recurrent conditions and for patients returning to significant athletic or work demands. This phase emphasizes advanced strength and coordination, sensory-motor control, and plyometric power.

Note: In this phase of rehabilitation, the clinician can choose some or all of the following goals.

The Warm-up

When patients do their rehab exercises, whether in the clinic, at home or in a health club, they should begin with a warm-up session.

In this phase, a warm up session could consist of UBE (upper body ergometer), and PNF diagonals with tubing and wall angels.

TREATMENT GOALS

1. Increase strength and local coordination.
2. Enhance sensory-motor control.†
3. Promote plyometric power.

TREATMENT GOAL: INCREASE STRENGTH AND LOCAL COORDINATION.

✓ *Continue strength and coordination program***.** Introduce challenges that require coordination and balance. Examples include exercises on a physioball (e.g., push ups with a plus in the CSPE protocol, *Serratus Anterior Training Track*); MAI activities with physioball (eyes closed); Body Blade™ or BOING™ exercises; using free weights or throwing a medicine ball.

✓ *Continue with advanced scapulothoracic and cervicothoracic stabilization exercises*. For advanced scapulothoracic activities, see appropriate sections of the CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*. Cervicothoracic stabilization also requires good coordination of the neck muscles as well as strong rapidly contracting deep flexors of the neck.

† This goal can be introduced as early as Phase 2 or 3, depending on the needs of the patient and the discretion of the clinician.

Summary of Office Treatment and Home Care: Phase 4 (Week 6-8)

- **Teach physioball activities; continue BOING™**
- **Teach advanced cervicothoracic and scapulothoracic stabilization**
- **Continue functional-demand training**
- **Teach advanced rocker/wobble board activities**
- **Plyometric exercises (medicine ball, wall bounce, mini-trampoline)**

✓ *Continue functional-demand training*. Exercises simulating occupational and recreational activities should first be done at slow, controlled speeds, then at actual speed used in the activities they are mimicking.

TREATMENT GOAL: ENHANCE SENSORY-MOTOR CONTROL.

Continue training whole-body coordination, especially by stimulating mechanoreceptors in the foot and ankle. The patient works on postural "sets" of the proximal stabilizers (e.g., scapula and head and cervical spine), while continuing to train local coordination and control at the GH joint.

✓ *Proprioceptive training.* The patient is now ready to perform the activities described in Goal 1 on a rocker or wobble board. When appropriate, challenges or perturbations can accompany activities done on the board. (See Special Appendix, Figure IX a-d. For the basics of rockerboard work in general, see CSPE protocol, *Low Back Rehabilitation*, the standing track.)

TREATMENT GOAL: PROMOTE PLYOMETRIC POWER.

✓ *Prescribe strengthening exercises* such as bouncing-wall push-ups, mini-trampoline push-ups, medicine ball or small plyoball toss against a wall or mini-trampoline. Throwing a medicine ball for power and coordination can be introduced when the injured shoulder attains 90% of the strength and endurance of the uninjured shoulder.[47,62]

OPERATIONAL END POINT: PHASE 4 REHABILITATION

Indicators for terminating care:

- **Patient appears to perform work or sport activities at pre-injury performance levels.**

OR

- **Patient no longer demonstrates reasonable progression while performing certain assigned exercises.**

MANAGEMENT: SPECIFIC THERAPEUTIC INTERVENTIONS

Manual Therapy: Joint Manipulation and Mobilization

Manipulation or mobilization of the following may be appropriate:

- **Glenohumeral joint**
- **Acromioclavicular, sternoclavicular, and scapulocostal joints**
- **Cervical, thoracic, and costotransverse joints**

Frequency: As needed to normalize motion.

General Rationale: Joint manipulation and mobilization techniques are used to treat joint dysfunction when indicated by stiffness, reversible hypomobility, or pain. Joint mobilization is a safe and effective means of restoring or maintaining joint play and can also be used for pain relief.[39]

Neurophysiologic effects. Even small amplitude oscillatory movements can be used to stimulate the mechanoreceptors that may inhibit the transmission of nociceptive stimuli at the spinal cord or brain stem levels.[39]

Mechanical effects. Atrophy of the articulator cartilage begins soon after immobilization is imposed on joints.[39] Joint motion stimulates the movement of synovial fluid, which brings nutrients to the avascular articulator cartilage of the joint surfaces.[27]

Relative Contraindications: Use caution when performing joint mobilization or manipulation in directions of instability or with patients with congenital hyperelasticity syndromes. Patients with hypermobility may benefit from gentle joint play techniques.[39] Anterior GH instability is a common secondary cause of shoulder impingement syndrome.

Side Effects: Forceful joint manipulation or mobilization may increase pre-existing instability. Mild temporary soreness may occur.

Charting: Other than grade V mobilization (which is actually considered to be a manipulation or adjustment), the clinician should record the grade of mobilization used on a particular visit.

Maitland's Grades of Mobilization [63]

- Grade I: Small-amplitude, rhythmic oscillations are performed at the beginning of the range.
- Grade II: Large-amplitude, rhythmic oscillations are performed within the range below tissue resistance, not reaching the anatomic limit.
- Grade III: Large-amplitude, rhythmic oscillations are performed to the limit of the available motion and into tissue resistance.
- Grade IV: Small-amplitude, rhythmic oscillations are performed to the limit of the available motion and to tissue resistance.
- Grade V: A small-amplitude, high velocity thrust technique is performed to stretch adhesions to the limit of the available motion.

GLENOHUMERAL JOINT MANIPULATION AND MOBILIZATION TECHNIQUES

Passive circumduction to tolerance in all ranges can be done as preparation for joint manipulation, or during the acute phase as a therapy in itself. The clinician may add traction to help the patient through the painful arc.[48]

GH joint restrictions are found by performing motion palpation. Evaluate for anterior, posterior, inferior, lateral, and internal/external motion restrictions. Common joint restrictions found in impingement syndrome are posterior, inferior, and external rotation. Small amplitude, high velocity thrust techniques can be used to correct these restrictions.

Some practitioners also determine the need for manipulation based on malposition of the shoulder.[64] Evaluation is performed visually and by static palpation. For example, compare the position of the proximal humerus bilaterally with the acromion, or evaluate tension in the muscles of the rotator cuff or glenohumeral capsule. Anterior malposition is a common finding in shoulder conditions in general, but other listings are possible.

Anterior humerus: Bilateral palpation reveals the humerus protruding more anteriorly relative to the acromion on one side. (Palpate just off the anterior margin of the acromion; the humerus is the sub-adjacent bony landmark.) Corroborating findings include: posterior capsule tightness; hypertonicity of infraspinatus, teres minor, and possibly pectoralis major muscles; tenderness at the anterior aspect of the humeral head (the anterior capsule); and restricted posterior glide joint play.

Superior humerus: The space between the acromion and humerus palpates as being reduced. (When palpating just off the lateral margin of the acromion, the humeral head or greater tubercle of the humerus is the bony landmark just beneath the angle of the acromion. Palpating bilaterally simultaneously allows comparison.) Corroborating findings include decreased inferior glide joint play and/or hypertonicity in the deltoid or rotator cuff muscles (e.g., supraspinatus).

Note: A humerus may be both anterior and superior at the same time.

Medial/lateral rotation: Humeral rotation may be determined by comparing the orientation of the elbows in a standing patient. Typically the cubital fossa faces obliquely forward and medially. Medial (internal) rotation of the humerus results in the cubital fossa turning more medially. Lateral (external) rotation of the humerus results in the cubital fossa facing more anteriorly. Corroborating findings for a medial rotation may include hypertonicity in the medial rotators of the arm (e.g., pectoralis major, latissimus dorsi, subscapularis), and weakness or tenderness in infraspinatus and teres minor.

Corroborating findings for a laterally rotated humerus may include an associated hypertonicity in external rotators and inhibition or weakness of internal rotators, although this seems to be uncommon.[65]

Note: For a review of adjusting techniques of the glenohumeral joint, see Special Appendix Figures IV a-f.

Specific Rationale: Loss of joint glide or joint restriction is one indication for adjusting/mobilization. The posterior glenohumeral joint capsule is commonly

restricted.[2] This tightness results in anterosuperior subluxation of the humeral head causing secondary impingement of the subacromial structures. Restoring both posterior and inferior glide of the GH joint is usually indicated.

ACROMIOCLAVICULAR, STERNOCLAVICULAR, AND SCAPULOCOSTAL JOINT ADJUSTING AND MOBILIZATION.

Technique: *For a review of adjusting techniques, see appropriate text.*†

Specific Rationale: The clavicle should roll and elevate during GH flexion and abduction. If either the AC or SC joint is restricted, it may impede this motion. If the clavicle does not elevate normally, this may impinge the structures be-neath it. Also the scapula normally protracts during GH flexion and abduction. If this motion is restricted, it may cause a reduction of acromion elevation, leading to further impingement.

CERVICAL, THORACIC, AND COSTOTRANSVERSE JOINT ADJUSTING AND MOBILIZATION.

Technique: *For a review of techniques, consult appropriate text; Bergman, Peterson, et al., for example, cited on previous page.*

Specific Rationale: Normalizing spinal motion may improve shoulder function. For example, Stenver *et al*. found that during glenohumeral flexion, C6 to T4 spinal joints extend and rotate ipsilaterally. The authors postulate that this spinal motion is necessary for full unrestricted GH flexion. VanderLinden *et al*. postulate that a restriction in mobility of the first rib may cause a restriction in the mobility in the glenohumeral joint through the costoclavicular ligament.[54]

Beside manipulating the spine to achieve certain mechanical effects, there may be value to high velocity, low amplitude thrust adjustments as a method of stimulating a neurologic response. Treatment may have an effect on joint receptors affecting referral patterns to the shoulder or perhaps on the roots themselves that innervate the muscles and joints of the shoulder girdle. Of particular importance is the integrity of the C4-T1 spinal joints.[66]

Manual Therapy: Soft Tissue

The most common tendons to be involved are the supraspinatus and the long head of the biceps. Occasionally the external rotator tendons (infraspinatus and teres minor), the subacromial bursa, or the coracoacromial ligament may need to be treated.

TRANSVERSE FRICTION MASSAGE [57,58]

Frequency. Up to 15 minutes of transverse friction massage, twice weekly. Approximately 2 to 6 weeks of treatment is usually sufficient. According to Cyriax, most patients will improve within two months; the average, approximately four weeks. Of course, if the patient continues to overuse the shoulder, there may be relapses.

Note: Some clinicians recommend *shorter treatment times* (e.g., 5 minutes), but this is somewhat controversial. If patient's response to briefer applications

† Bergman T, Peterson D, et al. Chiropractic Technique. New York: Churchill Livingstone; 1993:575-82.

Hammer W. Functional Soft tissue Examination and Treatment by Manual Methods. Gaithersburg, MD: Aspen; 1991:201-93.

Souza T. Sports Injuries of the Shoulder. New York: Churchill Livingstone; 1994:514-521.

is poor, then consider the longer treatment times noted in each specific section.

Rationale. The goal of transverse friction massage is to increase circulation, decrease collagen cross-linking, promote collagen healing, and decrease adhesion and nonmobile scar formation in soft tissue. The theory is that scar tissue may form in an irregular fashion and become a nociceptive focus that limits soft-tissue flexibility. Scar tissue found in the supraspinatus and/or the biceps long head may decrease the size of the subacromial space, thereby increasing the potential for impingement.

Technique. The depth of the massage should be to the patient's tolerance at first, continuing for about 2 minutes or until the area becomes numb. At this point, the physician should go deeper, to the patient's new tolerance level until it again begins to numb. This is continued in stepwise fashion, working up to 10-15 minutes a session (depending on the tissue and the condition being treated).

It is important to ice after this therapy and to avoid treating acute calcific tendinitis. (See CSPE protocol, *Transverse Friction Massage*, for additional information.)

Supraspinatus Tendon

Locating the Lesion

- Pain with full passive elevation indicates that the lesion is deep within the distal end of the tendon.
- A painful arc suggests that the lesion lies where the tendon can be pinched between the acromion and greater tuberosity. Because the lesion is very accessible, it improves rapidly with transverse friction massage.
- If full passive elevation is not painful and there is no painful arc, the musculotendinous junction of the supraspinatus is the probable location.
- The tissues overlying the bony tuberosity are often more tender than the adjacent tendinitis. The physician must apply friction to the site of the tendon and not simply to the most tender spot.

Hammer recommends, when possible, applying transverse friction to the area of greatest pain elicited *during the supraspinatus muscle test*, as opposed to the most tender spot based on static palpation.[58]

Patient Positioning. The patient's arm is placed behind the back in an Apley's scratch position ("fasten the bra" position), with elbow tucked near the torso. This combination of shoulder extension, adduction, and internal rotation should bring the supraspinatus tendon directly forward and over the head of the humerus, emerging under the anterior edge of the acromion. As an option, a large head piece can be extended to about 45 degrees (as on a Leander table) and the patient can lean back in the half-lying position, thus fixing the arm in place.

Specific Application. Place the slightly flexed tip of the index finger on the patient's tendon, and reinforce with the middle finger. The thumb is used as an anchor and fulcrum and is positioned as far from the point of treatment as the physician's thumb span will allow. Be careful not to be on the bone of the greater tuberosity, but directly posterior to this point (usually anterolateral to the acromion). The sweeps should be about 2 cm wide, with the movement coming from the wrist, transversely across the muscle and tendon fibers. It may take very deep massage to break up any scar tissue in the tendon.

Supraspinatus Muscle: Musculotendinous Junction

Locating the Lesion. Resisted abduction or a supraspinatus muscle test will be painful. Passive movement is complete and painless even at end range. There is no painful arc. This combination of findings suggests that the lesion is located near the proximal end of the tendon.

Patient Positioning. The seated patient's arm rests on a pillow at 90 degrees abduction, which helps expose the medial aspect of the tendon.

Specific Application. Standing opposite the injured shoulder, the clinician reaches across (behind the patient's neck) and applies friction to the most lateral aspect of the supraspinatus fossa, where the clavicle and spine of the scapula join. The middle finger is the contact finger, reinforced by the index. (See Special Appendix , Figures X a-b.) The transverse friction is applied deeply by rocking the middle finger back and forth, by alternating supination and pronation of the forearm.

Treatment Schedule. Working up to 15 minutes of friction 3 times a week (see note about application times, P. 41). The symptoms should resolve within 4 to 8 treatments.

Biceps Muscle: Tendon of the Long Head

Locating the Lesion. Resisted shoulder flexion (i.e., Speed's test) or resisted flexion and supination of the elbow elicits pain at the uppermost part of the arm (usually at the midpoint of the tendon of the long head). **Note:** It is important to distinguish this tendon from the anterior edge of the deltoid muscle and from the short head of biceps.

Patient Positioning. The patient is seated with the arm hanging down and the pronated hand resting on the front of the thigh. This position brings the bicipital groove directly anterior.

Specific Application. The clinician locates the biceps tendon (resisted elbow flexion may bring the tendon into prominence). Using the entire thumb flat against the tendon, and anchoring the rest of the fingers firmly at the back of the patient's arm, transverse friction is applied by adducting and abducting the thumb over the tendon. Alternatively, the thumb can be used to hold down the tendon, while the patient's humerus is passively rotated back and forth beneath it (use their flexed forearm as a lever). (See Special Appendix, Figure X c.)

Treatment Schedule. Up to 20 minutes on alternate days (see note about application times, P. 41). According to Cyriax, expect full recovery after 2 to 3 weeks, even in chronic cases.

Infraspinatus Tendon

Locating the Lesion. The painful scar lies close to or at the insertion of the infraspinatus tendon into the greater tuberosity of the humerus.

- Passive elevation at end range is painful as well as resisted lateral rotation. Other resisted movements do not exacerbate the symptoms. This indicates that the lesion is in the deep aspect of the distal end of the tendon.
- A painful arc suggests that a scar located in the superficial aspect of the distal end of the tendon is being pinched between the acromion and greater tuberosity.
- If neither of these signs appears, the lesion lies in the body of the tendon (not at the musculotendinous junction).

Patient Positioning. The patient is supine, propped up on elbows with arms laterally rotated to grab on to the sides of the table. The elbows and arms are tucked into slight adduction. This position maximally exposes the greater tuberosity. Running just below the most lateral aspect of the spine of the scapula, the infraspinatus tendon is easily palpated.

Specific Application. The clinician sits facing the head of the table and places his/her fingers on the front of the shoulder. Alternating abduction and adduction of the thumbs applies friction back and forth across the tendon. At the extreme of the adduction movement, the tip of the thumb is engaged against the posterior acromial edge.

Treatment Schedule. Twenty minutes, 2 or 3 times a week. (See note on treatment times, P. 41.). The main difficulty is to ensure that the massage is given exactly to the spot in the tendon where the strained fibers lie. When this is found, some 6 to 8 sessions of massage suffice to bring about recovery. Because, however, the physician cannot avoid occasionally making a false start slightly to one or other side of the lesion, it may take a few additional sessions of trial and error.

Coracoacromial Ligament

Indications for treating this ligament include tenderness over the ligament itself and pain with a positive impingement Kennedy-Hawkins test (with the shoulder and elbow both flexed to 90 degrees and the forearm internally rotated).[58]

MYOFASCIAL TRIGGER POINT THERAPY

Treatment Options

Cool and stretch
Ischemic compression
- **Travell method**
- **Other variations**
- **Nimmo method**

Acupuncture and trigger point injection

***Frequency*.** 2-3 times per week for 1-2 weeks as indicated.

Rationale. Myofascial trigger points are defined as hyper-irritable areas within a taut band of skeletal muscle, located in the muscular tissue or its associated fascia. These can cause myofascial referred pain to the shoulder region which may complicate a pre-existing impingement syndrome. Therefore, this therapy will help eliminate pain attributed to myofascial trigger points by improving the circulation and the flexibility of these tissues. The use of cryotherapy is based on the theory that cold receptors in the skin are stimulated and inhibit contraction, allowing a small window of time in which to further stretch the muscle.[44]

***Contraindications*.** Stay within the patient's pain tolerance so as not to aggravate the condition.

Side Effects: Mild soreness or local bruising may occur.

Cool and Stretch

The muscle is placed under tension and then ice (or a vapocoolant like fluoromethane) is applied along the direction of the fibers of the painful muscle and into the referred pain territory.

Be careful not to overly cool the area. A passive stretch is maintained and gradually increased. This procedure can be repeated one to three times. The muscle is then taken through its full active ROM and then warmed with moist heat.[44]

Ischemic compression

There are a number of methods that can be used to apply ischemic compression (this name implies that after the compression, the skin may first blanche, then show reactive hyperemia). In general, the relaxed muscle should be stretched to the verge of discomfort. Pressure should be administered gradually so that the patient does not guard.

***Travell*.** This method is recommended for recent, moderately active myofascial trigger points (MFTPs or TPs) and may respond with one treatment. Apply firm, tolerably painful pressure over the trigger point. The referral pattern should present. As the discomfort abates, continue increasing the pressure up to 20-30 pounds. Finish with hot pack and active ROM. If necessary, repeat again in the same visit.

This approach may fail if the TP is too irritable, if the clinician releases the pressure prematurely rather than increasing the pressure, if the initial pressure is too vigorous and the patient guards, or if there are other perpetuating factors.[44]

***Other Variations*.** In chronic, or very irritable TPs, other variations may be employed. Briefer applications (see Nimmo below), gentler applications, or intermittent compression (alternating pressure on and off) can be used. This may need to be repeated several times a day at home (e.g., using a tennis ball) and/or spread out over several office visits.

***Nimmo*.** Nimmo trigger point therapy is performed by applying ischemic compression to MFTPs for 3-5 seconds. Repeat treatment 3 times during the session. This should be done no more than every other day.

Acupuncture and Trigger Point Injection

These alternatives may be used if ischemic compression and/or stretching are not achieving desired results. A referral to the appropriate practitioners is needed.

MYOFASCIAL RELEASE TECHNIQUE

Note: This technique may be useful especially on external rotators. Effectiveness should be evident in 3-4 treatments.

***Technique*.** A firm pressure is applied *longitudinally* over the area of muscle, crossing the area of adhesion, fibrosis, or trigger point while the arm is either actively or passively moved through a full ROM. Use a broad contact, usually thumb or palm of hand. Lotion may be used and a stripping action may be performed. Three to five passes are made at each of the following levels:

Level 1: Involved muscle in a relaxed position.

Level 2: Pre-tension muscle before application.

Level 3: Muscle moved passively through range of motion while applying contact pressure.

Level 4: Patient moves muscle through ROM while clinician applies pressure. (**Note:** This is the most effective level.)

***Frequency*.** 4 -10 treatments over 3-5 weeks with significant improvement seen early in the treatment.

Re-evaluate if there is no change within 4-6 treatments.

Rationale. To stretch areas of adhesions and/or trigger points, and to promote optimal tendon healing.

Contraindications. Avoid directions of instability, positions causing shoulder pain, congenital hyperelasticity syndromes, and impingement positions. Use caution if treating subscapularis because of sensitive brachial plexus structures. *Do not treat areas that are inflamed or more often than every other day.*

MUSCLE STRETCH TECHNIQUES

These techniques include post-isometric relaxation, contract and relax, hold and relax, sustained stretch, reciprocal inhibition, isolytic contraction, and rhythmic stabilization.

Application varies, based on choice of technique and therapeutic goals. In general, if the goal is muscle relaxation, gentler techniques like post isometric relaxation (see following section, Muscle Energy Technique) and reciprocal inhibition can be used. If the goal is breaking adhesions and affecting connective tissue, then more assertive techniques like hold-relax, contract-relax, sustained stretch, or isolytic contractions may be more useful. Pre-heating the tissue may be helpful in recalcitrant cases.

If the goal is to increase range of motion as well as training speed and coordination of muscle contractions, rhythmic stabilization may be preferred. These techniques can be used in a variety of combinations with an individual patient. Often a patient's immediate response to the treatment is the best method for choosing one of the above techniques.

For a review of specific techniques and specific applications to the shoulder, consult appropriate text.[†]

Specific Application: The posterior shoulder capsule and muscles are commonly restricted in impingement syndromes and should respond to one of the stretching techniques. It is best stretched in horizontal adduction and the tissue can be pre-warmed by a hot pack or ultrasound.[30]

Frequency: 2-3 times per week for 3-4 weeks as indicated.

Rationale: Causes reflex relaxation of over-facilitated muscles and stretches areas of adhesions, which results in a decrease in pain, optimal muscle and tendon healing, and improved flexibility.

Contraindications: Acute muscle ruptures or strains.

MUSCLE ENERGY TECHNIQUE

Technique: This is a post-isometric relaxation technique aimed at affecting joints. The joint is placed in the position of restriction at the perceived barrier. Then, while maintaining this position, the patient isometrically contracts (10-25% of maximum) the agonist muscle for 5-7 seconds. At the end of the contraction, the clinician waits to feel the muscle relax and then takes out the additional "slack."

[†]Hammer W. Functional Soft tissue Examination and Treatment by Manual Methods. Gaithersburg, MD: Aspen;1991:251-62.

Liebensen C. Rehabilitation of the Spine. Baltimore, MD: Williams and Wilkins;1996:253-8 and 279-84.

This is primarily a reflex relaxation technique—not a stretching technique. Repeat this procedure approximately three times or until there is no further gain in motion.

Frequency: 2-3 times a week for 1-2 weeks as indicated.

Rationale: To increase range of motion and joint mobility, reduce muscle spasm.

Contraindications: Hyperelasticity syndromes, in directions of instability.

SOFT TISSUE MASSAGE TECHNIQUES

Techniques: *Refer to appropriate text.*

Frequency: As needed

Rationale: Helps flush debris left at the injured site following the acute phase; improves circulation; aids collagen healing; for relaxation and pain relief.

Precaution: During the acute and subacute phase of healing, stay within patient's pain tolerance to avoid aggravation.

Physical Therapy Modalities

[42,67–69]

In addition to the use of heat and ice, there are many electrical modalities that may be useful in the treatment of shoulder injuries. Therapeutic benefits from these different modalities include analgesia, prevention of muscle atrophy, re-education of damaged muscle, relaxation of muscles, reduction of edema, and wound healing.[70]

A Note on Electrical Stimulation: Avoid pad placements that cross the heart and/or stimulate the carotid sheath (vagus nerve and carotid sinus) and larynx.

During the acute phase, consider ice, TENS,[2,48] high volt therapy, interferential, or possibly microamperage stimulation for pain relief.[2]

For the most part, these modalities should be limited to the acute phase or during flare-ups. It is important that treatment begin to de-emphasize passive care as soon as it is reasonable and that the clinician works closely with the patient to actively restore function.

EFFICACY / EFFECTIVENESS

Although these modalities are commonly used, there have been few, high quality trials on outcomes. With only a few exceptions, there is no evidence at this time that one modality is more effective than another on patients in general or for specific shoulder problems. However, practice experience suggests that occasionally a patient who does not respond to one modality may respond to another.[66]

Based on the few studies available, TENS does not appear more effective than US or any other electrotherapy. There are no controlled trials comparing electrotherapy to placebo.

Cold therapy does not appear to be more effective than ultrasound therapy, steroid injection, mobilizations, or no intervention. Different methods of thermotherapy are not more effective than placebo or steroid injections and analgesics.[71]

***…A word on ultrasound*.** Ultrasound is a popular treatment modality for the shoulder and has a rational basis for application. The avascular/critical zone of the supraspinatus tendon (just proximal to the insertion on the greater tuberosity)

has been implicated as a contributing factor in impingement syndrome. Ischemia has been noted to increase tendon degeneration. Ultrasound increases blood flow and improves the exchange of metabolic products and thus theoretically should be of therapeutic value.[37,38] However, a systematic computerized literature search of Medline and Embase found only three small randomized clinical trials assessing the use of ultrasound with soft tissue shoulder injuries.[72-74]

A review and analysis of these limited clinical trials did not find ultrasound to be effective in the treatment of soft tissue shoulder disorders.[71] However, a large-scale RCT is needed to settle this controversy. Parameters for application of ultrasound are included in this document. Clinicians must make up their own minds about its potential usefulness.

Note: See the CSPE protocol, *Physical Therapy Modalities*, for specific parameters of the various modalities. Also, see Special Appendix, Figures XI-XIII.

The following are general considerations applicable to impingement syndrome or shoulder conditions in general.

ACUTE PHASE INTERVENTION

This phase of treatment deals primarily with pain and inflammation.

Note: Significant joint effusion and edema are not usually prominent features of impingement syndromes.

- **Ice, TENS,[2,48] or microamperage.** Consider these modalities for pain relief.[2]

- **TENS.** This modality may be an effective reliever of acute pain as it produces analgesia via the pain-gate mechanism through the release of endorphins.[70] However, its effectiveness is controversial.

- **High volt galvanism.** Treatment indications include tissue injury, edema reduction, and pain reduction.[70]

- **Interferential electrical stimulation.** Interferential can reach deeper tissue because its higher frequencies and short pulse widths create lower surface resistance than traditional stimulation techniques. In deeper tissue, it can promote muscle relaxation, analgesia, and soft tissue healing.[70]

- **Microcurrent.** This modality may be used for pain, edema, or tissue healing.

- **Low volt galvanism.** (Use positive pole in the acute phase.) This modality tends to harden tissues, vasoconstricts, and dehydrates tissues. Even if there may not be significant edema, low-volt may help control pain.

  Iontophoresis can be used to control pain and inflammation. Positive polarity can be used with hydrocortisone cream (0.5%) or magnesium sulfate (2% solution). Negative polarity can be used with sodium salicylate (2% solution) for analgesia and decongestive effects.

- **Ultrasound.** In the acute phase, use pulsed rather than continuous mode. For the biceps tendon, which is relatively superficial, consider 0.5-1.2 watts/cm for 5 minutes daily (or at each visit) for 10 days. The intensity setting should be modified based on the build of the patient and thickness

of the tissue. As the patient becomes subacute, continuous mode may be used. Because it is a deep-heat modality, it may occasionally exacerbate symptoms. For the supraspinatus tendon consider 1.2 watts/cm.[48]

- *Phonophoresis* can be used to manage inflammation with hydrocortisone ointment (1%) or salicylate ointment (10%, Myoflex). Analgesic effects can be achieved with lidocaine ointment (5%).

TREATING CHRONIC PAIN AND SCAR TISSUE

- **Low volt galvanism.** Negative pole tends to soften tissues, vasodilate, loosen fibrotic adhesions and can be used to apply potassium iodide (2% solution) for sclerocytic and analgesic effects.

- **Iontophoresis.** Use with different solutions to decrease calcific deposits and scar tissue.

- **Ultrasound.** Ultrasound sound can be used on continuous mode as a deep-heating modality, which may help to soften scar tissue and increase blood flow.

- **TENS.** This modality may be useful in chronic shoulder pain.[70]

- **Cryotherapy.** Ice can be used as part of the cool-and-stretch protocol to treat trigger points and over-facilitated muscles.

- **High volt.** High volt can be used to treat chronic pain.

- **Diathermy.** Short-wave or microwave increases circulation, decreases pain, and may help prepare tissue for soft tissue work. Requires extra rolled towel in axilla to absorb moisture and prevent burns.

- **Hot packs.** Local heat can be used to prepare the capsule and muscles for therapeutic stretching and to help relieve muscle soreness resulting from rehabilitation exercises.

STIMULATING MUSCLES

- **High volt galvanism.** This modality may be used to promote neuromuscular stimulation during the rehabilitation phases. It is applied to a particular muscle in patients who are having difficulty controlling or contracting the muscle voluntarily. Be sure to check the parameters because they are different than for pain and edema. This procedure can be done while the patient is actively exercising the muscle.

- **Sine wave.** Be aware of the proper settings, depending on treatment goals. Surging mode helps muscle strengthening and adhesion reduction. Reciprocal mode is for muscle re-education (electrodes on agonist/ antagonist) .

- **Russian muscle stimulation.** This mode of therapy is not usually necessary but can be used in special cases, such as with high performance athletes to prevent atrophy during the early stages of treatment or to promote control and isolation during later stages of treatment. It may also be used to increase strength along with power in later rehabilitation phases.

Rehabilitation—Active Care

Patients will be taken through a variety of rehabilitative procedures to retrain the muscles controlling the glenohumeral joint and the scapula. In most cases, this active care will be done at home. It is important to first demonstrate an exercise, then critique the patients' performance, and periodically check to ensure they are doing the exercise correctly.

Note: To encourage compliance, the patient can participate in a phone reminder program. In some cases, patients may need to be directly supervised while doing part or all of their routine, requiring an extended visit.

The general rehabilitative program has five major components: 1) instilling postural awareness and correction in order to reduce stress on joints and muscles, 2) preventing adhesions and increasing painless range of motion, 3) preventing atrophy and promoting strength and endurance, 4) increasing local proprioceptive input and improving speed and coordination of muscle groups, and 5) providing sensory motor training from the ankle up to increase the patient's balance and coordination.

In addition, specific sports may require further emphasis. For example, when working with swimmers, emphasize endurance training of the subscapularis and serratus anterior, concentric contractions of the posterior scapular muscles, and flexibility exercises (without overdoing them).[75,76]

Tennis players need to properly train the muscles of the trunk and lower extremities to reduce demand on the shoulder itself.[2]

However, in almost all cases, the acute phase of the program usually begins with postural awareness, passive ROM activities, and isometric exercises.

POSTURAL AWARENESS AND CORRECTION

In the acute phase, the clinician should begin with postural "first aid." That is, patients should be made aware of any slumping posture or forward rolling of the shoulders. These positions tend to place additional stress on the rotator cuff, especially the supraspinatus. This postural load can be temporarily mitigated by having patients perform a sternal lift (where they consciously lift their sternum up and out at a 45 degree angle toward the ceiling) multiple times throughout the day.

Stretching the pectoralis muscles and strengthening middle trapezius may also be necessary. If there appears to be excessive internal rotation at the shoulder, subscapularis and latissimus dorsi muscles may need to be relaxed. Finally, patients may be given the Brüegger's relief position multiple times through the day to promote postural awareness and training. (See Special Appendix, Figures VI a-b.)

A slumped posture may also place adverse load on the shoulders. This slump may be secondary to a shortening in the abdomen (approximating the xyphoid toward the pubis). Correction may be achieved through postural awareness by simply encouraging the patient to "open up" this area, by stretching the rectus abdominis muscle**,** or by giving the patient sternal lift exercises. Treatment of the abdominal musculature itself may be necessary if there is contraction within the muscle.

Even after the acute phase, the patient should always maintain good form while doing all of the other exercises in the rehab program. The patient should maintain a posture with the chin slightly retracted (tucked) and with a sternal lift. In addition, when doing activities requiring raising the arm, patients should consciously avoid early elevation ("hiking") of the shoulder. When teaching patients new exercises and observing their performance, it is critical to constantly give verbal and tactile cues to reinforce good form.

Monitor posture during ROM exercises to assess for inappropriate recruitment patterns. If the patient's middle or lower trapezius muscles are weak, the upper trapezius is commonly overactive. This may result in early shoulder "hiking." If patients inappropriately activate the upper trapezius at a particular angle in AROM, their exercise program should begin in a narrower functional range that limits this response. (See CSPE protocol, *Scapular Training Track*.)

Prevent Adhesions. Increase ROM.

Treatment Options

- **Passive ROM**
- **Active-assisted ROM**
- **Active ROM**

Passive ROM

The patient usually begins with passive ROM exercises for the GH joint on the first visit.

During the office visit, the clinician may use doctor-assisted passive motion therapy within pain-free tolerance. For the most part, however, the patient is taught to do the exercises at home.

Codman's exercises (PROM) are often prescribed immediately. Pendulum arm swings are done without weights at first. Patients begin with a 1-inch diameter circular motion, clockwise and counter-clockwise. As tolerated, the diameter of the circle can be increased and alphabet exercises may be added.

Note: *It is important that patients use the body to swing the arm so that the exercise is a passive one for the shoulder muscles.* As soon as tolerated, patients may perform these exercises actively, even while holding a weight or BOING™.

Patients may also use a wand or stick to passively move the injured shoulder through the arc of pain. (See Special Appendix, Figures I a-b.) Other methods include "wall walks" for flexion, scaption, or abduction, and having patients roll their arms over an exercise ball to induce passive elevation.

Active-assisted ROM

As soon as patients are able, they may graduate to active-assisted ROM with the wand, where the injured shoulder is sometimes active (through the pain-free range) and sometimes passive (through the painful range). Diagonal movements (PNF cross-patterns) can also be added.

Note: All procedures should be within pain-free tolerance at this stage and should be performed at home a minimum of 3 times a day—or ideally every 2 hours.

Active ROM

Patients can usually begin AROM immediately in internal and external rotation with the arm dependent and the

elbow tucked into the side. Other AROM exercises during the first phase of rehabilitation may need to be done supine with the arm at 120 degrees abduction (i.e., above the impingement arc of pain). These exercises should include flexion, abduction, and horizontal adduction.

As the impingement syndrome improves and pain permits, it is critical that patients also begin to work on regaining full range in flexion, extension, adduction, abduction, and scaption. It may be necessary at first to limit abduction and scaption to 60 degrees to avoid the painful arc.

Eventually, patients should progress until they regain complete active range of motion in all directions without pain.

PREVENT ATROPHY; PROMOTE STRENGTH AND ENDURANCE.

Treatment Options

- **Isometric exercises**
- **Multiangle isometrics (MAI)**
- **Scapula exercises**
- **Isotonic exercises**
- **Warm ups**
- **Tubing/band exercises**
- **Machines and free weights**

One of the main goals of the entire rehabilitative program is to strengthen the external rotator muscles (infraspinatus and teres minor), and subscapularis, relative to the supraspinatus and deltoid.[77] This is the mainstay of most rehabilitation programs and is thought to be effective.[60] A secondary goal, if necessary, is to strengthen the serratus anterior, as well as the middle and lower trapezius to promote good scapular stability.

Isometric exercises

In the acute phase and first phase of rehabilitation, the emphasis is to keep the key shoulder muscles actively engaged to prevent atrophy while preventing further impingement. The program begins with isometric contractions.[2] Focus primarily on the *external rotators* and the other muscles of the humeral head depressors, which include the long head of the biceps and the internal rotators.

Begin with submaximal isometric work at 65% of maximum effort and work up to maximum effort as pain allows. There are a variety of hold times and frequencies that have been recommended. One common formula is 6 repetitions with a 6 second hold for each exercise. These can be done multiple times a day. Minimally these are to be performed 3 times a day and at best every 2 hours.

Perform the following isometric exercises with the arm in the dependent position initially: shoulder flexion with the arm supinated (to prevent impingement), and internal and external rotation exercises within pain-free tolerance. These exercises can be performed with resistance provided by a wall or by the uninjured arm. (See Figure III, Special Appendix.)

Note: If patients cannot perform isometrics due to pain, then have them do hand grip squeezes with a ball (6 second hold for 6 repetitions). These can be done by holding the arm at different degrees of flexion or abduction (as long as holding the arm position is pain-free) or by going through diagonals.[2]

Another option for patients who cannot do the exercises with their injured shoulder is to start them working the opposite shoulder to promote a “spill over” training effect.

Multi-angle isometrics (MAI)

When patients can do the isometrics without a problem (avoiding the impingement positions), they graduate to multiangle isometrics for internal and external rotation; shoulder flexion and scaption (at first either below 45 degrees or above the painful arc, around 120 degrees); shoulder extension; and flexion at the elbow (for the biceps). Eventually—often during Phase 2 of rehabilitation—abduction and diagonals, or PNF cross-patterns, should be added.

Isotonic exercises

By Phase 2 of the rehabilitation program, the goals are, first, to improve endurance by increasing the number of repetitions, and, second, to build greater strength in the rotator cuff, biceps, and scapular stabilizers by increasing resistance when using tubing or weights.

Note: *It is usually safe to start isotonic exercises, within impingement-free ranges, when the patient has >20-30 degrees of pain-free active ROM in flexion, abduction, and scaption.*

Exercises include prone horizontal abduction with external rotation, flexion and scaption with resistance, internal and external rotation, biceps work (with palm up and down). (See Figure VII a, Special Appendix.) Eventually, exercises in abduction must be added. If available, lat pull down exercises can be introduced.

Note: It is recommended that lat pull downs be done in front of the patient's body, with the chin slightly tucked.

Based on current electromyographic evidence, the general program described above should include some or all of the following exercises that target the glenohumeral and scapular stabilizers.[2] Patients can start these exercises as simple isometric "holds" and ROM exercises without weights or tubing, then progress to isotonics with resistance. Be sure that patients do not elevate the shoulder and that the lower trapezius is firing during these activities.

Isotonic exercises

For the rotator cuff

- **Prone horizontal abduction with external rotation**. This exercise maximally activates the supraspinatus and works all of the other rotator cuff muscles. This may be the single best of the exercises that have been studied.[2] (See Special Appendix, Figure VII a.)

- **Forward flexion.** Be careful when approaching extreme end range because it may cause impingement.

For both the rotator cuff and the scapular muscles

- **Scaption.** Scaption should be below 90 degrees or, if too painful to perform, substitute flexion.

- **Chair press up.** This exercise can be started in Phase 1 or 2. (See Special Appendix, Figure VII b.)

For scapular muscles

(For more on exercises for the scapular muscles, see the CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*.)

- **Bent-over rowing** (See Special Appendix, Figures VII c-d.)

- **Push-ups with a plus** (See pictures in CSPE protocol, *Serratus Anterior Training Track*.)

Note: Active-assisted ROM can be continued into the ranges that are still reduced and painful.

When selecting resistance exercises, there are two schools of thought. One is to begin with tubing/band exercises and work up to free weights. The other is to start with light free weights (1-5 lb.) before attempting tubing exercises. This approach has been suggested for non-athletes who may be less conditioned and more likely to "overdo" the activity, possibly causing a setback.

In general, the eccentric phase of any resistance exercise should initially be *de-emphasized* to prevent an overuse injury. This can be done by having the patient perform the concentric portion slowly and deliberately, while allowing the eccentric "return" to be aided by the indifferent hand or with gross recruitment of other muscles. Later, by rehabilitation Phase 3, the eccentric phase can be worked by performing this portion of the exercise more slowly while allowing little or no recruitment.

Note: Abduction exercises should be done in a fashion that does not excessively recruit the deltoid. When doing tubing or barbell exercises with the arm down by the side, having the patient hold an object such as a magazine under the arm keeps the deltoid relaxed.

Warm-up

Whichever resistance exercises are chosen, the patient should *warm up before beginning each session*. Multiangle isometrics (MAI) and/or some type of rapid, repetitive motion (e.g., hand peddling an ergometer) for 5 minutes is very useful. As the patient progresses, other warm-up activities can be added or substituted including PNF cross-patterns with tubing/bands (see Special Appendix, Figures VIII a-l.) and wall angels (see CSPE protocol, *Scapular Training Track*).

Tubing/band exercises [2]

When performing tubing/band exercises, slow controlled motions are recommended and progress should be closely monitored. Proper posture should be maintained throughout the exercise. (See P. 50, Postural Awareness and Correction.)

There are a number of different protocols that can be used. These can be introduced when the patient becomes less acute. This could be during either Phase 1 or Phase 2 of rehabilitation. These must be done without re-creating the patient's shoulder pain.

Begin with the least resistance bands and eventually progress to higher resistance bands through the following phases.

1. Slow, mid-range for 60 seconds or until fatigue (optional)

2. Fast, mid-range for 60 seconds or until fatigue (goal: facilitation)

3. Slow, full range, hold at end range up to 30 seconds; release through eccentric range in slow, controlled manner. (goal: strength)

4. Fast, full range for 60 seconds or until fatigue (goal: endurance)

5. Repeat above phases, using movements that mimic the sport or job the patient is returning to. For example, attach tubing to a racket and have the patient go through the motions of a serve.

Stay within the pain-free ranges of motion. Initially, remain below 90 degrees of flexion and 45 degrees of scaption to avoid impingement.

It is suggested the exercises be done daily, but should a patient spend more than one week per phase, then an alternating day schedule should be followed.[78]

***Optional applications*.** In later rehabilitation phases, these exercises can be repeated while standing on a rocker or wobble board to enhance proprioceptive training. This would be appropriate for athletes or workers returning to jobs that will place significant work demands on the shoulder.

PNF cross-patterns with tubing resistance can be given as home care. (See Special Appendix, Figures VIII a-l.)

Note: In cases of instability, rapid mid-range tubing activities with the arm and shoulder positioned just below the unstable range can provide good proprioceptive training.

As the patient progresses, eccentric training should be emphasized (perhaps in Phase 3). The indifferent hand is used to pre-position the training arm at an end range where it is fully loaded by the elastic band. The patient then slowly moves the arm of the shoulder being exercised in the direction of the tubing, slowing release with a controlled eccentric contraction.

Note: It is important that eccentric training be preceded by a period of free-weight training so that the muscles are first properly conditioned.

Machines and free weights

Another option is the use of free weights (e.g., barbells or even soup cans), cables, or Nautilus™ machines. One advantage of using free weights is that they also improve proprioception. By Phase 2 rehabilitation, the patient exercises to the point of fatigue.

Additional exercises that may supplement this rehabilitation program include the following:

1) progressive push-ups (wall push-ups, prone push-ups on knees, military style, push-ups with a plus; see Serratus Anterior Training Track protocol),
2) bent-over rowing (see Special Appendix, Figures VII c-d),
3) biceps curls,
4) eated scapular retraction
5) serratus push on cables, and
6) chair press-up. (See Special Appendix, Figure VII b.)

High-repetition endurance training at 25-40% of maximum voluntary contraction (MVC) should precede strength training using greater than 90% MVC.[61]

Strengthening exercises should begin to incorporate various coordination and proprioceptive components. *When the injured shoulder achieves adequate strength and endurance (about 90% compared to the opposite shoulder), overhead medicine ball toss can be introduced*. This exercise stimulates high activity of the upper trapezius, lower subscapularis, pectoralis major, and anterior deltoid, and aids proper coordination. It is particularly good for athletes returning to sports requiring overhead swinging or throwing, but may also be useful for golfers and swimmers. Medicine balls of different weights and sizes can be used according to the demands of the sport.[62]

Plyometric exercises† like throwing a ball against a trampoline or rebound push-ups on a trampoline will increase strength and power as well as train coordination and control.

By Phase 3, the patient should be simulating occupational and recreational activities by using the medicine ball or tubing. (See Tubing/band exercises, P. 54.)

Scapula exercises

Once the middle and lower trapezius and serratus are "activated," exercises are given that train these muscles to become appropriately engaged in shoulder movements. (See CSPE protocols, *Scapular Training Track* and *Serratus Anterior Training Track*.)

LOCAL PROPRIOCEPTIVE TRAINING

It is important to train the patient's GH and scapular muscles to co-contract in a *coordinated* fashion to provide stability to the shoulder girdle. Increasing the *speed of contraction* is also critical to ensure that the joints will be protected during activities of daily living.

The clinician and patient can choose from a variety of exercises. When coordination and control are treatment goals, brief sessions of an exercise (1-5 minutes), 2 to 3 a day are a useful training schedule.

Brief, clinician-assisted rhythmic stabilization activities (e.g., rapid, alternating isometric contractions in internal-external rotation, abduction-adduction combinations) can be added to office visits throughout the treatment program.

If the patient progresses to free weights during the strengthening portion of the rehabilitation program, the weights themselves promote proprioceptive input, resulting in a mild training effect (i.e., a coordinated motor response).

PNF cross-patterns with and without resistance (tubing/band or weights) also promote co-activation training of rotator cuff muscles in various combinations. The "seat belt" and "sword" diagonals are very useful. (See Special Appendix, Figures VIII a-h.)

Balancing a physioball in one hand at different points along an entire range of motion creates an MAI exercise that will stimulate both control and coordination. Performing the activity with eyes closed will further increase the proprioceptive demand. (See Special Appendix, Figure IX d.)

Using hand-held oscillating devices like the BOING™ or the Body Blade™ can also provide a higher degree of challenge and training, especially when the patient has achieved nearly full range of motion and is beginning to build some endurance.

When using the BOING™, the patient can perform a variety of ranges of motion (e.g., scaption, abduction, flexion, diagonals). It is important that the motions come primarily from the shoulder rather than from the wrist or elbow. These activities can be introduced during Phase 3 rehabilitation (although in some cases, clinicians may wish to introduce them earlier). (See Special Appendix, Figure XIV.)

† This training approach is based on the concept that a *quick eccentric* muscle contraction, followed by a *quick concentric* contraction, will augment the training effect of the concentric contraction. This effect is based on the fact that during the eccentric phase, energy will be stored in the elastic tissue and a specific muscle spindle reflex will be triggered—resulting in a more powerful concentric contraction.

Note: Whenever possible, the exercises described above should eventually be modified to mimic actual shoulder actions that the patient finds most troublesome at home, work or play.

As usual, these activities are taught to the patient during an office visit and then performed as home care. It is important that the clinician check the quality and the form of the exercises during subsequent visits. Patients with poor compliance or poor body awareness may need a more supervised program requiring extended visits.

SENSORY MOTOR COORDINATION

Besides training the upper quadrant (arm, shoulder, etc.) to work as a coordinated unit, it is useful to integrate shoulder activities from the ankle up, mirroring the closed chained kinesthetics used during actual demands of daily living. This additional dimension of training may be particularly important for patients returning to significant demand on the shoulder either at work or in sports.

As previously stated, when coordination and control are treatment goals, brief sessions of an exercise (1-5 minutes), multiple times (2-3) a day appear to represent a useful training schedule.

Rockerboard work can be very useful to promote good balance throughout the entire body, often referred to as "sensory motor training."[55] (See CSPE protocol, *Low Back Rehabilitation*, the standing track.) Any of the exercises outlined in the section above, including selected activities of daily living, can be adapted to the rockerboard. For example, patients can do BOING™ exercises, ROM with tubing, mimic a sports activity (like tossing a basketball in a smooth shooting motion), or a work activity (actually swinging a hammer overhead) while concentrating on their balance. (See Special Appendix, Figure IX a-d.)

Other Aspects of Care

The last section of this care pathway discusses a variety of issues that will help patients avoid re-injuring or aggravating their shoulder conditions. It also looks at botanicals and OTC medications, the use of corticosteroids, and indications for work release and referral.

HOME-CARE ADVICE

Teach patients to avoid impingement positions. Any elevation above 60 degrees in abduction or 90 degrees in flexion tends to impinge the suprahumeral structures. Humeral internal and external rotation in these positions may further irritate the structures and should be avoided. In addition, inferior loading should be avoided (e.g., carrying a briefcase or shoulder bag).[40]

The clinician should encourage relative rest and activity modification.

The patient must discontinue any aggravating activity. No overhead activity should be performed for 3 to 6 weeks, as appropriate (based on patient's progress).[37,40] Work and sports activities will need to be examined. Necessary modifications and/or restrictions should be discussed at this time.[4,18,37,38,40,56] Athletes should probably avoid any sporting activity that requires significant use of the upper extremity for about 2 to 6 weeks.[2] However, general aerobic activity should be maintained (e.g., walking, bicycle riding). Return to sports should be gradual, perhaps icing after activity.

In addition, the clinician and patient should work together on strategies to

protect the shoulder from re-injury and to identify alternate arm positions that could be used when returning to sports or work-related activities.

For example, swimmers should use the body roll instead of arm lifts to initiate strokes, thus preventing early fatigue of infraspinatus, teres minor, and serratus anterior—muscles necessary for GH stability. The use of hand paddles should be avoided because the increased work load can be detrimental to the rotator cuff muscles.[2]

Tennis players should raise their arms well above 90 degrees of abduction (135 degrees would be better) when initiating a serve to avoid the arc of impingement. Using an appropriate racket can also decrease mechanical stress. An open throat with a leather grip is recommended. The proper grip size can be determined by measuring the lateral aspect of the ring finger from the tip to the palmar crease. Racket head size should be midsize (larger for novices), strung with nylon between 62-67 lb. (72-80 lb. for novices). Avoid playing on wet surfaces.[2]

Weight lifters must be taught to avoid exercise positions where shoulders are held at 90 degrees abduction or 90 degree horizontal adduction. Initially, avoid front raises for the deltoids. Any exercise that requires internal rotation should be done *below* 90 degrees of abduction or forward flexion. If instability is also present, all unstable positions should be avoided or modified. For example, patients should avoid the "dumbbell fly" and wide-grip barbell/ dumbbell maneuvers, and substitute narrow grip bench presses. [2]

Athletes should be encouraged to work on off-season conditioning to prevent recurrence.[2]

BOTANICAL AND NUTRITIONAL SUPPLEMENTS

Supplements can be used to control pain and inflammation in the acute phase of injury, as well as during the healing or rehabilitative phases. (See Table I., Summary of Supplements for Musculoskeletal Trauma on the next page, and the CSPE protocol, *Trauma: Diet, Nutritional Supplements, and Botanical Considerations*.)

Table I. Summary of Supplements for Musculoskeletal Trauma Treatment and Prevention

Phase of Injury	Substance	Therapeutic Effects	Dose
Acute (1-14 days post injury)	Bromelain Chymotrypsin Trypsin	Anti-inflammatory	2000-9000 MCU/day bromelain (or equivalent); 1/3 dose between meals. For 5-14 days.
Acute Citrus	bioflavonoids, Curcumin	Anti-inflammatory	900-1800 mg/day: May be useful only before peak of inflammatory phase.
Acute Proprietary	enzyme/ flavonoid combinations (e.g. Wobenzym®)	Anti-inflammatory	3-4 tablets, 3-4 times per day at least 30 minutes before meals
Acute Kava		General sedative effects; anxiety reduction	100 mg t.i.d. standardized kava
Acute, Chronic	Valerian	General sedative effects; treating insomnia	300-400 mg b.i.d. standardized valerian; for insomnia, 300-500 mg 1 hr before bedtime
Preventive Fluids/electrolytes/	Minerals Vitamin E and/or Ginkgo	Prevention of muscle cramps due to a) fluid, electrolyte, or mineral imbalances; b) peripheral vascular disease	a) Increased fluid, electrolyte, calcium and magnesium intake b) Vitamin E, 600-1600 IU/day and/or Ginkgo biloba, 120 mg/day
Preventive	Vitamin C	Reduce symptoms of delayed-onset muscle soreness	400-3000 mg/day
Rehabilitative (after inflammation has subsided)	Broad-spectrum vitamin and mineral supplement	Tissue-healing support	At least 100% RDA or Daily Value of most ingredients
Rehabilitative	Vitamin C	Tissue-healing support	Up to 1000 mg/day
Rehabilitative	Zinc	Tissue-healing support	Up to 50 mg/day
Rehabilitative Glycosaminoglycans	(GAGs)	Tissue-healing support	Chondroitin sulfate,1200 mg/day; glucosamine sulfate, 1500 mg/day
Rehabilitative	Bone-related nutrients	Fracture healing support	100% RDA or Daily Value of calcium, magnesium, vitamin D, phosphorus
Rehabilitative Microcrystalline	Hydroxyapatite Complex (MCHC)	Correction of delayed fracture union	Six grams daily

Over-the-Counter Medications (OTCs)

Both analgesics and NSAIDs can be used for patients with impingement syndrome. See over-the-counter NSAID protocol for how and when to recommend these drugs and to evaluate possible side effects.

Indications for Work Release or Limited Duties

During the acute phase, the patient may need a temporary work release depending on occupation and severity of pain. In the acute and subacute phases the patient should avoid all pain-provoking activities, such as repetitive lifting. Specifically, any overhead activity should be avoided for 3 to 6 weeks. Any elevation above 60 degrees in flexion and abduction especially with added internal or external rotation tends to impinge the suprahumeral structures. Therefore, this activity should be avoided for 3 to 6 weeks (the time will depend on patient's progress).

Summary of Operational End Points

Acute Phase

- Patient can tolerate acute phase home exercises with little or no discomfort.
- As inflammation clears, severity of pain is reduced.
- No visible signs of swelling or bogginess (compared with well shoulder).
- Pain at rest (if present) is decreased.

Rehabilitation: Phase 1

- Painless AROM of approximately 45-60 degrees in flexion and scaption plane.
- Isometric exercises can be performed to maximum effort without pain in all motions including IR, ER, flexion, extension, and scaption. Multiangle isometrics (MAI) are begun in pain-free limits.
- The patient can demonstrate good scapular awareness, sternal lift, and neutral cervical posturing.

Rehabilitation: Phase 2

- Patient has achieved full pain-free AROM without recruitment.
- Progressive gains in muscle strength are evidenced by upgrades in band resistance or weights.
- Good scapulothoracic control is displayed (e.g., no unnecessary winging or shoulder hiking, good engagement of the lower and middle trapezius).

Rehabilitation: Phase 3

- Patient can perform strengthening program to fatigue and to full range of motion.

Rehabilitation: Phase 4

- Patient no longer demonstrates reasonable progression while performing certain assigned exercises, or
- Patient appears to perform at work or sport at pre-injury performance levels.

INDICATIONS FOR REFERRAL/CONSULTATION [16,48]

Note: A range from 6 weeks to as long as 6 months is considered appropriate for a trial of conservative treatment for primary and secondary impingement syndrome. Approximately 90% of cases will resolve without surgery. Primary (structural) impingement may be more resistant to resolution with conservative care.

- Persistent pain after a conservative treatment trial of 6 weeks to 6 months including attempted vocational rehabilitation.
- Intractable pain with no improvement after 3 to 14 days of conservative treatment (depending on severity of pain).
- Suspected rotator cuff or biceps tendon rupture (complete). Persistent shoulder weakness, especially in abduction, indicates a probable rotator cuff tear. This is uncommon in patients under 35.
- Suspected glenoid labrum tear usually requires an MRI and consideration for a surgical consultation.
- Inability to accomplish a graded return to the offending activity following conservative care suggests an undetected structural abnormality of the subacromial arch or a tear of the glenoid labrum.

The common surgical approach consists of some type of decompression procedure and repair of any rotator cuff defect that may be present.

Acromioplasty, i.e., removal of the anteroinferior portion of the acromion process, is the basis of subacromial decompression, as this is the anatomic structure responsible for most of the symptoms of impingement syndrome. Performed in an open manner, this surgery is associated with necessary surgical reattachment of the origin of the deltoid muscle, with concerns regarding its stability through subsequent rehabilitation. Full recovery may take as long as 4 to 6 months.

Arthroscopic acromioplasty is associated with less deltoid complications, but may be insufficient to achieve symptomatic relief in more severe cases of impingement because of the lesser amount of acromial reshaping that is possible with this approach. The rehabilitation period, however, is typically shortened to a maximum of 3 months.

Pharmaceutical Therapeutics

Oral corticosteroids and/or NSAIDs

Occasionally, patients may be in such intractable pain that referral for prescription strength NSAIDs or oral corticosteroids is considered. It is important to balance perceived benefits with potential side-effects.

Corticosteroid Injection Therapy[79-81]

Corticosteroids injected into the subacromial space are considered an effective, short-term treatment for impingement syndrome. This treatment, however, is generally reserved for cases refractory to more conservative physical modalities as described by this pathway, but may be appropriate in some cases as early as the beginning of Phase 1 of rehabilitation. It has been shown to result in improvement in objectively measured

range of motion and reversal of the impingement sign, sustained for as long as three to twelve months after injection.

Note: Documented concerns regarding disruption of the mechanical integrity of tendons and articular cartilage limit this technique to no more than two injections, three months apart.

In addition, competent administration is important in order to avoid instillation directly into the tendon as well as the glenohumeral joint. Avoidance of strenuous physical activity for two to three weeks following injection is advised to minimize the potential rupture of these structures while in a relatively weakened state.

In stage 2 or 3 impingement syndrome, partial tears of the rotator cuff should be ruled out before injecting corticosteroids. Rotator cuff tears are a contraindication to this procedure because further damage to the injured tissues may limit the utility of subsequent surgical repair.

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APPENDIX

Figure I. Passive ROM Exercises; Posterior Capsule Stretch

WAND EXERCISES

As early as possible, it is important for the patient to perform passive range of motion (ROM) exercises. The stick or wand can be used to propel the involved shoulder up to or even through a painful arc. The next progression is to use the stick for active-assisted movement. The involved arm moves actively through the shoulder ROMs and is aided by the uninvolved arm wherever pain is still encountered.

a. Abduction

b. Flexion

POSTERIOR STRETCH

Shown here is a stretching procedure in horizontal adduction, targeting the posterior capsule and the external rotators of the shoulder (infraspinatus and teres minor). The posterior capsule can often be tight in impingement syndromes. Preheating the area and/or using a PIR or “hold relax” technique can be useful.

c. Posterior capsule stretch

Figure II. Isometric Exercises – Operator Assisted

a. Internal Rotation

b. External Rotation
(at about 45° of abduction)

c. Abduction

d. Flexion at the elbow
(for biceps)

Isometric exercises should be started as early as possible in the management of shoulder problems. Whereas most of the time exercises will be unsupervised, it can be useful for the clinician to use operator-assisted isometrics to activate the muscles and as a tool to teach the patient home exercises. It is important to isolate the muscle as carefully as possible to give patients a sense of where they are to feel the activity. Flat hand contacts make it easier for the patient to identify the direction of the force. Try to never load the patient's wrist joint during the treatment. The clinician should explore contractions in multiple angles along the available range of motion. This treatment can be complemented by gentle post-isometric stretching.

Figure III. Isometric Exercises – Home Care

a. External Rotation

b. External Rotation

c. Internal Rotation

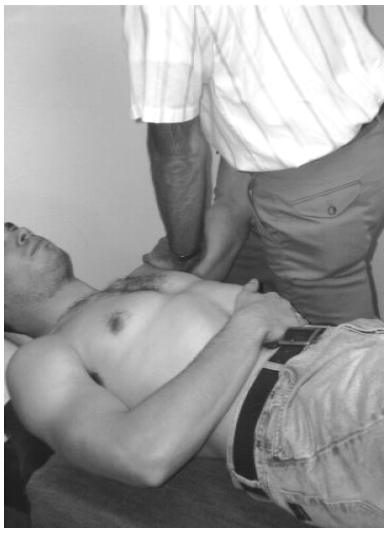
d. Adduction

Isometric exercises, especially in internal and external rotation, can usually be started even during the acute phase. The arm is kept down by the patient's side, safely out of the impingement range. Six repetitions of six-second holds at 40-65% maximum voluntary contraction (MVC) is a common recommendation. This can be done multiple times a day. Resistance can be provided by a pillow up against a wall or the patient's off hand. As soon as possible, the patient should begin multi-angle isometrics (MAIs) at approximately 20-degree intervals.

Figure IV. Glenohumeral Adjusting

Anterior Humerus
At least two different methods may be used to adjust a humerus with an anterior malposition. As illustrated in Figures *a*. and *b*. below, manipulation is described in supine and sitting postures.

With a supine patient, the doctor stands at the side of the table in a fencer's stance. The doctor supports the patient's distal arm with her/his lateral hand and contacts the patient's proximal arm just lateral to the acromion process with her/his medial hand using a soft hypothenar contact. A thrust is delivered through the contact hand in an anterior to posterior direction while the support hand distracts and counter stabilizes the arm.



a.

With a seated patient the doctor stands behind. The patient's arm is flexed 90° with a fully flexed elbow. The doctor contacts the elbow from behind, cupping the olecranon process in the palm. In this position, as the doctor increases pressure from anterior to posterior through the patient's arm, the patient's scapula is stabilized on the doctor's sternum. (Some doctors may choose to use a pillow between patient and sternum for protection.) An anterior to posterior thrust can then be delivered by pulling sharply back with the hands over the elbow.

b.

Figure IV. Glenohumeral Adjusting, continued…

Superior Humerus
At least two different methods may be used to adjust a humerus with a superior malposition. As illustrated in Figures *c.* and *d.* below, manipulation is described in supine and sitting postures.

With a supine patient, the doctor stands above the patient's shoulder in a fencer stance facing caudad. A web contact is taken just lateral to the acromion process with the medial hand. The support hand grasps the patient's elbow distracting the shoulder as needed and positioning the shoulder in the scaption plane. Then the contact hand delivers a thrust from superior to inferior.

c.

A seated patient needs to face one side of the table so the doctor can sit straddling the table and face the involved shoulder. The patient's arm is abducted and externally rotated such that the patient's olecranon rests on the doctor's shoulder. The doctor places both hands on the proximal humerus just lateral to the acromion process. The patient is asked either to grasp the table with the other hand or to lean away from the doctor while the doctor delivers a thrust from superior to inferior.

d.

Figure IV. Glenohumeral Adjusting, continued…

Internally Rotated Humerus
At least two different methods may be used to adjust a humerus with an internally rotated malposition. As illustrated in Figures *e.* and *f.* below, manipulation is described in supine and sitting postures.

With a supine patient, the arm is placed in the scaption plane. The elbow is flexed and the doctor grasps the patient's distal arm creating pretension in external rotation. A pulling thrust is delivered from proximal to distal along the long axis of the arm. To protect the cervical spine, the patient may be asked to use the other hand to grasp behind the neck for stabilization.

e.

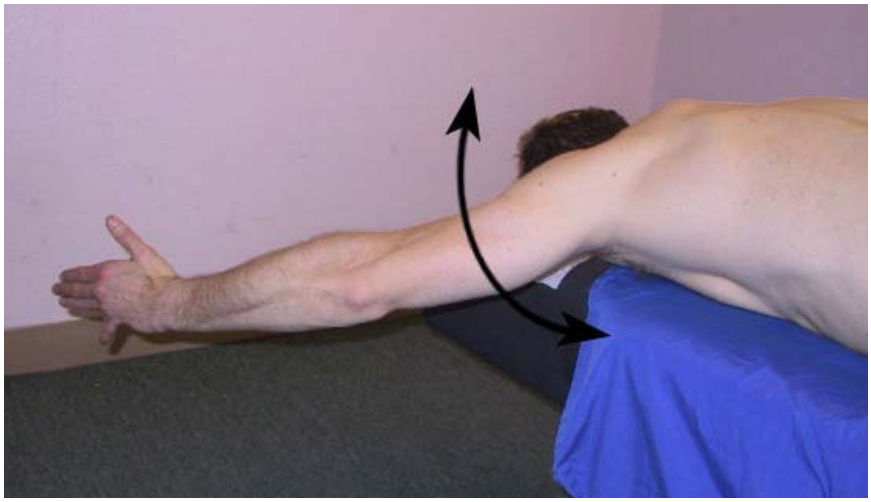
With a sitting patient, the arm is abducted and flexed in the scaption plane, pretension in external rotation is applied, and a thrust is delivered from proximal to distal along the long axis of the arm. Once again, the patient may be instructed to grasp behind the neck with the other hand for stabilization.

f.

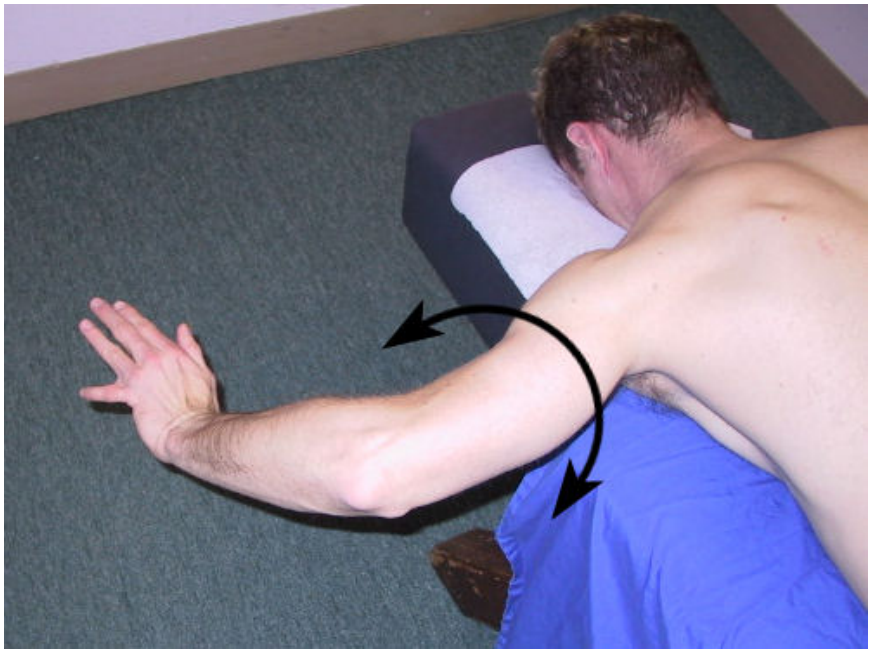
Figure V. Active Range of Motion Exercises (in 120 degrees of abduction)

Patients with impingement syndromes can often perform active range of motion exercises both below and above the arc of impingement. For example, flexion, extension, rotation, and even abduction and adduction may be done relatively pain-free with the arm kept at above 120 degrees of abduction. Depicted before are exercises that can be performed lying down with the arm raised above the painful arc.

Note: Extreme end ranges may also have to be avoided.



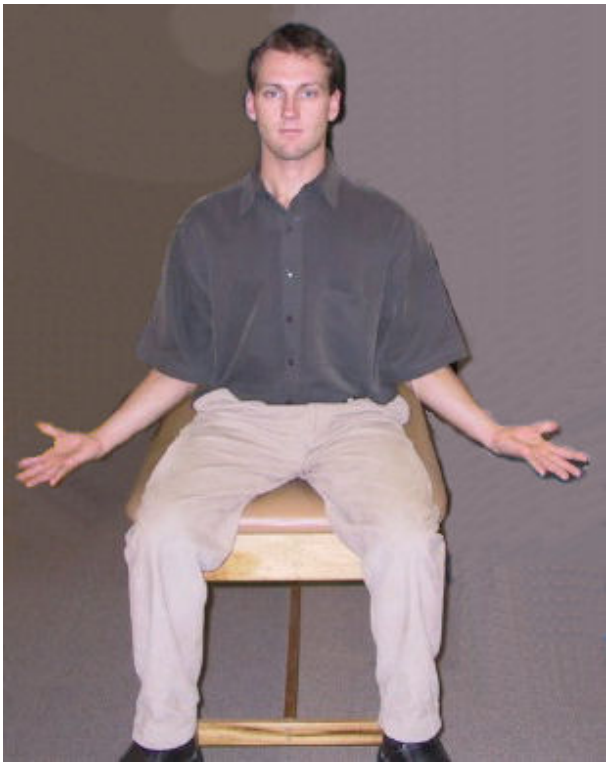
a. Abduction and Adduction



b. Internal and External Rotation

Figure VI. The Brüegger Rest Position

The Brüegger position can be used as a postural awareness and rest position, useful for a number of conditions including low back, shoulder and neck pain. Take brief, periodic breaks throughout the day (for perhaps 10 seconds, every 20-30 minutes) and settle into this stylized posture. Sit at the edge of a chair, with the legs slightly abducted, the feet and knees turned out, and the hip at an open angle (greater than 90 degrees). The pelvis is tilted forward and the stomach allowed to "pooch out," establishing a hollow in the low back which encourages maximum lordosis. The sternum is lifted up and out, which will have the automatic effect of allowing the shoulders to settle back without strain. The arms are allowed to rest on the thighs, preferably in slight external rotation. Lastly, the chin is gently tucked in and the head held high and erect. Relative to shoulder conditions, this should remove postural loading from the supraspinatus, open up the pectoralis muscles, allow for proper breathing, and allow the shoulders to relax.



a.

b.

Figure VII. "High Pay Off" Exercises

Based on EMG studies, the following exercises are "high pay off" in terms of working many key muscles important in shoulder rehabilitation: prone horizontal abduction with external rotation, exercises in the scapular plane, chair press ups, prone (bent over) rowing and push ups with a plus.*

This exercise is strongly recommended. Lying prone, the patient begins the exercise in about 120 degrees of abduction (this is usually beyond the range of any arc of pain) with arm externally rotated (the thumb is pointing up). Using the scapula as a base (rather than the GH joint) the arm is raised toward the ceiling. This can be done as isometric holds or movement through a range of motion with or without added resistance (e.g., holding a hand weight). The patient's head should be tucked in neutral or a slightly flexed position.

a. Prone horizontal abduction with external rotation.

b. The chair press up.

The patient simply raises his/her body weight off the chair and can work up to six repetitions of six-second holds.

*See CSPE protocol, Serratus Anterior Training Track for photos of push up with a plus.

Figure VII. "High Pay Off" Exercises, continued…

Based on EMG studies, the following exercises are "high pay off" in terms of working many key muscles important in shoulder rehabilitation: prone horizontal abduction with external rotation, exercises in the scapular plane, chair press ups, prone (or bent over) rowing and push ups with a plus.*

c.

d.

Prone (bent-over) rowing.

This exercise is done with a weight in the hand. It can also be done bilaterally. The motion should primarily be from the scapula. Troubleshooting: as shown here, the movement appears "hinging" at the GH joint. The clinician would have to make the patient aware of using more middle trapezius. Also, the head should not be held in extension.

* See previous page for prone horizontal abduction with external rotation and chair press up. See CSPE protocol, Serratus Anterior Training Track for photos of push up with a plus.

Figure VIII. PNF Cross Patterns (diagonals)

PNF cross patterns of diagonals retrain muscles of the shoulder girdle to work in a coordinated fashion as well as train the shoulder to work along with the other joints of the upper extremity (elbow, wrist and fingers) as part of a well-controlled "team." The diagonal direction, crossing the midline of the body, closely mimics basic functional movements of life. The clinician first acquaints the patient with the movement by taking him or her through it passively, but resistance is added as soon as possible.

Resistance can be modified, if necessary, through arcs of pain. These movements are done repetitively (10-15 times or to patient tolerance). Once patients know the cross patterns, these may be assigned as active home exercises, either with resistance (e.g., bands or tubing), or without. Two of the movements (somewhat simplified here) are the "sword" and "seat belt" patterns.

"SWORD" PATTERN (*aka*, D2 pattern)

Photos *a-f* depict the cross pattern that generally suggests putting a sword into its sheath and then drawing it out again. The first half of this movement (placing the sword back into the sheath) is represented in photos *a-c*. Pay special attention to the beginning position (photo *a*) and the ending position (photo *c*). Also note where the clinician is placing his hands to create resistance against the patient's movements at the finger, wrist, elbow and shoulder. At the GH joint the patient is primarily adducting (across his/her body), internally rotating (toward the opposite pocket). He/she is also pronating the arm, while extending the elbow and flexing the wrist and finger.

a.

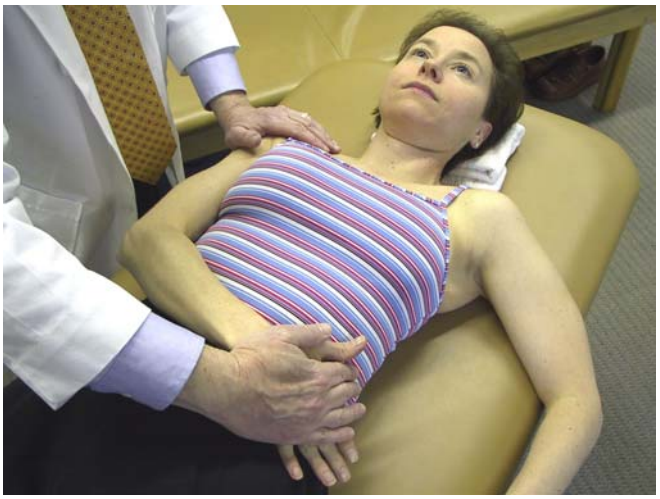
b.

c.

Figure VIII. PNF Cross Patterns (diagonals), continued…

"SWORD" PATTERN (*aka*, D2 pattern)

Photos *d-f* show the reverse direction. The primary movements are abduction and external rotation at the GH joint, flexion at the elbow, supination at the forearm, and extension at the wrist and fingers. Note how the clinician must reposition his hands at the beginning of the pattern (see photo *d*). Note also the movements of the elbow, wrist and fingers and how the clinician must provide resistance to each of these joints in the opposite direction (*d-f*).



d.

e.

f.

Figure VIII. PNF Cross Patterns, continued…

"SEAT BELT" PATTERN

Photos *g-i* depict the cross pattern that generally suggests pulling a *driver's side* shoulder harness-type of seat belt down across the body and then slowly taking it back to its starting position. The first half of the movement is like pulling the shoulder harness down and across (photos *g-i*). Pay special attention to the beginning position (photo *g*) and the ending position (photo *i*). The primary movements at the GH joint are horizontally abducting across the body, while extending down toward the floor. The elbow is simultaneously extending while the forearm is pronating and the wrist is extending.

g.

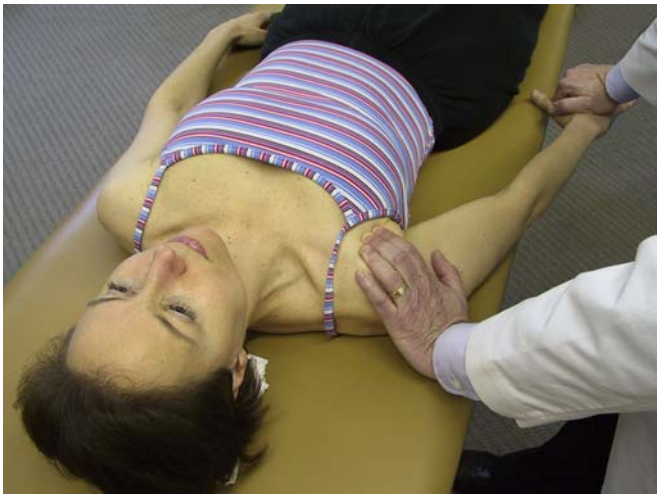
h.

i.

Figure VIII. PNF Cross Patterns, continued…

"SEAT BELT" PATTERN

To begin the return trip, the clinician must change his/her hand positions (see photo j). At the GH joint the patient is now primarily horizontally adducting (across his/her body), and flexing (up toward the ceiling). The elbow is flexing and the forearm is supinating. The fingers are flexing. Note the ending position (see photo l).



j.

k.

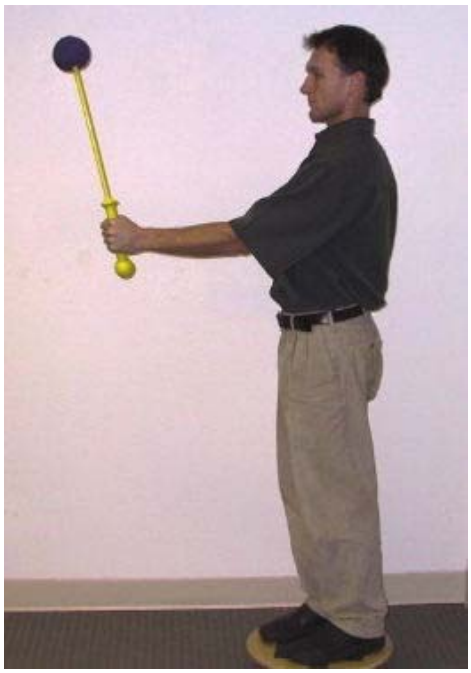
l.

Figure IX. Sensory Motor Testing

Advanced rehabilitation techniques incorporate activities that place a proprioceptive demand on the joints of the shoulder girdle along with sensory-motor coordination demands on the entire kinetic chain, from the subtalar joints on up. In each of the examples below, a rocker or wobble board provides a labile surface on which to train. Proper posture should be maintained throughout the exercises.

a.

b.



c.

d.

Figure X. Transverse Friction Massage

Supraspinatus muscle: the musculotendinous junction

The clinician reaches behind the patient's neck and applies the massage to the most lateral aspect of the supraspinatus fossa. One method of application is to use the middle finger reinforced by the index finger. The clinician rolls his/her forearm back and forth (supinating and pronating) perpendicularly across the fibers. Treatment time range from a few minutes up to about 15.

a.

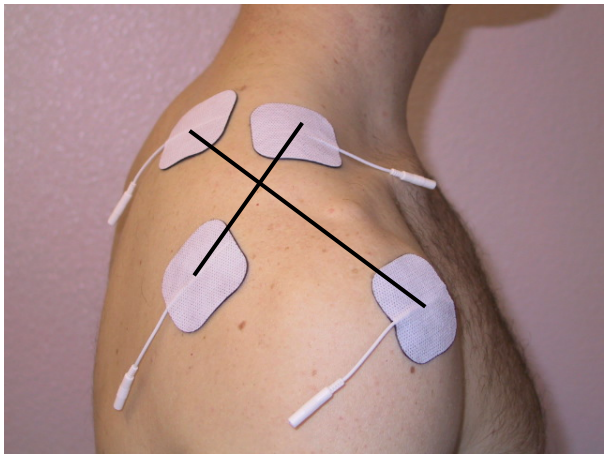
Tendon of the long head of the biceps
The patient is seated with his/her arm hanging down and resting pronated on the thigh. This brings the bicipital groove directly anterior. The clinician can use his/her thumb to anchor the treatment hand, while strumming the reinforced index finger across the tendon (photo *b*).

b.

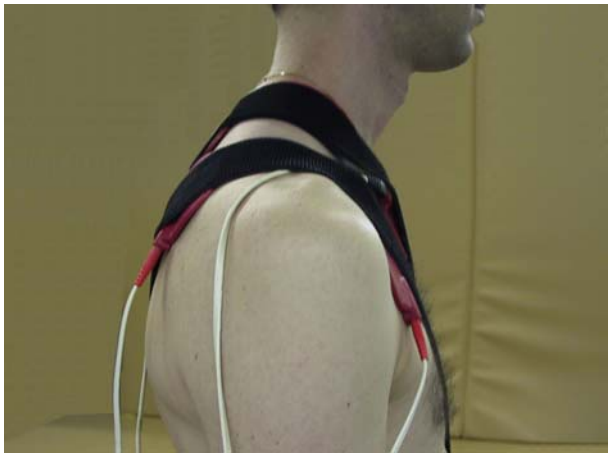
Alternatively, the hand position can be reversed, with the thumb administering the massage while the first and second fingers provide the anchor behind the patient's arm. A third option is to use the thumb to pin the tendon down while the humerus is passively rotated back and forth beneath it (photo *c*).

c.

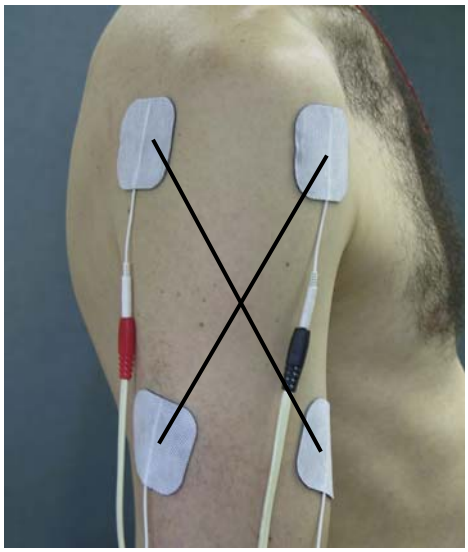
Figure XI. Interferential Current (IFC)



a. Quad polar pad placement for treating supraspinatus muscle.



b. Graphite pad placement for treatment of supraspinatus tendon.



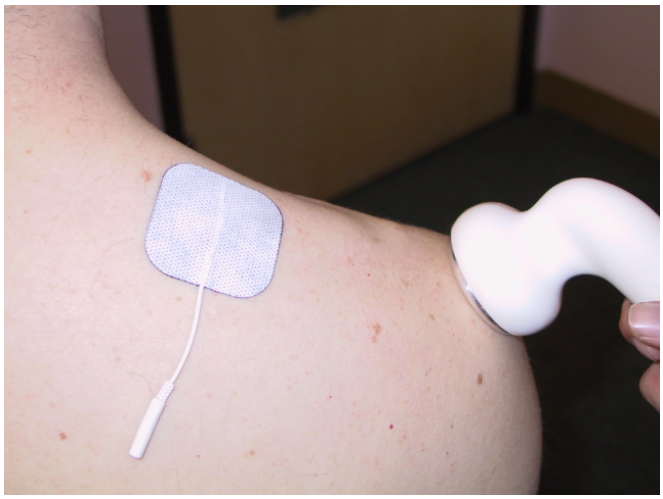
c. Quad polar pad placement for treatment of biceps tendon.

d. Graphic pad placement for treatment of biceps or supraspinatus tendon.

Figure XII. Ultrasound (U/S)

a. Ultrasound head placement for biceps tendonitis.

b. Pad placement for U/S-HVG or U/S-sine combo for supraspinatus tendonitis.



c. Pad placement for U/S-HVG or U/S-sine combo for biceps tendontitis.

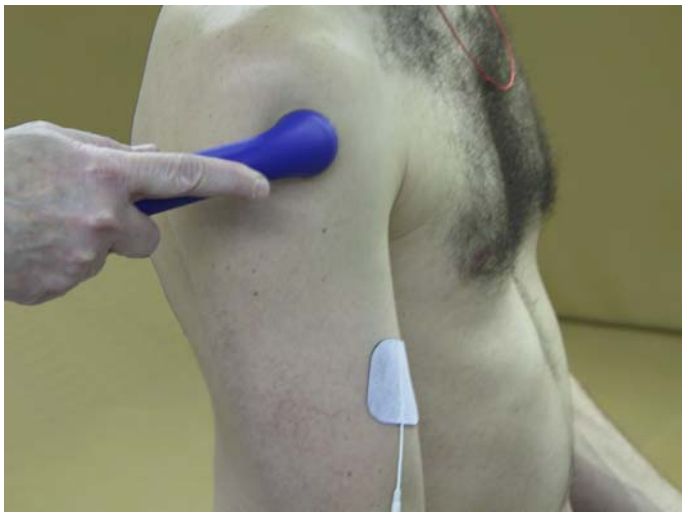
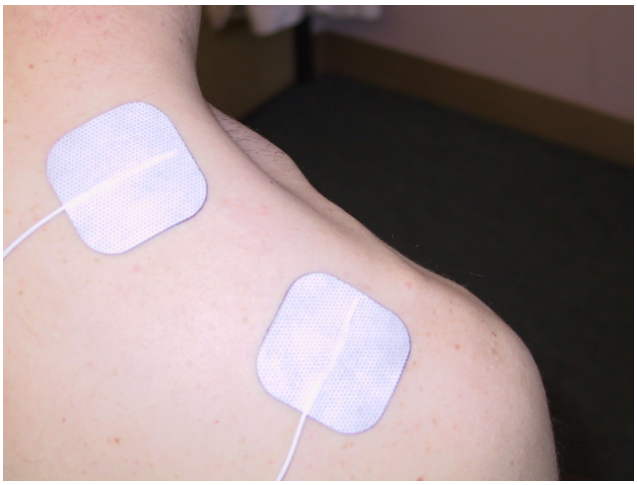
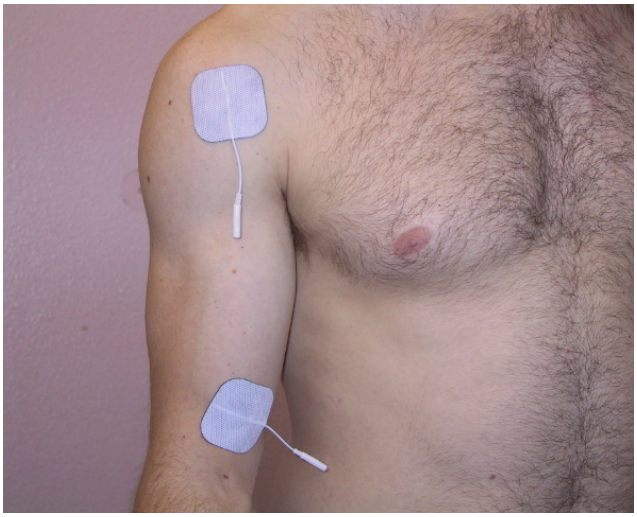


Figure XIII. High Volt Galvanic (HVG) and Sine Wave

a. HVG or sine pad placement for supraspinatus muscle.



b. HVG or sine pad placement for biceps muscle.



c. HVG or sine pad placement for biceps tendonitis.

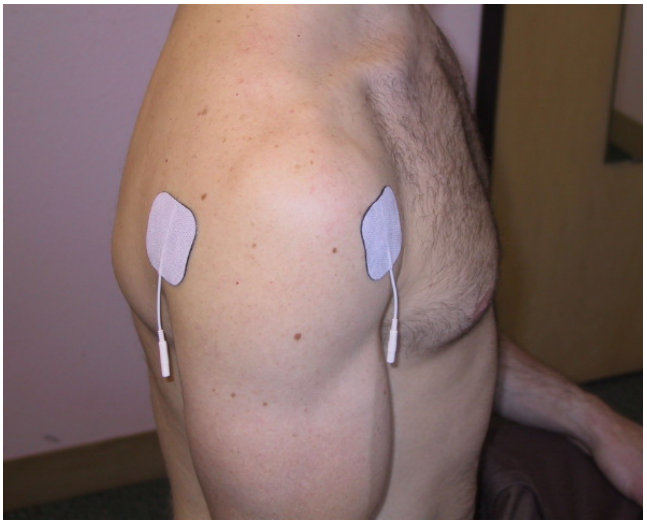


Figure XIV. BOING™

Exercises that enhance proprioceptive feedback may increase a patient's kinesthetic awareness and motor control. An oscillating instrument, such as the BOING™, can pose such a training effect. When possible, the oscillating motion should come from the GH joint. However, the wrist or elbow may also instigate the rhythmic oscillations while the shoulder moves through specific ranges of motion.

a.

Figures *a-c* depict the GH joint going through internal and external range of motion exercises while the BOING™ is oscillating. Photos *d* and *e* illustrate flexion exercises.

b.

c.

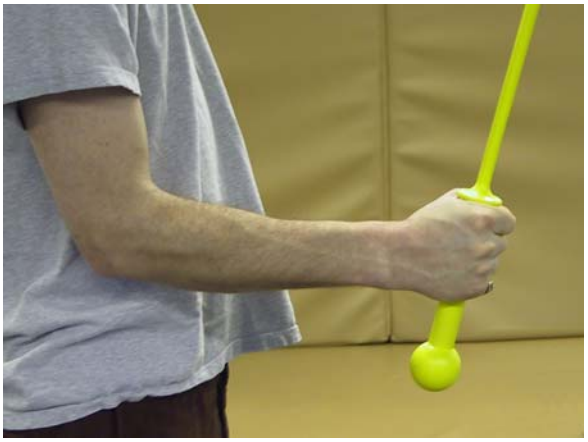
d.

e.

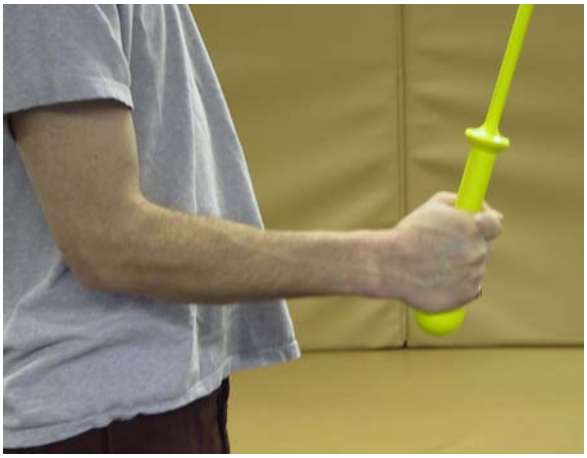
Figure XIV. BOING™

Photo *f* shows a patient protracting the scapula while attempting to control the BOING™. Photos *g-i* show different hand holds on the BOING™. Each hand position can change the difficulty of the exercise.

f.



g.



h.

i.

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strengthening program for 6 weeks. Patients were followed for an average of 27 months. 67% had satisfactory results, 28% no improvement, 5% unsatisfactory. Better prognosis for patients with acute vs chronic symptoms; patients younger than 21 and between 41-60 years old did better than patients between 21-41; patients with flat (Type I) acromion did better than those with curved (Type II) or hooked (Type III) acromion.]

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