chapter 7

Conditions of the Shoulder

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chapter objectives

At the conclusion of this chapter, the reader will understand:

- the bony anatomy of the region
- how to locate the bony landmarks and soft tissue structures of the region
- where to find the muscles, as well as the origins, insertions, and actions of the region
- how to assess the movement and determine the range of motion for the region
- how to perform manual muscle testing to the region
- how to recognize dermatome patterns for the region
- trigger-point location and referral patterns for the region
- the following elements of each condition discussed:
  - background and characteristics
  - specific questions to ask
  - what orthopedic tests should be performed
  - how to treat the connective tissue, trigger points, and muscles
  - flexibility concerns

key terms

adhesive capsulitis
attrition tendonosis
capsular pattern
impingement tendonosis
painful arc
pseudothoracic syndrome
scapulohumeral rhythm
subacromial impingement syndrome

Introduction

The shoulder is one of two pairs of ball-and-socket joints in the body (the other set is located in the hip). Because of its complex anatomy, the shoulder has the greatest range of mobility compared to any other joint in the body (Beltran et al., 2003). Unfortunately, this greater mobility results in diminished stability. Two mechanisms contribute to the joint's stability:

Active mechanisms include the contractile tissues around the joint:

- The tendon of the long head of the biceps
- The rotator cuff muscles and tendons

Passive mechanisms include the support given by the inert tissues in the area:

- The size and shape of the glenoid fossa
- The labrum
- The joint capsule
- The glenohumeral ligaments (Beltran et al, 2003)

Because of this combination of high mobility and low stability, there is an increased risk of pathology, which explains why the shoulder is the most dislocated joint in the body.

Shoulder pain can originate from myriad causes, including not only intrinsic disease and dysfunction in the structures around the joint but also referrals from related areas such as the cervical spine, thorax, and soft tissue structures.

Shoulder dysfunction accounts for about 5% of visits to primary care physicians and is the third most common musculoskeletal complaint (Wilson, 2005). Assessment of shoulder dysfunction can be difficult in part because of the sophisticated interaction between the shoulder complex and other areas of the body. Shoulder injuries can arise from both traumatic and chronic overuse conditions, and they can be exacerbated by underlying postural concerns that lead to a predisposition to re-injury. While not comprehensive, this chapter addresses the complex components in order to provide an understanding of the overall functioning of the region. The chapter reviews basic anatomy and then moves into other areas, including:

- Specific bony landmarks that mark important areas for palpation
- Soft tissue structures, including muscles of the region
- Movements of the region
- Manual muscle tests for the shoulder
- Dermatome and trigger-point referral patterns for the involved muscles

Practical Tip

Remember that shoulder pain can originate from surrounding structures and not just from the shoulder.

ANATOMICAL REVIEW

Bony Anatomy of the Shoulder Girdle

"The humerus, scapula, clavicle, sternum and first eight thoracic ribs are the skeletal fundamentals of the shoulder" (Levy et al., 2002). The *humerus* is the long bone of the upper arm and has very differently shaped ends (Fig. 7-1). Its proximal end has a semiround head that articulates with the glenoid fossa of the scapula and a distal end that articulates with the ulna. At its proximal end are two prominences: the greater tuberosity, positioned laterally, and the lesser tuberosity, positioned anteriorly and medially. These are the attachment sites for the rotator cuff muscles and

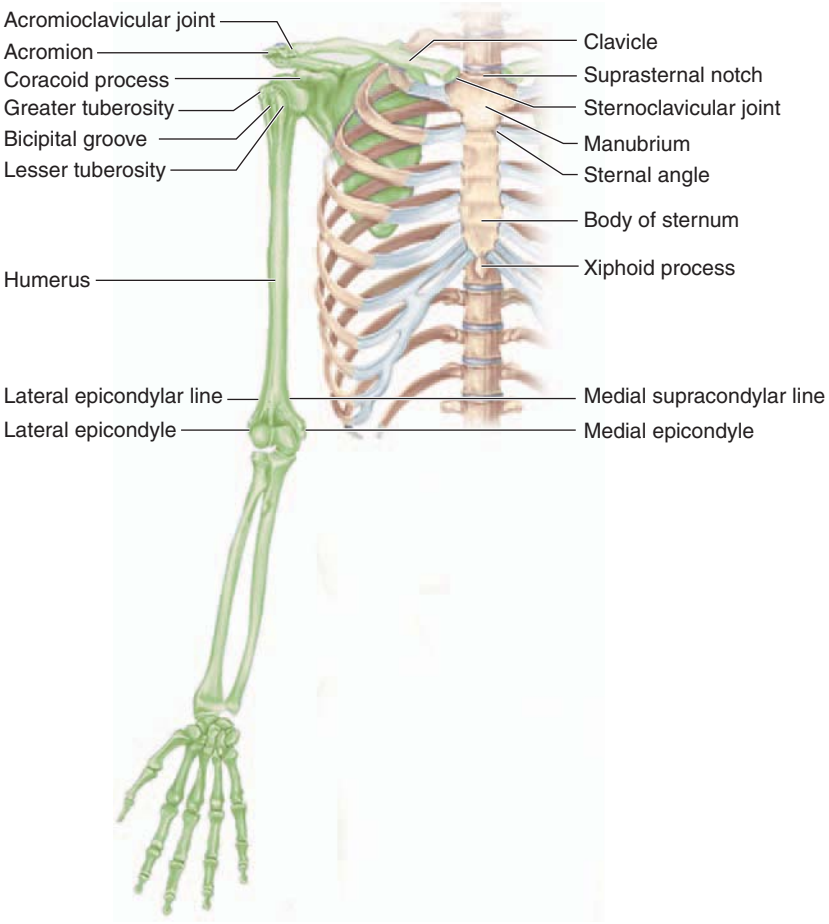


Figure 7-1 Skeletal and surface anatomy structures of the shoulder girdle.

create a groove between them to accommodate the tendon of the long head of the biceps brachii. The distal end has an hourglass-shaped notch that sits within the deep ulnar groove and forms the elbow joint.

The *scapula* is an important component within the shoulder girdle. It is a flat, triangular-shaped bone that lies over the 2nd through 7th ribs and has three distinct features (Fig. 7-2). The spine of the scapula lies on the posterior side of the bone and runs at a slightly upward angle from the medial aspect, about two-thirds up the medial border to the superior lateral aspect of the bone. It divides the scapula into unequal sections known as the *superior and inferior fossas,* both of which serve as sites for muscle attachments. As the spine moves to the superior lateral aspect, it ends in the next distinct feature, the *acromion process.* This flat end of the spine lies at the tip of the shoulder and articulates anteriorly with the clavicle to form the acromioclavicular joint.

The last feature is on the anterior aspect of the bone and projects through to the front of the shoulder. The *coracoid process* (see Fig. 7-1) serves as an attachment site for both trunk and arm muscles. The scapula is a unique bone because it does not articulate directly with the ribs and is held in place by numerous muscles.

The *clavicle* is the only bone that connects the axial and upper appendicular skeletons. It is an S-shaped bone that runs horizontally along the anterior part of the shoulder at the top of the thorax (see Fig. 7-1). Its medial edge is rounded and articulates with the manubrium of the sternum;

Practical Tip

Keep in mind that the weakest part of the clavicle is the part at which it changes from a convex curve to a concave curve.

its lateral edge is flat and articulates with the acromion process of the scapula. The medial half of the bone bends in a convex direction, while the lateral portion of the muscle curves in a concave fashion. The part of the clavicle at which the curve changes from a convex curve to a concave curve creates a structural weak spot; therefore, the largest number of fractures occurs at this point.

The *sternum* is a bony plate that ties the rib cage together anteriorly and protects the heart. It is subdivided into three parts: the manubrium, the body, and the xiphoid process. The *manubrium* is the most superior part and articulates with the clavicle and 1st and 2nd ribs (see Fig. 7-1). Moving in an inferior direction, the *body* is the longest part of the sternum and articulates with the 3rd through 6th ribs directly and the 7th through 10th ribs indirectly via the costocartilage. The most inferior part, the *xiphoid process,* is the distal tip of the sternum and can damage the organs if it is broken off.

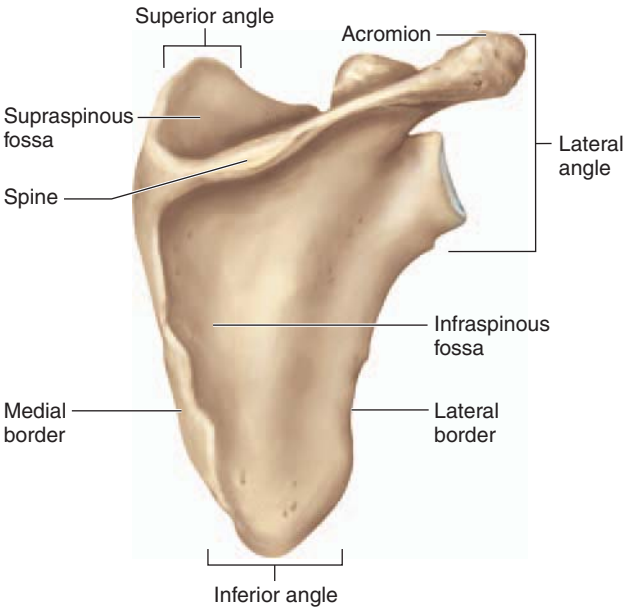


Figure 7-2 Posterior skeletal and surface anatomy structures of the scapula.

Bony Structures and Surface Anatomy of the Shoulder

Palpation of the shoulder area should take place in a systematic way and include the proximal humerus, clavicle, scapula, sternum, and ribs. Movement is often incorporated to make identification of the structures more accurate. We will start with the scapula, move to the clavicle, and palpate the humerus last (see Fig. 7-1).

Scapula

The *spine of the scapula* is on the posterior shoulder girdle on the upper half of the bone and runs in a transverse direction at a slight upward angle. The medial end lines up with T3, and the lateral end is the acromion process. To locate the spine, use the palm of your hand and place it on the upper half of the scapula. Palpate back and forth in a vertical fashion to find the distinct edge, and then use your fingertips to trace its borders to either end. Once you trace the spine to its medial edge, you can easily find the *medial border of the scapula*. It runs along the spinal column the entire length of the scapula and is palpated easier by placing the client's hand in the small of his or her back.

If you trace the medial border to its most superior part, you will encounter a sharp corner known as the *superior angle of the scapula*. This point is commonly tender and is the insertion for the levator scapula. Tracing inferiorly along the medial border until its inferior tip, you will feel another prominent corner, which is the *inferior angle of the scapula*.

The last structure on the posterior aspect of the bone is the *lateral border*. Using the inferior angle as a starting place, round the corner and move up the lateral edge of the bone to the axilla. This border may be more difficult to define since it is covered by thick muscles.

Practical Tip

Movement is very helpful in identifying structures in the shoulder.

As you move around to the anterior structures on the scapula, you encounter the *acromion process*. This is the flat, L-shaped lateral end of the spine of the scapula that forms the acromioclavicular joint with the clavicle. Place the palm of your hand on the lateral tip of the shoulder, and move it in a circular fashion, feeling for a flat, bony surface. Once you locate the general structure, use your fingertips to trace the borders. To ensure you are on the right structure, have the client move the shoulder. If you are on the acromion process, it should not move. If it does move, however, you are probably on the acromioclavicular joint or the head of the humerus.

The last structure on the scapula is the *coracoid process*, which lies on the anterior surface. It is located about 1 inch medial to the acromion and about a half-inch inferior to the clavicle. It feels like a small marble and will most likely be tender.

Clavicle

The *clavicle* is an S-shaped bone anterior to posterior. It has a convex curve medially and a concave curve laterally. The medial end is rounded and forms a joint with the sternum, while the lateral end is larger and flatter and forms a joint with the acromion process of the scapula. Starting at either end of the clavicle, trace the bone between its two ends. At the lateral end, the *acromioclavicular joint* can be a difficult structure to find on some clients. Start by tracing the clavicle to its lateral edge. Once you reach the end of the clavicle, you should feel a space where it meets the acromion process. This is the joint. You can also start by locating the acromion process and working your way medially until you feel a "step" up to the clavicle. The space before the step is the joint. You can ensure you are on the joint by having your client protract and retract the shoulders. You should feel it move.

At the other end of the clavicle, the *sternoclavicular joint* joins the axial to the upper appendicular skeleton. Trace the clavicle medially until you feel the joint space. It sits a little superior on the sternum and should be fairly prominent. You can also use the suprasternal notch as a starting point, and move just lateral until you feel the medial edge of the clavicle. In order to make the joint easier to feel, place a finger on the joint and have the client protract and retract the shoulders.

Sternum

Moving medially from the sternoclavicular joint onto the sternum, the *manubrium* is the most superior portion of the bone. The top of this structure is known as the *suprasternal* or *jugular notch* and is easily palpated. The first ribs also attach here on either side below the clavicle. Moving down the sternum, the *sternal angle*, also referred to as the *angle of Louis*, is the junction between the manubrium and the body of the sternum. To find it, start at the suprasternal notch and move in an inferior direction about 1 inch to 1½ inches. You will feel a ridge of bone, which is the angle and the landmark for the second rib. Continuing inferiorly, the *body of the sternum* is the largest portion of the sternum and runs inferiorly to the tip. It serves as the attachment for the last true rib via the costal cartilage. At the most inferior tip of the sternum lies the *xiphoid process*. It can differ in size and can point internally or externally or remain neutral.

Humerus

The last piece of the shoulder girdle is the humerus. The *humeral head* can be palpated in one of two ways. The first method is to stand behind the client and place one hand on the top of the shoulder while cupping the shoulder from the side with the other hand and placing your fingers around the front and your thumb around the back of the shoulder. With the client relaxed, slide the shoulder in an anterior and posterior direction; you will feel the head moving between your fingers and thumb. The second method of palpating the humeral head is to abduct the humerus to the end range and palpate in the axilla with your palm to find the round head of the humerus.

The next structure is the *greater tuberosity of the humerus*. It lies on the superior, lateral humerus and may be difficult to find. Using the acromion process, move off in an inferior direction and slightly medially until you find a large bony prominence. Once you have located it, use your fingers to palpate its borders. The *lesser tuberosity of the humerus* is smaller and deeper than the greater tuberosity. From the anterior portion of the acromion, move in an inferior direction onto the smaller tuberosity.

Practical Tip

You may have to move medially to find the greater tuberosity because the shoulder may be internally rotated.

Between the two tuberosities is the *intertubercular* or *bicipital groove*. It runs in a vertical fashion and is home to the tendon of the long head of the biceps brachii. To locate it, have the client put his or her arm down by the side and bend the elbow to 90°. Locate the greater tuberosity, and laterally rotate the arm. Your finger should fall off the greater tuberosity into a groove. As you continue to rotate the arm, your finger will come up onto the lesser tuberosity. Rotate the arm medially and laterally to find the groove between the tuberosities.

Practical Tip

Make sure you rotate the arm back and forth to a great enough degree to ensure that you don't miss the groove.

Moving down from the head of the humerus, the *shaft* runs to the epicondyles. It can be directly palpated midway down the inside of the arm between the biceps brachii and the triceps brachii. At the distal end of the humerus on the medial side is the *medial epicondyle of the humerus*. Locate the bend in the elbow, and trace it in a medial direction until you find a round, bony structure. Just superior to the condyle is the *medial supracondylar line of the humerus*. Locate the medial epicondyle of the humerus, and palpate in a superior direction along the ridge. The *lateral epicondyle* is the distal lateral end of the humerus and may be more difficult to find than the medial epicondyle. Locate the bend in the elbow, and move laterally until you feel a round, bony prominence. From the lateral condyle, locate the *lateral epicondylar line* by palpating in a superior direction along the ridge.

Soft Tissue Structures of the Shoulder

This section discusses the four separate joints that constitute the shoulder region (Fig. 7-3).

Glenohumeral Joint

The *glenohumeral joint* is the multiaxial ball-and-socket joint of the region and has the greatest degree of motion out of the four joints (see Fig. 7-3). It is formed by the humeral head and the glenoid fossa. As stated earlier, stability is sacrificed in exchange for motion. The humerus has three to

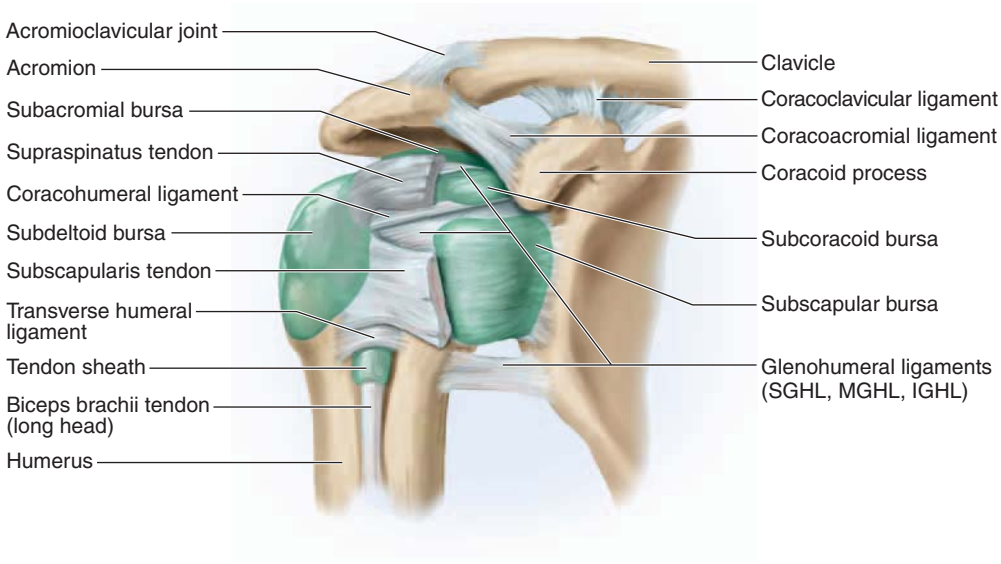


Figure 7-3 Soft tissue structures of the shoulder girdle.

four times the amount of surface area as the glenoid fossa. When combined with the shallowness of the joint, the humerus has been described as a basketball on a saucer or a golf ball on a tee. The relative shape of the humerus compared to that of the glenoid enables both rotation and linear motion, or translation.

A ring of fibrocartilage called the *glenoid labrum* attaches around the edge of the glenoid fossa and acts to deepen the socket (Fig. 7-4). Its most important function is to assist in anchoring the tendon of the long head of the biceps and the glenohumeral ligaments. The glenoid capsule encloses the joint and is attached around the periphery of the glenoid. It is quite loose and assists in enabling range of motion.

There are three anterior thickenings of the capsule that are classified as the glenohumeral ligaments (see Fig. 7-3). Each of the three ligaments contributes a different degree of stability to the joint depending on the position of the arm (Beltran et al., 2003):

1. *Superior glenohumeral ligament (SGHL):* Arises just anterior to the insertion of the long head of the biceps and inserts just superior to the lesser tuberosity on the humerus, lending stability to the superior part of the joint.

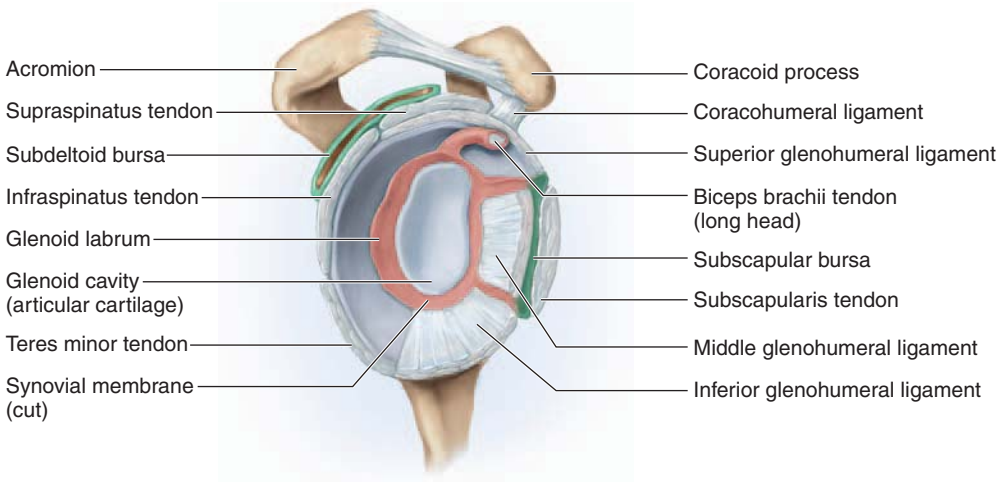


Figure 7-4 Soft tissue structures of the glenohumeral joint.

2. *Middle glenohumeral ligament (MGHL):* Runs across the front of the joint to the anterior aspect of the humerus inferior to the SGHL, lending stability to the anterior portion of the joint.
3. *Inferior glenohumeral ligament (IGHL):* Has three portions that run between the inferior glenoid and the anatomical neck of the humerus. The IGHL is the most important stabilizing ligament of the shoulder; it is the main stabilizer against anterior/inferior dislocations, especially when the arm is in abduction and external rotation.

Practical Tip

The shoulder is most vulnerable when the arm is in abduction and external rotation.

Acromioclavicular Joint

The lateral end of the clavicle and the acromion process of the scapula form the *acromioclavicular joint.* This joint enhances the motion of the glenohumeral joint and assists with freedom of movement in the area (see Fig. 7-3). It is considered a diarthrodial joint with limited movement and is surrounded by a thin capsule with a fibrocartilaginous disk between the two articulating surfaces. The superior and inferior acromioclavicular ligaments are strong ligaments that add stability to the joint. A third ligament supports the overall position of the joint and runs between the coracoid process and the acromion process. It is called the *coracoacromial ligament.*

Sternoclavicular Joint

The *sternoclavicular joint* is formed by the articulation of the medial end of the clavicle and the manubrium of the sternum (see Fig. 7-1). The clavicular component is larger than the sternum and tends to sit higher on the joint. The two surfaces are separated by an articular disk, which significantly strengthens the joint. It also absorbs shock and prevents the medial displacement of the clavicle. The joint is surrounded by a thin capsule that is reinforced by four strong ligaments:

- Anterior sternoclavicular
- Posterior sternoclavicular
- Costoclavicular
- Interclavicular

This proximal joint allows the distal clavicle to move in superior, inferior, anterior, and posterior directions, as well as allows some rotation.

Scapulothoracic Joint

While the *scapulothoracic joint* is not a true joint by definition, the articulation formed by the scapula on the wall of the thorax is critical to shoulder movement, so we include it as a joint.

This articulation is held in place entirely through soft tissue and has two important functions. First, the muscles attaching to the scapula stabilize the area during arm movements to provide a fixed base from which the shoulder can work. Second, the muscles move the scapula to assist in the proper positioning of the glenohumeral joint. Dysfunction will arise if the glenohumeral joint is not allowed to move properly.

Other Structures

There are several other relevant soft tissue structures in the shoulder region (see Fig. 7-4). The various bursae that surround the shoulder act to reduce friction between adjoining structures. The most important of these is the *subacromial bursa*, which is situated in the subacromial space and surrounded by the acromion process superiorly, the humeral head inferiorly, and the coracoacromial ligament anteriorly. It cushions the tendons of the rotator cuff muscles and can become a source of dysfunction if irritated.

The *coracoacromial ligament* is an important structure as well. It runs between the coracoid process and the acromion process of the scapula. It helps form the subacromial arch along with the undersurface of the acromion process and is a common site for impingement of the rotator cuff tendons (discussed later in the chapter).

The *brachial plexus* emerges from the cervical spine and consists of the nerve roots of C5 through T1. (Refer to Fig. 5-7, page 105.) As it leaves the neck and passes into the shoulder and arm, it starts as separate nerves and converges into three trunks. Just before the shoulder, the trunks split into anterior and posterior divisions. These divisions divide into cords as they enter the shoulder region and then branch to form the more familiar nerves that enter the arm. The posterior cord branches into the radial and axillary nerves; the lateral half of the medial cord converges with the medial half of the lateral cord to form the median nerve; and the rest of the medial cord becomes the ulnar nerve. The remaining part of the lateral cord becomes the musculocutaneous nerve.

There are a few additional soft tissue structures that are important to identify:

- *Brachial artery:* Lies along the medial humerus between the biceps and triceps brachii; it should be palpated carefully.
- *Cephalic vein:* Runs along the delto-pectoral interval, lateral to the biceps brachii and down the lateral humerus.
- *Basilic vein:* Runs superficially along the medial humerus between the biceps and triceps brachii.
- *Median cubital vein:* Runs along the cubital crease and connects the cephalic and basilic veins.
- *Epitrochlear lymph nodes:* Lie just above the medial epicondyle, along the medial supracondylar line. These lymph nodes are the last structures in the region. Use your fingers in a circular fashion to palpate these structures.

Muscles of the Shoulder Region

The muscles that are involved in the movement of the shoulder girdle are shown in Fig. 7-5. Refer to the Quick Reference Table "Muscles of the Shoulder Girdle" at the end of this chapter (page 269).

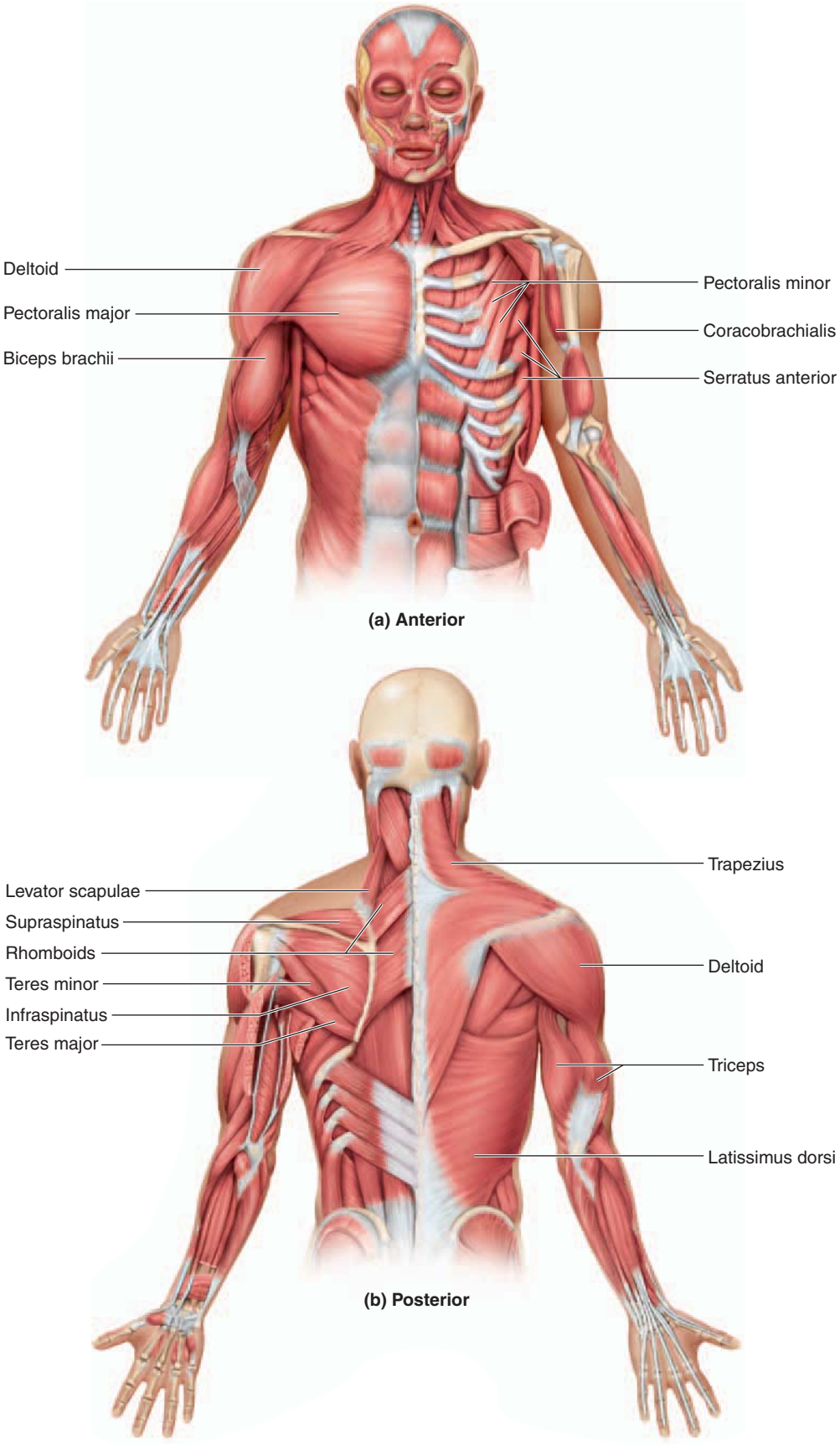


Figure 7-5 Muscles of the shoulder region.

MOVEMENT AND MANUAL MUSCLE TESTING OF THE REGION

The shoulder is a complex joint with many simultaneous activities that are dependent on each other to prevent dysfunction. A thorough understanding of the baseline information of the region is important in performing an accurate assessment. This section discusses the information used to obtain that baseline.

Extensive range of motion is available at the shoulder. This is partially due to the laxity of the structures that create the glenohumeral joint, but it is also a result of the relationship among all the joints in the area. The coordination and combination of the various motions at the glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic articulations create the overall mobility of the region. This section explains the movements available at each of the joints in the shoulder, as well as the overall movement pattern of the shoulder complex.

Movements of the Region

Glenohumeral Joint

True glenohumeral movements occur before the contributions of the associated joints in the area. Actively distinguishing true glenohumeral motion can be difficult. Pin the scapula as best you can to the chest wall by placing your palm over the inferior angle and holding it in a secure position. The end of true glenohumeral movement comes when the inferior angle cannot be held anymore. The movements are assessed easier through passive methods, but their ranges are as follows:

- Flexion–90°
- Extension–45°
- Abduction–90° to 120°
- Adduction–45°
- Medial and lateral rotation–55°, and 40° to 45°, respectively

Sternoclavicular Joint

The sternoclavicular joint is important in shoulder motion and is often overlooked when discussing dysfunction in the area. It has a wide range of motion and can move in the following directions:

- Elevation–45° to 60°
- Depression–10°
- Protraction/retraction–20° to 30°
- Rotation–30° to 50°

Acromioclavicular Joint

The acromioclavicular is a gliding joint that has movement in three different planes. It has less motion than the other shoulder joints, but it still contributes to the overall mechanics of the shoulder complex:

- Protraction/retraction–20°

- Elevation–20°
- Rotation–45°

Scapulothoracic Joint

Because of the unique configuration of the scapulothoracic joint, we will not discuss the degrees of ranges of motion. Instead, we'll focus on the available movements at the articulation. The proper mobility at this joint contributes a large portion of the overall functioning of the shoulder. Its motions include:

- Elevation
- Depression
- Protraction
- Retraction
- Endorotation (downward rotation)
- Exorotation (upward rotation)
- Anterior tilt (inferior angle lifts off the rib cage)

Shoulder-Complex Movement

When assessing overall shoulder motion, place the client in a seated, standing, or supine position and perform the most painful movements last. While the client is performing the motions, watch for the combined participation of the various joints to accomplish the desired movement. Movements should be in a normal, coordinated sequence and should be smooth, with no apprehension. Movements should be observed from the front and back, and sometimes they should be performed in combination to determine the functional capacity of the client.

There are three combined movement patterns that can quickly screen for functionality (Fig. 7-6). They are known collectively as the *Apley*

Practical Tip

Watch the contributions of each joint to the overall movement of the shoulder.

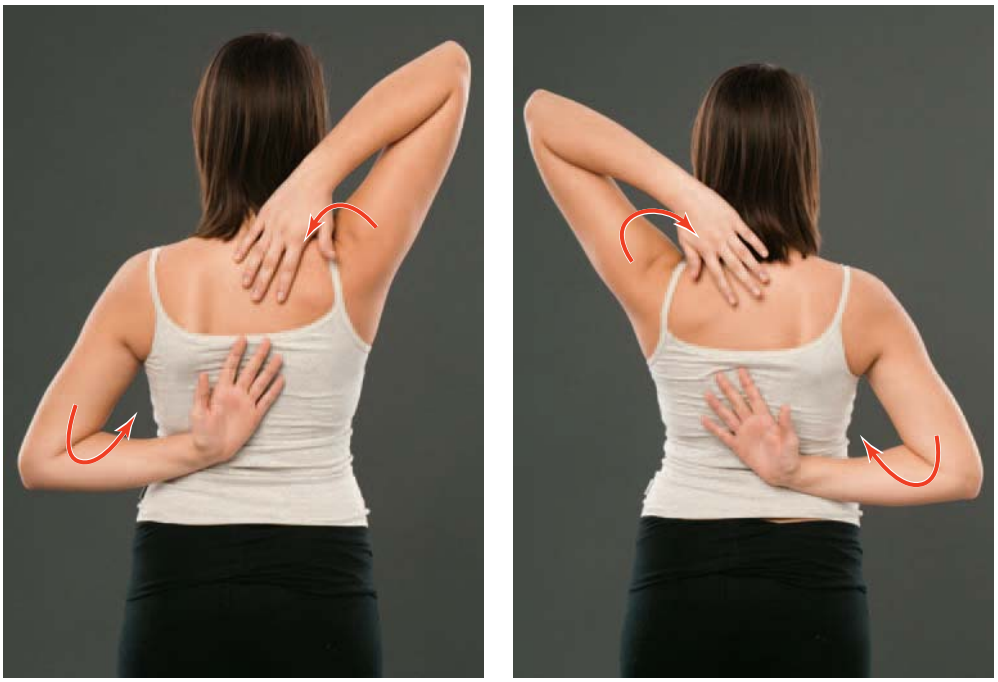


Figure 7-6 Apley scratch test.

scratch test and are also used to assess for adhesive capsulitis (addressed later in the chapter).

Apley Scratch Test

1. The first phase tests external rotation and abduction. Ask the client to reach behind the head and down the back as far as possible. Record how far the client can reach, repeat the movement for the opposite side, and compare the results.
2. The next phase assesses internal rotation and adduction. Have the client reach up behind the back as far as possible. Record the level, repeat the movement for the opposite side, and compare the results.
3. The third phase tests adduction and internal rotation. Have the client reach out in front of his or her body and touch the opposite shoulder. Repeat the movement for the opposite side, and compare the results.

The overall movements available at the shoulder complex are discussed below and are performed with the client standing.

Flexion—180° Starting with the arm at the side (0°), have the client raise the arm straight out in front of his or her body with the thumb up as far as possible.

Extension—45° to 60° Starting with the arm at the side (0°), have the client bring the arm back as far as possible. Make sure that the movement is coming from the shoulder and not the spine. Clients may lean forward to give the appearance of shoulder extension.

Abduction—180° From the same starting position (arm at the side, 0°), have the client abduct the arm as far as possible. If the arm reaches 90°, have the client turn the palm up and continue farther. This motion utilizes a special relationship between the scapula and humerus. The **scapulohumeral rhythm** is a ratio of movement between the scapulothoracic and glenohumeral joints. Through the 180° of abduction, the ratio of movement of the humerus to the scapula is 2:1; that is, 120° occurs at the glenohumeral joint, and 60° is contributed by the scapulothoracic articulation. This rhythm occurs in three phases:


scapulohumeral rhythm A ratio of movement between the scapulothoracic and glenohumeral joints.

1. For the first 30° of abduction, there is little or no movement of the scapula and there is up to 15° of elevation of the clavicle. The scapula is said to be "setting" in this phase; thus, there is no ratio of movement.
2. During the next 60° of movement, the ratio becomes evident, with the scapula rotating 30°. The clavicle continues to elevate to 30° during this phase.
3. The last phase continues the 2:1 ratio with the humerus abducting to 120° and the scapula rotating to 60°. At this point, the clavicle rotates posteriorly 30° to 50° to allow the full range of motion. If the clavicle does not rotate and elevate, abduction is limited to 120°.

Lateral (External) Rotation—80° to 90° This is performed easiest with the client in the supine position and the arm abducted to 90° and the elbow flexed to 90°. As you look at the client from the side, the hand should be pointed toward the ceiling, which is considered 0° as a start point for this measurement. Let the client's hand fall backward toward the table, making sure the shoulder does not come off the table. This will provide a true measurement.

Medial (Internal) Rotation—70° to 90° Start with the client in the same position as that for lateral rotation and with the same start angle, but let

the palm fall toward the table. Be careful that the client does not arch the back to add more movement.

Adduction—50° to 75° Starting with the client's arm at the side (0°), have the client bring the arm in front of the body. Be sure the client does not rotate the trunk to increase the movement.

Horizontal Adduction—135° With the arm abducted to 90°, which is the start position and a reference angle of 0° for this measurement, have the client bring the arm across the front of the body.

Horizontal Abduction—30° to 45° Starting with the arm abducted to 90°, which is the start position and a reference angle of 0° for this measurement, have the client bring the arm backward.

Passive Range of Motion

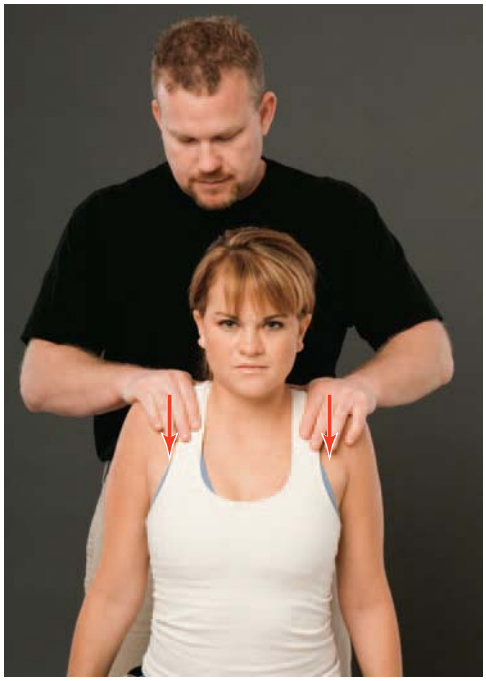
If the client has full range of motion actively, passive assessment is not necessary. If the active range is not full or the end-feels cannot be tested, each direction must be tested passively. If a client has full range of motion passively but not actively, muscle weakness or injury is likely the cause. If both active and passive ranges are limited, consider other causes, such as intra-articular blockages. The passive ranges are the same as those for the active movements, and they should be assessed with the client in either the supine or the seated position. It is important to ensure that the client is completely relaxed during this type of assessment.

Passive range-of-motion testing is better than active for assessing the range of motion at the true glenohumeral joint. With the client in the seated position, pin the scapula to the rib cage and take the humerus through flexion, extension, adduction, and abduction. The motion at the glenohumeral joint will occur before the scapula starts to move.

Practical Tip

Make sure the client is totally relaxed to facilitate passive testing.

Manual Muscle Testing



Motions at both the scapula and the humerus should be tested, as these bones work together to produce movement at the shoulder. With the client in the seated or standing position, create an isometric contraction by instructing the client not to allow you to move him or her. Strength should be tested at more than one range, and testing should be repeated several times to determine the presence of weakness or fatigue.

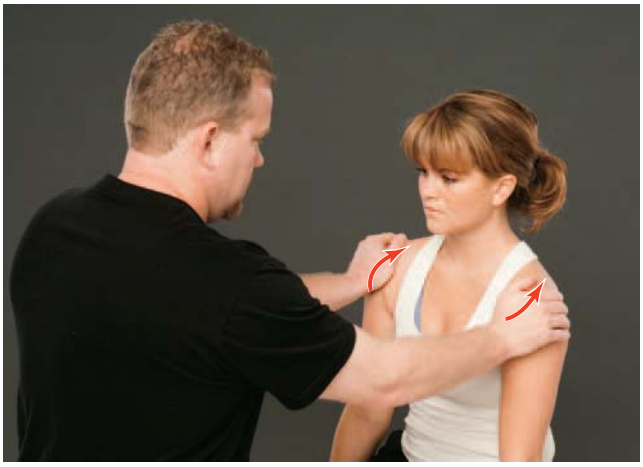
Scapular Tests

Elevation Have the client shrug the shoulders. Place your hands on top of the shoulders, and instruct the

client to resist your pressing down. Repeat the process for varying degrees of elevation.

Depression Instruct the client to bend the arms to 90° and press the shoulders down. Place your hands under the client's elbows, and press up while the client resists. Repeat in several positions.

Protraction Stand in front of the client, and instruct him or her to round the shoulders. Place your hand on the front of the shoulders, and push backward while the client resists. Repeat in several positions.



Retraction Stand behind the client, and instruct him or her to pinch the shoulder blades together. Place your hands on the back of the shoulders, and press them forward while the client resists. Repeat in several positions.

Shoulder Tests

Flexion Have the client hang his or her arm down at the side, bend the elbow to 90°, and bring the shoulder into a slight amount of flexion. Stand behind the client, and place one hand on the shoulder and the other around the front of the biceps. Use your hand on the shoulder to stabilize the client; then pull on the upper arm while the client resists. Repeat using several different degrees of flexion as starting positions.

Extension Start with the client's arm bent to 90° and in slight extension. Place one hand on the client's shoulder and the other on the triceps. Push the client into flexion while he or she resists. Repeat using several different degrees of extension as starting positions.

Abduction The client should have the elbow bent to 90° and the arm abducted slightly. Stand behind the client, and place one hand on the shoulder and the other on the distal humerus. Press the client's arm into his or her body while the client resists. Repeat using several different degrees of abduction as starting positions.

Adduction Stand behind the client, and begin with his or her arm slightly abducted, with the elbow flexed to 90°. Stabilize the client's shoulder with one hand; place the other hand on the medial side of his or her elbow, and move the arm into abduction as the client resists.

Lateral Rotation Stand behind the client, and place one hand on the shoulder to stabilize him or her. Keeping the client's arm against his or her side, have the client bend the elbow to 90°. Place your other hand on the lateral side of the distal forearm, and press medially while the client resists. Repeat using several different degrees of lateral rotation as starting positions.

Medial Rotation Have the client bend the elbow to 90° and place his or her arm at the side. Stand in front of the client, and place one hand on the shoulder and one on the medial side of the distal forearm. Press the client into lateral rotation while he or she resists. Repeat using several different degrees of medial rotation as starting positions.

Elbow Flexion Stand next to the client, and have the client bend the elbow to 90° with the forearm supinated. Place one hand under the elbow to stabilize it and the other on the client's distal forearm. Press down on the forearm while the client resists. Repeat using different degrees of flexion as starting positions.

Elbow Extension Have the client bend the elbow to 120° and pronate the forearm. Stand on the side, and place one hand under the client's elbow and the other on the distal forearm. Press the client into flexion while he or she resists. Repeat using several different degrees of extension as starting positions.

To ensure that there is no neurologic involvement, assess the myotomes for the shoulder as well. Perform the movements that were done for the manual muscle tests:

- *C4–scapular elevation:* Have the client shrug the shoulders and resist while you press down.
- *C5–shoulder abduction:* Have the client abduct the shoulders and resist while you move him or her into adduction.
- *C6–elbow flexion:* Flex the client's elbow to 90°, and have the client resist while you press the elbow into extension.
- *C7–elbow extension:* Flex the client's elbow to 90°, and have the client resist while you flex his or her arm.

DERMATOMES FOR THE SHOULDER GIRDLE

Dermatomes are the sensory areas innervated by the nerves and can be an indication of dysfunction in the area. Using a fingertip or blunt object, touch the area lightly bilaterally, and ask the client whether the sensations are equal. Include the neck, shoulder, anterior and posterior sides of the chest, and down both sides of the arms. Remember to stay in the middle of the dermatome to avoid overlap into adjacent dermatomes (Fig. 7-7). Any differences between sides can indicate pathology; moreover, dermatomes can vary from person to person. The dermatomes of the shoulder are summarized in Table 7-1.

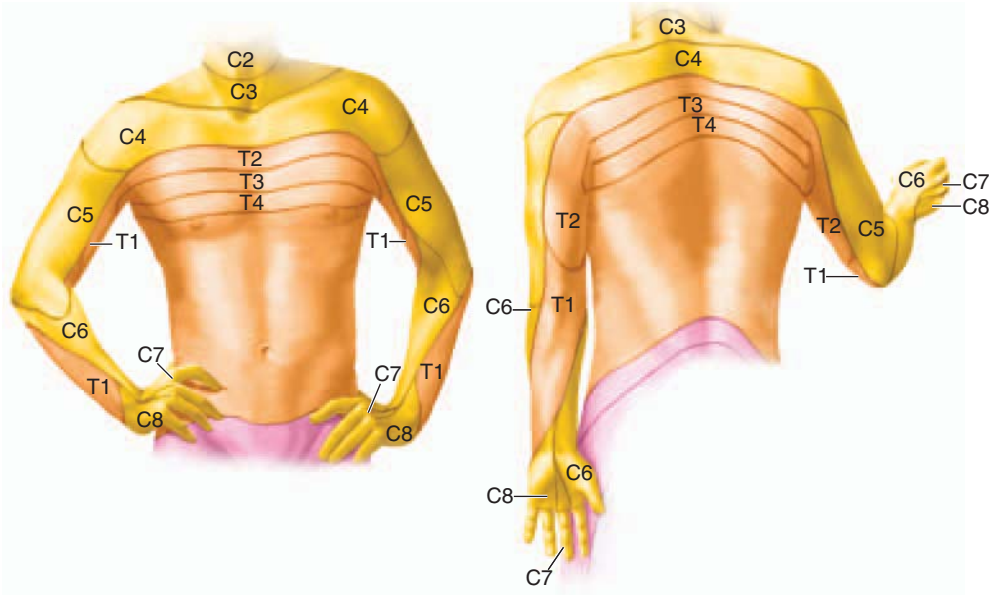


Figure 7-7 Dermatomes of the shoulder region.

Table 7-1 Dermatomes of the Shoulder Complex

C3	Base of the lateral neck
C4	Upper shoulder to base of neck; top of anterior and posterior chest
C5	Lateral upper arm
C6	Distal anterior biceps and lateral forearm
C7	Posterior shoulder down middle of posterior arm
T1	Half of the inside of the upper arm
T2	A 2-inch band running just below the clavicles
T3	A 2-inch band running just below the T2 dermatome
T4	A 2-inch band running across the nipple line

TRIGGER-POINT REFERRAL PATTERNS FOR MUSCLES OF THE REGION

pseudothoracic syndrome The referral pattern created when three of four muscles (pectoralis major, latissimus dorsi, teres major, and subscapularis) have active trigger points.

Myofascial trigger points in the shoulder region are relatively common and can cause a variety of problems. The symptoms that these points create can mimic various conditions, resulting in misdiagnoses and often leading to more invasive treatments. These conditions include:

- **Pseudothoracic syndrome:** Occurs when three of four muscles (pectoralis major, latissimus dorsi, teres major, and subscapularis) have active trigger points. The points refer pain that is similar to the true thoracic outlet syndrome.

- *Adhesive capsulitis (frozen shoulder):* Occurs when trigger points in the rotator cuff, particularly in the subscapularis, restrict motion just as if the shoulder were frozen.
- *Carpal tunnel syndrome:* Stems from the referral patterns of trigger points in the scalenes, the brachialis, and other muscles.

Because the symptoms created by myofascial trigger points in various shoulder muscles can be mistaken for other conditions, it is important for therapists to recognize their presentation. This ensures that the client will receive the appropriate treatment.

Trapezius

The *trapezius* (see Figs. 7-9 and 7-16) is the muscle most often affected by trigger points. There are three different divisions of the trapezius, each with its own trigger points. The two points in the upper fibers are approximately at the same level, one anterior and the other posterior. The anterior point is the most frequently identified point and refers behind, up, and over the ear in a ram's-horn pattern. The posterior point refers up the back of the neck to the area behind the ear. Both of these points contribute to tension headaches.

Moving inferiorly, the *middle trapezius* has two main points. One of these points may occur anywhere in the middle part of the muscle; the other is an attachment trigger point near the acromion. The point in the belly of the muscle refers superficial burning pain medially that will stay local to the point. The attachment point refers to the top of the shoulder or acromion.

The *lower trapezius* has one central point that is common but often overlooked. It is located about halfway along the lower border of the muscle and is key in inducing other trigger points in the upper back and neck. It refers sharply to the high cervical paraspinals, the mastoid process area, and the acromion. It also produces a deep ache in the suprascapular region.

Levator Scapula

The *levator scapula* is one of the most common muscles involved in shoulder and neck pain and is a unique muscle because of its spiral twist as

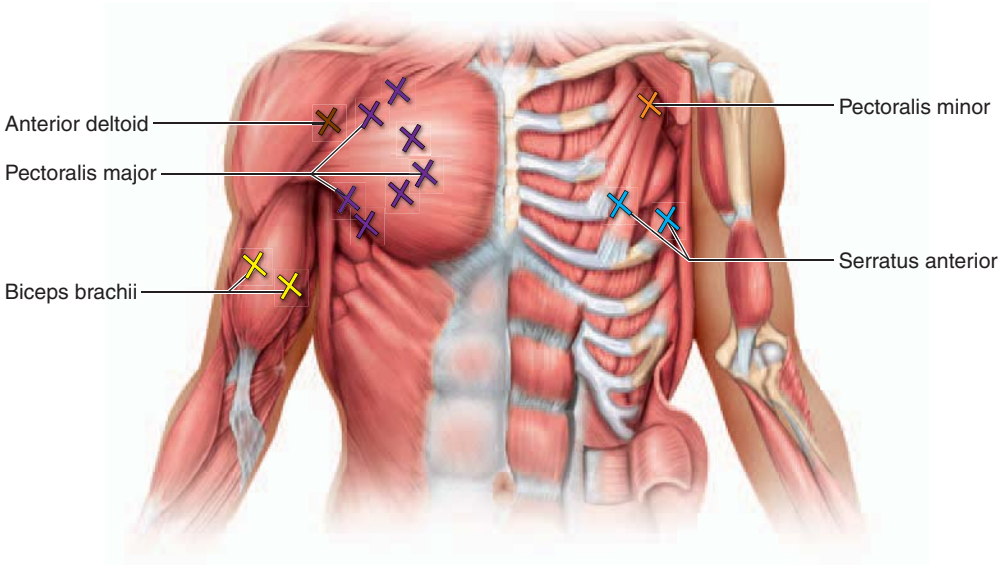


Figure 7-8 Trigger-point locations for the anterior deltoid, pectoralis major, biceps brachii, pectoralis minor, and serratus anterior.

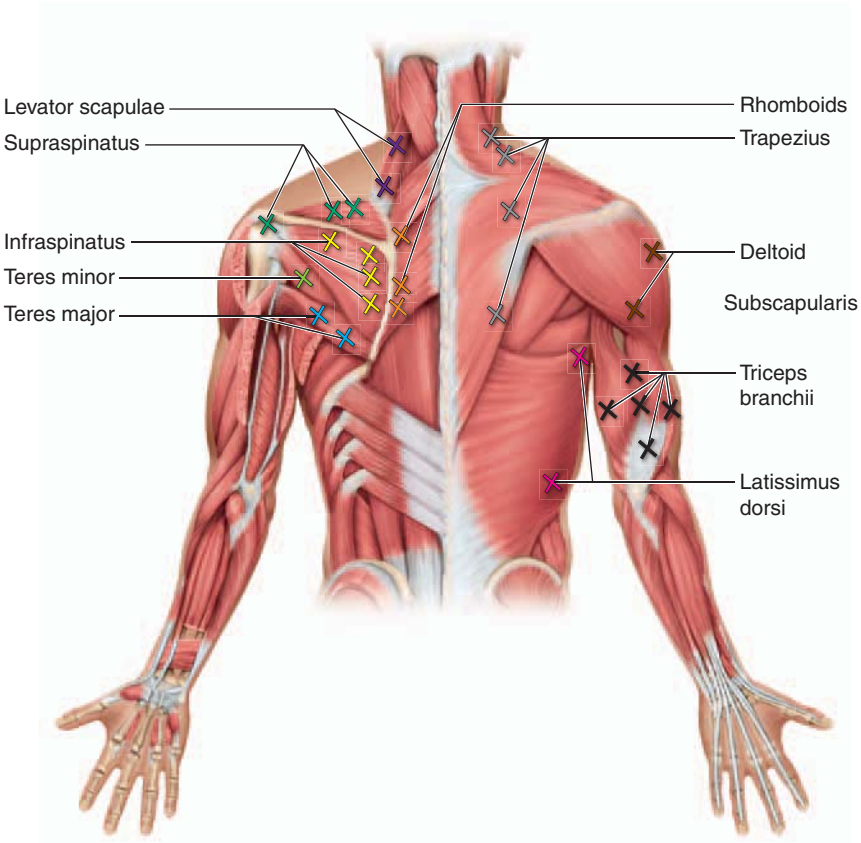


Figure 7-9 Trigger-point locations for the levator scapulae, supraspinatus, infraspinatus, teres minor, teres major, rhomboids, deltoids, trapezius, triceps brachii, and latissimus dorsi.

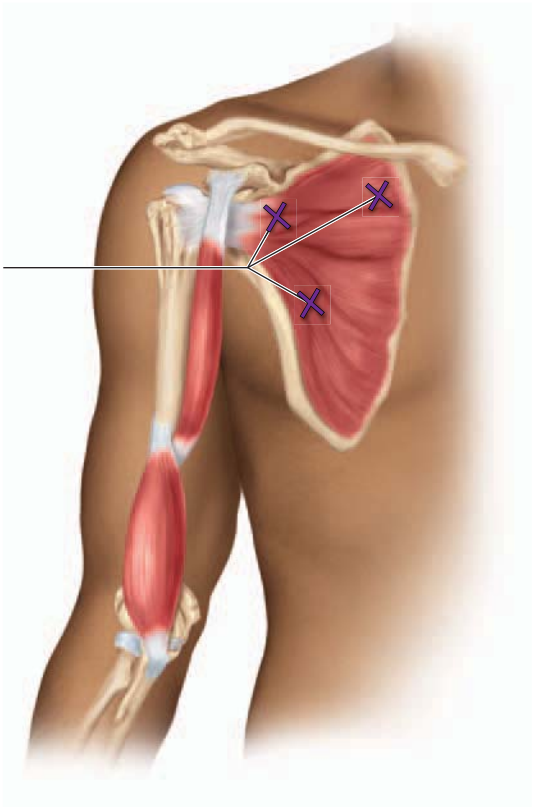


Figure 7-10 Trigger-point locations for the subscapularis.

it moves from the scapula to the neck. There are two main trigger points (see Figs. 7-9 and 7-11) associated with this muscle: one at the superior angle of the scapula and one about halfway up the muscle, where it emerges from underneath the upper trapezius. Typical symptoms include pain at the angle of the neck and stiffness with limited range of motion, which prohibits full movement of the head to either side. There may also be some referral into the posterior shoulder and medial scapular border.

Rhomboids

The *rhomboids* (see Figs. 7-9 and 7-11) often develop trigger points as a result of being in an overstretched position for long periods of time. The larger, stronger muscles on the anterior chest become shortened and pull the shoulders forward into a rounded position, which overloads the weaker posterior muscles. There are three main points that develop in this muscle. Pay attention to fiber direction when palpating the points to ensure that you are not finding the points in the trapezius.

All the points lie along the vertebral border, with one roughly at the level where the spine of the scapula meets the vertebral border. The other two are inferior to each other and lie about halfway down the vertebral border. Pain from these points concentrates around the vertebral border and does not radiate too far away. These points can also cause a snapping or crunching sound during movement of the scapula.

Practical Tip

Determining muscle fiber direction will ensure you are addressing the right structure.

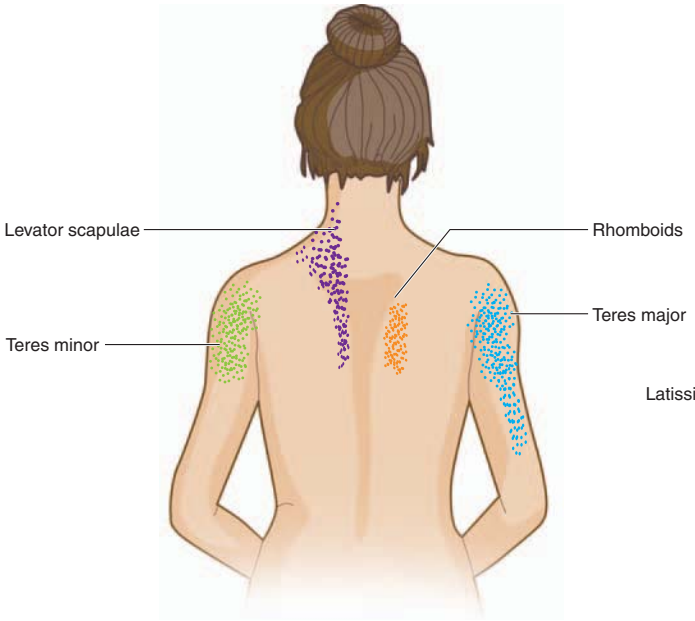


Figure 7-11 Trigger-point referrals for the levator scapulae, teres minor, teres major, and rhomboids.

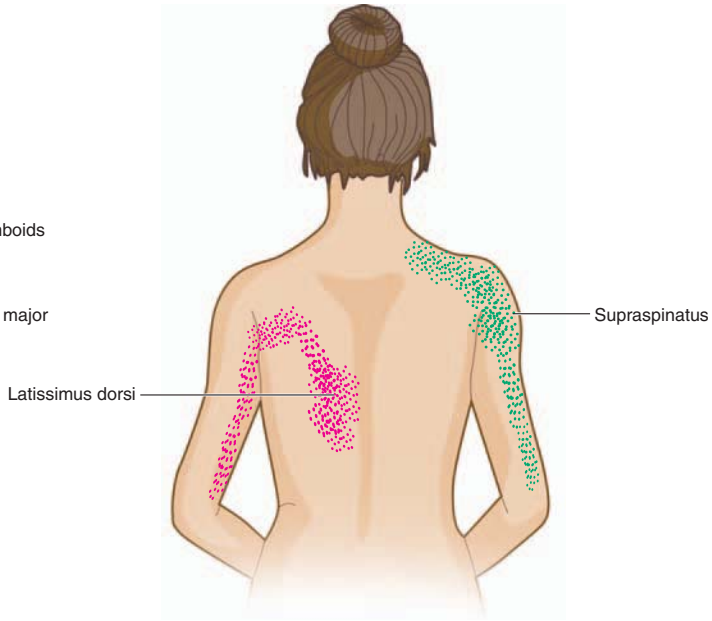


Figure 7-12 Trigger-point referrals for the latissimus dorsi and the supraspinatus.

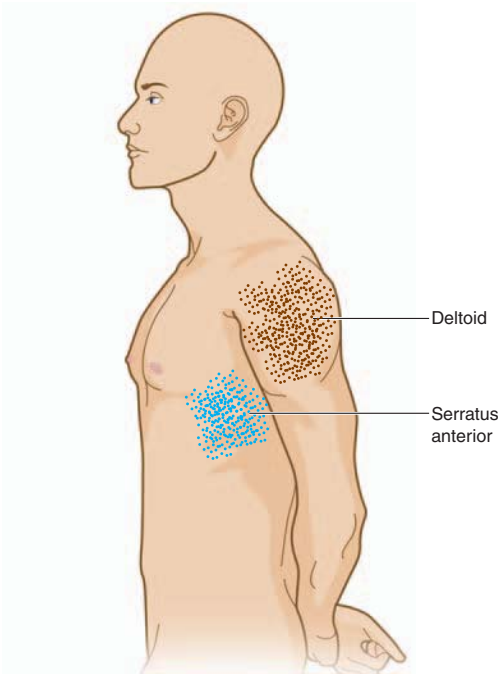


Figure 7-13 Trigger-point referrals for the deltoids and the serratus anterior.

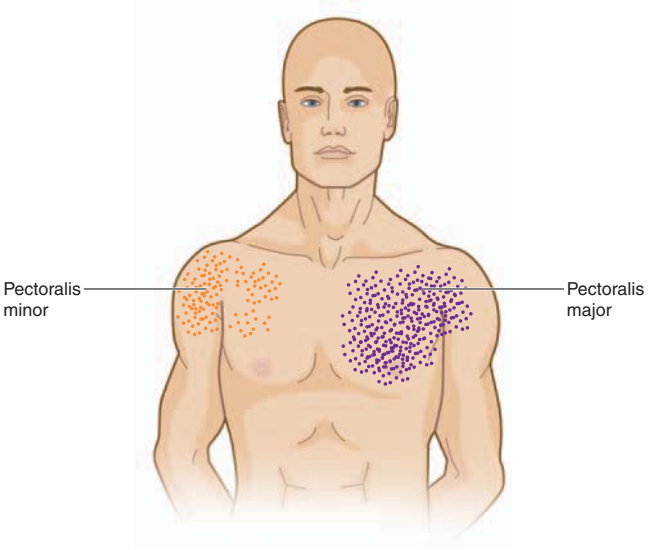


Figure 7-14 Trigger-point referrals for the pectoralis minor and pectoralis major.

Rotator Cuff

The next group of muscles is collectively known as the *rotator cuff.* The first muscle of the group is the *supraspinatus* (see Figs. 7-9 and 7-12). Active trigger points in this muscle cause a deep ache of the shoulder and center around the middle deltoid. This ache can extend down the lateral side of the arm all the way to the lateral epicondyle of the elbow. There are three points along the same line of the muscle. The first two are in the

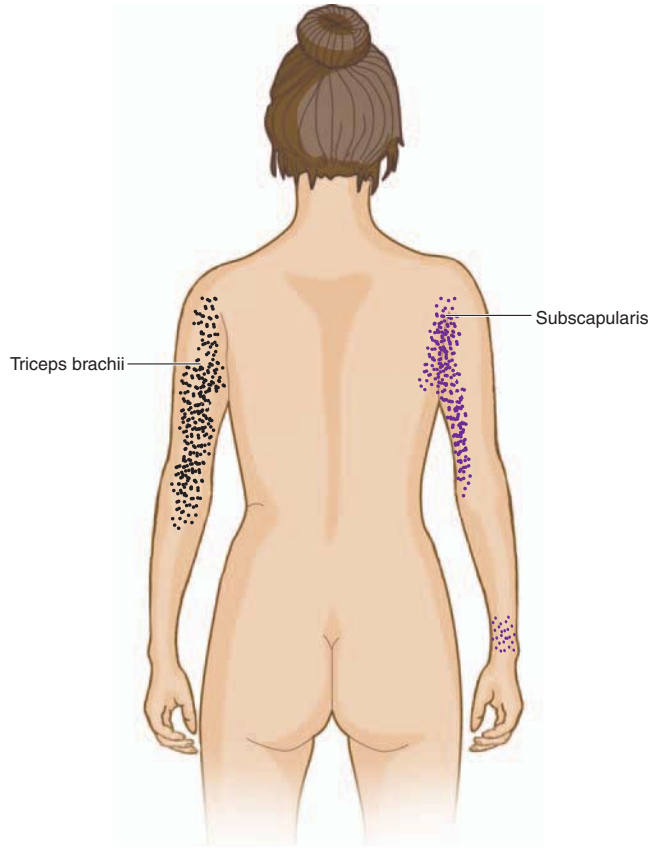


Figure 7-15 Trigger-point referrals for the subscapularis and the triceps brachii.

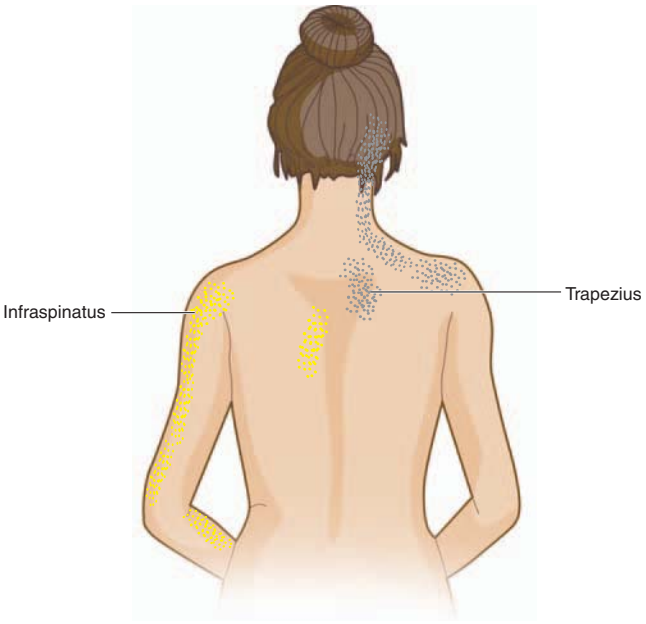


Figure 7-16 Trigger-point referrals for the trapezius and the infraspinatus.

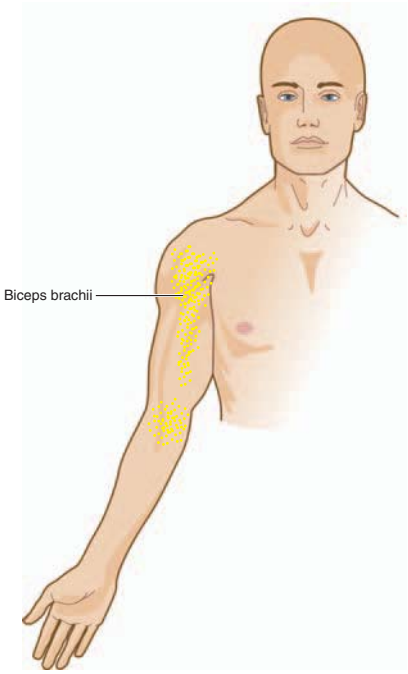


Figure 7-17 Trigger-point referrals for the biceps brachii.

belly of the muscle. One is close to the medial border, and the other is farther lateral, just before the muscle dives underneath the acromion. The third point is in the proximal tendon and may be difficult to locate. These points can be activated by carrying a heavy load at the side and will result in referred pain during abduction, as well as difficulty in performing overhead activities.

The next muscle of the rotator cuff is the *infraspinatus* (see Figs. 7-9 and 7-16). There are four points that can occur, all of which are in the belly. The first three points are located centrally in the belly, just under the spine of the scapula. They refer pain deep into the anterior shoulder and often down the anterior and lateral aspects of the arm, the lateral forearm, and the radial aspect of the hand. The fourth point is farther inferior and medial to the other three. It refers to the adjacent rhomboid area along the medial border of the scapula, and pain at this point may be difficult to distinguish from trapezius pain. All of these trigger points contribute to the client's inability to internally rotate and adduct the arm. Clients may also have trouble sleeping because lying on the painful side will compress the points and stimulate them.

The third muscle in the cuff is the *teres minor* (see Figs. 7-9 and 7-11). Clients with active trigger points in this muscle will complain of posterior shoulder pain that feels like an inflamed bursa around the posterior deltoid. The points refer just proximal to the deltoid tuberosity, which is why the client will compare it to bursitis. The points themselves lie about midbelly along the muscle and are relatively prominent and easy to find.

Completing the group of rotator cuff muscles, the *subscapularis* (see Figs. 7-10 and 7-15) contains trigger points that can be difficult to access manually. Trigger points in this muscle are often a significant contributor to "frozen shoulder." They can cause pain both at rest and during motion. Initially, clients are able to reach forward but not backward. As the trigger-point activity increases, abduction at the shoulder becomes severely restricted, sometimes to less than 45°, leading to the pseudodiagnosis of adhesive capsulitis. There are two lateral trigger points and one medial point in the muscle, and they may be difficult to access. The lateral points are located above one another. The superior point lies just inferior to the coracoid process; the inferior point is located about halfway up the lateral border of the scapula. The medial point is close to the superior medial edge of the muscle and may be better accessed from the prone position. The primary zone of referral for these points is the posterior shoulder. There can be some spillover into the posterior arm and elbow. One distinct characteristic of subscapularis trigger points is a straplike area of pain that encircles the wrist. The posterior side is often more painful than the anterior side.

Latissimus Dorsi

The next muscle extends from the lumbar spine to the shoulder. The *latissimus dorsi* (see Figs. 7-9 and 7-12) is frequently overlooked as a source of shoulder and thoracic pain. Active points in this muscle refer a constant aching to the inferior angle of the scapula and the surrounding thoracic region. Pain can also travel down the back of the shoulder, along the medial forearm to the ulnar side of the hand. There are two main points in the muscle. The more common point is located in the superior portion of the muscle at the posterior axial fold. A less common point is located along the midregion of the muscle and refers to the anterior shoulder and the lateral aspect of the trunk over the iliac crest.

Teres Major

Sometimes referred to as the "little lat" because it shares the same functions as the latissimus dorsi, the *teres major* (see Figs. 7-9 and 7-11) has three trigger points that can refer to the posterior shoulder and over the long head of the triceps. The first point is located medially along the muscle near its origin at the inferior angle of the scapula. The second point is located midmuscle in the posterior axillary fold, and the third point is located at the lateral musculocutaneous junction. The pain is primarily produced during movement and is usually mild at rest.

Deltoids

The *deltoids* (see Figs. 7-8, 7-9, and 7-13) consist of three heads and often develop trigger points in each of the divisions. Points in the anterior head lie along its medial border close to the cephalic vein. The middle head can develop multiple trigger points almost anywhere due to the fact that its motor end plates are widely distributed. The posterior deltoid trigger points are along the lateral border of the muscle, closer to the insertion.

Trigger points in the various heads of the muscle refer locally either in the same head or adjacent ones. Anterior points refer to the anterior deltoid and possibly spill over into the middle head. Points in the middle deltoid tend to refer central to the region, with some spillover to adjacent areas. Posterior points refer over the posterior shoulder and possibly into the arms. None of the trigger points in the deltoids refer any great distance.

Serratus Anterior

The *serratus anterior* (see Figs. 7-8 and 7-13) is commonly overlooked as a contributor to shoulder pain. It is a very large muscle that covers a lot of surface area. It can develop trigger points in the middle of any of its digitations but are most commonly located at about the 5th or 6th rib along the midaxillary line and refer to the anterolateral thorax. Pain can also be projected down the inside of the arm to the palm and ring finger. Another referral from trigger points in this muscle is interscapular pain over the distal half of the scapula. This particular referral pattern can be quite aggravating for the client and is often diagnosed as something else.

Biceps Brachii

Moving down the humerus, the *biceps brachii* (see Figs. 7-8 and 7-17) contains trigger points that primarily refer in a superior direction to the front of the shoulder but can also travel to the suprascapular region and the antecubital space. The trigger points in this muscle are usually found midbelly in either head. The pain that accompanies these points is typically superficial and does not present as deep shoulder pain; however, pain will occur during arm elevation above shoulder level. Other presentations include aching over the anterior arm and weakness.

Triceps Brachii

The antagonist to the biceps, the *triceps brachii* (see Figs. 7-9 and 7-15) can develop trigger points in all three of its heads in five locations, each with a unique referral pattern. The client may complain of diffuse pain posteriorly in the shoulder and upper arm. The points can affect movement but this is often overlooked by the client, especially if the client is able to make compensatory movements.

The first point is located in the central belly of the long head and refers upward over the posterior arm and shoulder, sometimes extending into the upper trapezius and down the posterior forearm. The second point is in the lateral portion of the medial head of the muscle. This point refers to the lateral epicondyle of the elbow and is often a component of tennis elbow. The third point is in the lateral head and refers centrally around the point over the posterior arm and sometimes down the posterior forearm into the 4th and 5th fingers. The fourth point is most likely an attachment point created from the other central points. It is located in the tendon and refers to the olecranon process. The last point is the least common and is most easily located from the anterior side. This point is in the medial portion of the medial head of the muscle and refers along the medial forearm and the palmar surface of the 4th and 5th fingers.

Pectoralis Major

The last two muscles in the shoulder region are the pectoralis major and minor. The *pectoralis major* (see Figs. 7-8 and 7-14) develops trigger points in five different areas, and each has a distinct referral pattern. The first area is in the clavicular head of the muscle, along the lateral edge; it refers pain over the anterior deltoid. The next area is the sternal section of the muscle. The points here lie in the belly of the sternal portion of the muscle, along the midclavicular line. The symptoms are often mistaken for a cardiac episode because they refer intense pain to the anterior chest and down the inner aspect of the arm, sometimes down to the hand. The third area for trigger points in the pectoralis major is along the lateral border of the muscle, about halfway between the origin and insertion. These points refer into the breast area and can cause tenderness and hypersensitivity of the nipple and intolerance to clothing. This occurs in both men and women but is more often found in women. The fourth area is along the medial sternum. Its points cause pain locally over the sternum, but the pain will not cross over to the opposite side.

Finally, the last area is only on the right side and does not cause significant pain. It is located just below the level of the 5th rib, midway on a line between the sternal margin and the nipple. It is known to contribute to certain cardiac arrhythmias, which are terminated on the trigger point's inactivation.

Pectoralis Minor

Lying underneath the pectoralis major, the *pectoralis minor* (see Figs. 7-8 and 7-14) can develop trigger points that may be difficult to discern from those of the major. There are two main points that occur along the belly of the muscle, one close to the insertion and one close to the origin. These points refer strongly over the anterior deltoid and down the medial arm, forearm, and hand. This pattern is similar to that of the clavicular trigger point in the pectoralis major. When the pectoralis minor becomes chronically shortened due to the trigger points, it can entrap the neurovascular bundle passing beneath it and mimic cervical radiculopathy. This is one of the distinct differences between trigger points in the major and minor. Refer to the Quick Reference Table "Trigger Points of the Shoulder Girdle" at the end of this chapter (page 272).

SPECIFIC CONDITIONS

Because of its many structures, movements, and potential pathologies, the shoulder complex can be extremely difficult to assess. Performing a thorough assessment will narrow down the focus of the treatment. Since many of the pathologies involve the same structures, there will be an overlap of treatment techniques. Remember that just because two people have the same condition does not mean they will require the same treatment. Each treatment should be customized to meet the specific needs of the individual.

Rotator Cuff Injuries

Background

Injuries to the rotator cuff are one of the most common types of shoulder problems. They can arise from a traumatic episode to the area but are more often caused by repetitive movements of the glenohumeral joint. This section discusses two of the more common rotator cuff injuries: impingement syndrome and tears to the supraspinatus tendon, two conditions that are intimately related to each other. Before discussing these specific injuries, it is necessary to review the functioning of the rotator cuff and other anatomy that is directly related to these conditions.

The tendons of four separate muscles form the rotator cuff:

1. Supraspinatus
2. Infraspinatus
3. Teres minor
4. Subscapularis

The cuff, which is a composite "sleeve" around the head of the humerus created from all the tendons, occupies the space between the humeral head and the coracoacromial arch. Its function is multifaceted. Individually, the muscles provide various movements of the glenohumeral joint. The supraspinatus abducts the humerus; the infraspinatus and teres minor extend and externally rotate the humerus; and the subscapularis internally rotates the humerus. While these roles are important, more critical is the muscles' combined function in regard to injury prevention: stabilizing the head of the humerus on the glenoid fossa of the scapula. When these muscles contract as a group, they compress the humeral head against the fossa, keeping it centered over the glenoid and creating a dynamic fulcrum for the deltoid muscles to produce movement. If there is any imbalance in the functioning of these muscles, an alteration in shoulder biomechanics will occur. This dysfunction of the cuff will cause the humeral head to shift or translate on the glenoid, eventually leading to problems in the shoulder.

In addition to muscle imbalances, other predisposing factors can contribute to shoulder problems. One factor is the anatomical shape of the acromion. The acromion can have three variations in shape:

- *Type I:* Relatively flat acromion; occurs in 17% to 32% of the population
- *Type II:* Curved acromion; occurs in 40% to 45% of the population
- *Type III:* Hooked acromion; occurs in 26% to 40% of the population

A higher incidence of rotator cuff injuries occurs in individuals with type II or type III acromions. These two morphologies reduce the already limited space within the coracoacromial arch.

Another anatomical factor is the so-called hypovascular zone in the supraspinatus tendon, about 8 mm proximal to its insertion. This zone corresponds to the most common site of rotator cuff injuries. Since vascularity decreases with age, there is an increase in the chance of injury to the rotator cuff in individuals over the age of 40.

These underlying conditions can lead to impingement syndrome. **Subacromial impingement syndrome** is defined as the "painful contact between the rotator cuff, subacromial bursa, and the undersurface of the anterior acromion" (Cohen et al., 1998). It is a mechanical phenomenon in which there is weakness

subacromial impingement syndrome A condition characterized by the painful contact between the rotator cuff, subacromial bursa, and undersurface of the anterior acromion.

or imbalance in the strength of the rotator cuff that allows superior translation of the humerus, resulting in the repetitive compression of the supraspinatus tendon into the coracoacromial arch. When the arm is abducted, the deltoids and supraspinatus pull the humeral head superiorly. The other rotator cuff muscles must produce force that cancels out this superior movement in order to prevent impingement. Other factors can also contribute to this syndrome, such as:

- Instability patterns in the glenohumeral joint
- The anatomical concerns listed earlier
- Glenohumeral capsular tightness
- Postural misalignments that change the position of the glenoid
- Dysfunctional scapular motion in which the acromion fails to rotate with the humerus

Initially, symptoms include deep pain in the shoulder that also occurs at night, crepitus, weakness, and pain over the subacromial space. Activity involving movements that are repetitive or are above 90° of flexion or abduction will exacerbate the symptoms. A characteristic sign of shoulder impingement is the presence of a "**painful arc**." As the client abducts the arm, no pain occurs between 0° and 45° to 60° because the structures are not being compressed (Fig. 7-18). Once the arm passes 60°, impingement of the structures begins, resulting in pain. This may prevent the client from abducting any further; however, if the client does abduct further, the pain will disappear after 120°. This is because the compressed structures have passed completely under the acromion and are no longer being impinged.

painful arc The arc of the shoulder that is created during abduction and goes through a phase of no pain between 0° and 45° to 60°, pain between 60° and 120°, and then no pain again after 120°.

Repeated impingement of the rotator cuff structures will lead to tendon degeneration and the second rotator cuff injury: the eventual tearing of the supraspinatus tendon, or *rotator cuff tear.* The tears are almost always near the insertion and can be either partial or full thickness. Partial-thickness tears occur twice as often, with most full-thickness tears appearing in individuals who have a long history of shoulder problems and are typically over the age of 40. The signs and symptoms are the same for both impingement syndrome and rotator cuff tears, but more severe tears will present with significant weakness and some atrophy of the muscles. As previously stated, these two conditions are intimately related. A series of stages have been described that demonstrate how impingement syndrome progresses into a tear of the rotator cuff:

- *Stage I:* An initial injury to the supraspinatus tendon and surrounding structures causes inflammation with edema in the area. This results in pain during and after activity (especially abduction and flexion), point tenderness over the supraspinatus tendon, and a temporary thickening of the supraspinatus tendon and subacromial bursa. There is no palpable muscle defect, weakness, or loss of motion. While it can occur in any age group, it is most commonly seen in clients under the age of 25, and it is reversible.
- *Stage II:* This stage involves a permanent thickening of the supraspinatus tendon and subacromial bursa. Pain occurs more frequently during activity, throughout the painful arc (60° to 120° of abduction), and at night. The client has some range-of-motion loss and crepitus but

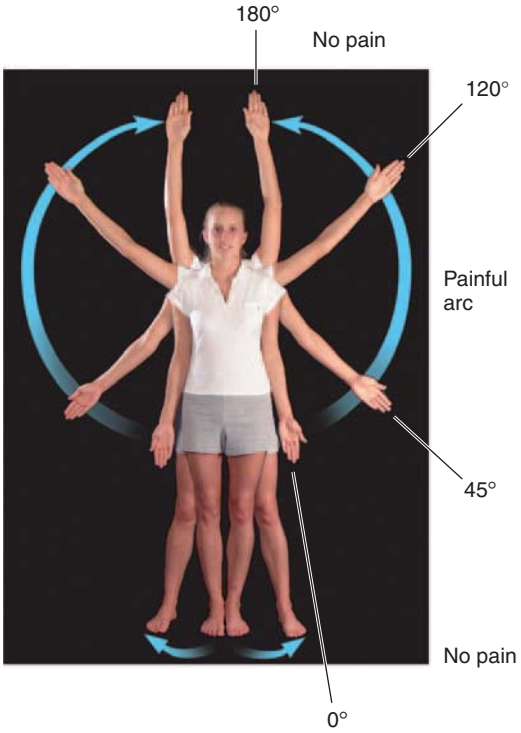


Figure 7-18 The phases of the painful arc.

still no palpable defect. This stage is common in individuals between 25 and 40 years of age.

- *Stage III:* Because of the repetitive impingement, this stage is characterized by a tear in the rotator cuff less than 1 centimeter (cm). When the client reaches this stage, he or she has had a long history of shoulder problems with significant weakness and a possibility of multidirectional instability. The client has significant pain on activity, which increases at night, with obvious atrophy of the rotator cuff. This stage typically occurs in individuals over the age of 40.
- *Stage IV:* This is a progression of the previous stage and is characterized by a tear in the rotator cuff that is greater than 1 cm. The client experiences significant motion reduction and weakness.

Assessment

Both shoulder impingement and tears to the rotator cuff are multifactorial and can have additional contributing pathologies in the surrounding joints and cervical region. Be sure to assess any related areas to ensure that proper treatment is administered.

Condition History Therapists should inquire about the following when taking the client's history:

Question	*Significance*
What is the client's age?	Many conditions in the shoulder can be age-related. Rotator cuff tears occur more in patients who are 40 years of age or older.
What was the mechanism of injury?	Most impingement and rotator cuff injuries occur as a result of repetitive micro-traumas; however, a fall on an outstretched hand or a blow to the tip of the shoulder can also cause a traumatic rotator cuff injury.
Are there any movements that cause pain?	Repetitive movements above 60° can be painful in a client who has impingement problems.
How is the pain qualified?	A deep, toothache-like pain that gets worse with activity and is bad at night can indicate what is known as *primary impingement.* Primary impingement is caused by chronic overuse and degeneration of the rotator cuff tendons. A "dead arm" feeling is an indicator of *secondary impingement,* which is a result of an underlying instability problem with the glenohumeral joint.
How does the injury affect the ability to function?	The more limited the functioning, the longer the client has had the condition.

How long has the client had the problem?	Over a period of time, simple impingement syndrome can evolve into a more serious tear in the rotator cuff.
Is there any feeling of weakness or a change in sensation?	These symptoms can indicate neurologic involvement.

Visual Assessment In order for the therapist to inspect the shoulder, the client must disrobe to the appropriate level (no shirt for males and a tank top or sports bra for females). This is a perfect opportunity to observe the functional capacity of the client: As the client disrobes, observe the quality of movement, compensation patterns, and symmetry of motions. From the front, observe the overall position of the head and neck in relation to the shoulders. Check for obvious swelling, bruising, or muscle atrophy. Look for a step deformity at the lateral end of the clavicle. This indicates an injury to the acromioclavicular joint and a sulcus sign, which may be an indication of instability. From the back, check the contour or the neck and note any atrophy in the musculature as well as any swelling or bruising. Check the position of the scapulae. Make sure that they are equal and that there is no winging. Assess the active and passive ranges of motion.

Palpation During shoulder palpation, be sure to include the neck and thoracic spine, since they can contribute to the dysfunction. Begin along the clavicle, palpating the sternoclavicular and acromioclavicular joints. Note any spasm or hypertonicity in the musculature of the area. Check the bicipital groove and subacromial space for tenderness, along with the coracoid process. Be sure the scapulae are positioned symmetrically on the thoracic spine. Complete the palpation of the area by locating the structures discussed earlier in the chapter.

Orthopedic Tests The information gathered from the history, visual assessment, palpation, and range-of-motion testing should give the therapist a good idea of which structures are involved. Orthopedic tests will add the missing data needed to provide a comprehensive assessment. Table 7-2 shows the tests and how to perform them.

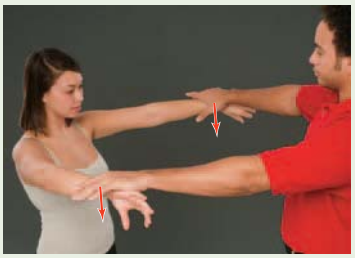
Soft Tissue Treatment

As previously discussed, a wide range of motion in the shoulder results in diminished stability. Because the structures that make up the joint do little to offer stability, the muscles of the shoulder girdle not only are put into a locomotive role but are forced to create the stability in the area that the joint does not. This delicate balance between the various muscles of the area is frequently disrupted. Imbalance creates a domino effect and leads to the eventual breakdown of the system. The restoration of the balance between the muscles is vital in restoring proper biomechanical functioning. Once the correct biomechanics of the shoulder have been restored, any dysfunction in the area can be resolved. Other areas, including the back and neck, can contribute to problems in the shoulder; therefore, it is important to address these areas as needed.

Table 7-2 Orthopedic Tests for Rotator Cuff Injuries

Orthopedic Test	How to Perform
Neer shoulder impingement test  • This test is for shoulder impingement. *Note:* With this particular arm position, the greater tuberosity of the humerus will be "jammed" into the anterior inferior acromion.	Client is in the seated position. Standing at the client's side, use one hand to stabilize the posterior shoulder and use the other hand to grasp the client's arm at the elbow. Internally rotate the arm passively, and then flex it forcibly to its end range. Pain with motion, especially at the end of the range, indicates a positive test. It also indicates a possible impingement of the supraspinatus or long head of the biceps tendon.
Hawkins-Kennedy impingement test  • This test is for shoulder impingement. *Note:* This test will cause the greater tuberosity of the humerus to contact the anteroinferior surface of the acromion and the coracoacromial arch.	Client is in the seated position. Forward flex the shoulder to 90°, and bend the elbow to 90°. Keeping the shoulder at 90° of flexion, place one hand under the bent elbow to support the arm and place the other at the wrist. Horizontally adduct the arm slightly across the chest, being careful not to lower the arm and internally rotate the shoulder. Pain that occurs with this test may indicate shoulder impingement.

Table 7-2 Orthopedic Tests for Rotator Cuff Injuries *(Continued)*

Empty-can test  • This test is for rotator cuff tears, specifically in the supraspinatus.	Client is standing. Have the client abduct the arms to 90°. Standing in front of the client, horizontally adduct the arms 30° and internally rotate the arms so that the client's thumbs point toward the floor (empty-can position). Place your hands on the proximal forearms of the client, and apply downward force while the client resists. Weakness or pain in the shoulder indicates a positive test and a possible tear of the supraspinatus tendon.
Drop-arm test 	Client is in the standing position with his or her arms at 90° of abduction. Instruct the client to slowly lower the arms down to the sides. A positive test is indicated if the client cannot lower an arm smoothly or has increased pain during the motion. An alternative test is to place the arms in 90° of abduction and apply downward force at the distal humerus while the client resists. A test is positive if the client cannot hold an arm up and drops it to the side. If either variation of test elicits a positive result, this may be an indication of a more severe tear of the supraspinatus tendon.

Connective Tissue One common imbalance in the region occurs from the chronic posture of protracted shoulders. Over time, the connective tissue restricts the motion of the shoulder girdle; thus, addressing the area becomes vital.

Prone Position Begin by assessing the superficial fascia of the back from superior to inferior, from medial to lateral, and at various angles, paying special attention to the posterior shoulder girdle. A common pattern of restriction of the posterior shoulder is from the superior angle of the scapula down at a 45° angle toward the lateral border. Move into any restriction in the various directions until it releases. The incorporation of active and passive movements is very effective in this area. Passively apply pressure in the direction of the restriction, and then passively move the limb in the opposite direction, effectively pulling the tissue under the hand that is applying the pressure. Active motion can be applied in the same manner, with the client actively moving the limb in the direction opposite the restriction.

Once the superficial fascia has been addressed, move into the deeper layers and begin to strip out the borders of the muscles in the area. Be sure to address any muscle that attaches to either the scapula or the humerus. The lateral border of the lower trapezius is best identified by placing the fingertips on the lateral portion of the rib cage and pressing toward the opposite shoulder. Once the border is located, it can be stripped out by separating your hands along the border while keeping the fingertips on the border. Pay special attention to the muscles of the posterior rotator cuff and the deltoids. The posterior deltoid becomes tight because of the protracted posture of the shoulder.

One muscle that often gets left out when treating the shoulder is the latissimus dorsi. Because of its insertion on the humerus, it can affect the overall motion of the shoulder and should not be ignored. Another muscle that often gets left out is the triceps brachii. The long head attaches on the scapula and can play a role in restricting motion.

Supine Position Addressing the connective tissue in this position contributes a great deal to correcting the underlying postural concerns that create some of the muscle imbalance issues. Essentially, almost everything we do requires reaching in front of us. This constant movement pattern leads to the tightening of the connective tissue, which exacerbates the postural concerns.

Begin by assessing the superficial fascia of the chest, anterior shoulder, and upper arm in various directions, including any associated area as necessary. Move into any restrictions that are found in the various directions. One effective method of treating the chest is to place the arm over the head, which aligns the muscle fibers of the pectoralis major. Focus on strokes that will mimic shoulder retraction and encourage the reversal of the rounded shoulder posture by moving up and out from the sternum toward the shoulder.

Incorporating movement is also beneficial in this position. While standing at the client's side and facing his or her head, hold the wrist with the outside hand and lift the arm so that the hand is straight up toward the ceiling. Start at the edge of the drape, and apply pressure with the inside hand toward the shoulder. During the stroke, move the client's arm up and out at various angles to address restriction in different parts of the muscle. Another good technique involves abducting the client's arm to 90° or as far as possible and flexing the elbow by grasping the wrist. Perform a stroke from the medial portion of the chest toward the shoulder while you internally and externally rotate the arm, paying special attention to the

anterior deltoid. Address the lateral border of the chest and axilla from either a superior or an inferior direction, depending on the restrictions. Once the superficial restrictions have been addressed, strip out the individual muscles that are involved in the shoulder. It is important to create space between the pectoralis major and and the pectoralis minor. With the arm abducted, find the lateral edge of the pectoralis major, and run your fingertips along the border from superior to inferior. This area is generally tender, so make sure to address the client's comfort.

Another area that is necessary to define is the inferior border of the clavicle and sternoclavicular joint. Defining this area will remove any restrictions around the joint and address the clavicular attachment of the pectoralis major. The biceps brachii should also be defined, especially where it crosses under the anterior deltoid. This area is also very tender, so use caution. Finally, make sure the border between the lateral scapula and the rib cage is stripped out. This will address the portion of the rotator cuff and teres major that may not have been worked on in the prone position.

Side-Lying Position The best way to reach the subscapularis on the anterior surface of the scapula and the serratus anterior is to have the client in a side-lying position. These two muscles contribute a great deal to shoulder girdle motion and often get stuck together; therefore, removing their restrictions is extremely beneficial. Once the restrictions have been assessed, move into them until they release.

Both active and passive movements are effective in this position as well. After the superficial concerns have been cleared up, work into the individual muscles in the area. The posterior deltoid is treated effectively in this position. Support the humerus with one hand, and use the thumb to trace its borders.

Since they lie under the scapula, the subscapularis and serratus anterior are not completely accessible. Support the humerus with one hand, and find the lateral border of the scapula with the other, using your fingertips or thumb and making sure you are lateral to the teres major. Because this area can be tender, a more comfortable approach for the client may be to leave your hand stationary and protract the client's shoulder by pulling it onto your thumb or fingertips. Move up and down the border of the scapula, and use passive movement, pulling the arm at different angles. The emphasis should be on creating space between the scapula and the rib cage. If the pressure is directed up into the anterior scapula, the focus will be on the subscapularis; if the pressure is down onto the rib cage, the focus will be the serratus anterior.

Tissue Inconsistencies Trigger points in the muscles of this area can be major contributors to the improper biomechanics that are causing dysfunction. Special attention should be given to the muscles that cause protraction of the shoulder, such as the pectoralis minor and serratus anterior. These muscles contribute to the underlying postural concerns, and releasing them will benefit the client. Be sure to expand the treatment area into the neck if necessary, and do not forget about the biceps and triceps brachii. They are traditionally thought of as arm muscles, but they can affect the shoulder as well. The use of movement during the releasing of the points will help with the neuromuscular reeducation of the muscles and will help relieve the client's associated discomfort.

Muscle Concerns

The focus of the muscular work should be on restoring normal biomechanics to the area and further removing any imbalances between the muscles. Utilize strokes that incorporate movement at every opportunity.

Prone Position The posterior rotator cuff and any involved back muscles are best addressed in this position. Working between the shoulder blades with the forearm or elbow is very effective for the rhomboids and trapezius. Start at the head of the table, and run your forearm down the back; or start at the side of the table, and run your forearm up the back between the scapulae.

One effective technique for the posterior cuff is to hang the arm off the front of the table and perform a stroke using a loose fist from the inferior angle of the scapula up toward the shoulder. This technique addresses the muscles in a parallel direction. To treat the muscles perpendicularly, keep the client's arm in the same position and stand facing his or her shoulder. Drag your loose fist down from the medial border of the scapula toward the table, taking care not to slip and pinch the tissue into the table. Strip out each muscle using active movement to increase the stroke's effectiveness.

Another technique that helps increase shoulder mobility is to place the client's hand in the small of his or her back. If the client lacks the range to place the hand on the back, have the client slide the hand up his or her side. As the client relaxes the arm, the medial border of the scapula will become prominent. Cup the front of the shoulder with your front hand, and grasp the medial border of the scapula with your fingertips. Passively retract the scapula with the hand that is cupping the shoulder, and distract the scapula with the hand on the medial border. Compress and distract the scapula in various directions to increase the mobility.

When addressing the triceps in the prone position, an effective technique is to hang the arm off the side of the table. This allows the muscle to be compressed into the table for the most effective stroke possible. Perpendicular compressive effleurage works well in this application. Both active and passive movements can easily be added in this position by using the techniques described in Chapter 3.

Supine Position The muscles that control the protraction of the shoulder can be treated effectively in the supine position. An effective method of treating the pectoralis major is to stand at the side of the client and hold the wrist in the manner described for the connective tissue work. Passively abduct the arm at various angles while performing strokes from the medial aspect of the muscle to the lateral. This addresses the different orientations of the fibers.

The biceps brachii can be treated in the supine position by holding the wrist with one hand and working the muscle with the other. Movement can easily be incorporated into this part of the treatment by flexing and extending the client's arm or having the client do so. From the biceps, move into the anterior deltoids, which can be very tight.

To treat the pectoralis minor, abduct the arm to find the lateral edge of the pectoralis major. Place your fingertips underneath the pectoralis major, and adduct the arm; this will place slack in the muscle. Place your

other hand on top of the client's shoulder, and passively depress it onto your fingertips. As the muscle begins to loosen, change the direction of your fingers to address different portions of the muscle. Be sure that pressure is directed onto the rib cage. You can incorporate active movement by having the client raise his or her arm to 90°. Protract the shoulder toward the ceiling, or, conversely, have the client reach down toward the feet and depress the shoulder.

Side-Lying Position With the client in this position, have the client make a fist and place his or her arm over the head, resting the fist on the table. Stand at the client's hips, and face the head of the table. Perform a stroke between the lateral border of the scapula and the chest, up the axillary line, to treat the serratus anterior.

To treat the subscapularis, hold the client's wrist and place your thumb or fingers along the lateral edge of the scapula, making sure you are lateral to the teres major. Passively protract the client's shoulder by pulling it onto your thumb or fingers. Change the direction of both your fingers and the pull of the arm to address the entire muscle. Direct pressure up into the anterior scapula for the subscapularis and down onto the ribs for the serratus anterior. Incorporate active motion by having the client reach with the arm while you protract the shoulder in different directions.

Access the medial edge of the anterior scapula by having the client move so that his or her back is at the edge of the table. Place the client's top hand in the small of his or her back. This will cause the medial edge to stick out, and you can access the anterior medial edge by grasping it and curling your fingers around the medial border.

Stretching

Because of the chronic posture patterns of the shoulder, the anterior structures will typically be tighter. The posterior muscles may feel tight because they are being chronically lengthened. This is why it is important to stretch the anterior structures first and then move to the posterior ones. All of these stretches are performed with the client in the seated position; however, they can be modified if the client has any limitations.

Chest To stretch the chest, have the client sit up straight and place his or her arms straight out in front of the body with the palms together (Fig. 7-19). As the client exhales, have him or her open the arms as far as possible. Assist at the end by reaching over the top of the client's arms and gently pulling at the elbows. Have the client return to the starting position and repeat for one to two sets of 10 repetitions. As the tissue loosens, have the client raise the arms 10° to 15° for three different angles.

Figure 7-19 Pectoralis stretch.

Pectoralis Minor To stretch the pectoralis minor, have the client interlock the fingers behind the head and bring the elbows together in front of his or her body (Fig. 7-20). As the client exhales, have him or her move the elbows back as far as possible.

Figure 7-20 Pectoralis minor stretch.

At the end of the range, gently assist in an upward and backward direction at a 45° angle by either reaching under or over the top and holding at the elbows. Repeat for one to two sets of 8 to 10 repetitions.

Anterior Arm and Shoulder Moving to the anterior arm and shoulder, have the client sit up straight and place the arms at the sides (Fig. 7-21). Without bending at the waist, the client should exhale and extend the arms as far back as possible, keeping them close to the sides with the elbows locked. At the end of the range, assist gently in the same direction by holding the forearms, and then return to the starting position. Repeat for 10 repetitions.

Anterior Shoulder A similar stretch for the anterior shoulder is to have the client interlace the fingers behind the back with palms facing away from the body (Fig. 7-22). While exhaling, the client should lift the arms upward as far as possible. At the end of the range, gently assist the client in the same direction by holding under the forearms, and then return to the starting position. Make sure the client does not lean over to compensate. If necessary, the client may flex his or her neck 15° for comfort. Repeat for one to two sets of 10 repetitions.

Rotators While the rotators of the shoulders can be stretched in various positions, the safest is the prone position.

Internal Rotators For the internal rotators, have the client lie prone and hang the arm off the table at 90° with the elbow bent (Fig. 7-23). Place a folded towel under the front of the shoulder to prevent the humerus from translating anteriorly. Place the hand or forearm of the side closest to the table on the scapula of the client to stabilize the posterior shoulder. While exhaling, the client should rotate the arm and bring the hand up as far as possible. At the end of the range, gently assist the client by grasping the wrist and pulling. Release to the starting position, and then repeat for one to two sets of 10 repetitions.

Figure 7-21 Anterior arm stretch.

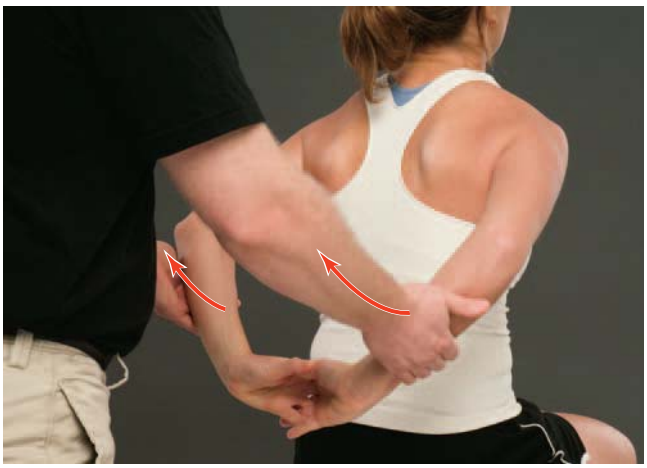


Figure 7-22 Anterior shoulder stretch.

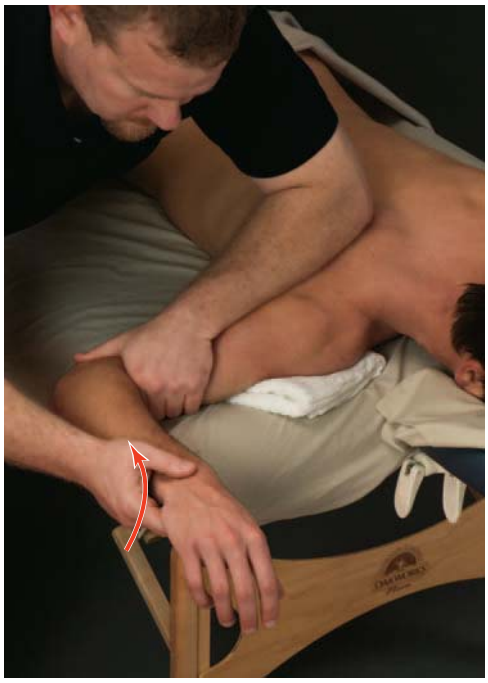


Figure 7-23 Internal rotator stretch.

Figure 7-24 External rotator stretch.

External Rotators To stretch the external rotators, begin in the same position as that for the internal rotators, except stand at the head of the table and face the feet. Use the folded towel under the front of the shoulder for this stretch. While exhaling, the client should rotate the shoulder inward, bringing the palm up as far as possible (Fig. 7-24). To make sure the client's arm does not adduct, apply firm pressure to the scapula. At the end of the range, gently assist in the same direction by grasping the wrist and pulling up, and then return to the starting position. Repeat for one to two sets of 10 repetitions.

Posterior Shoulder Once the anterior muscles are loosened, you can move to the posterior muscles. To stretch the posterior shoulder, have the client reach the arm in front of his or her body with the thumb up (Fig. 7-25). While exhaling, the client should reach across the front of the chest toward the top of the shoulder, keeping the arm parallel to the ground. At the end of the motion, gently assist by grasping the elbow and compressing the arm into the chest. To make sure the client does not rotate the trunk to compensate, stabilize the opposite shoulder. Return to the starting position, and then repeat for one to two sets of 10 repetitions.

Another stretch for the posterior shoulder begins by having the client place the arm to be stretched on the opposite shoulder. Stabilize the shoulder being stretched to prevent it from shrugging or moving out of the neutral position (Fig. 7-26). As the client exhales, he or she should walk the fingers down his or her back as far as possible. At the end of the range, gently assist the client by placing your hand on the elbow. Return the arm to the starting position, and then repeat for 8 to 10 repetitions.

Figure 7-25 Posterior shoulder stretch with arm straight.

Figure 7-26 Posterior shoulder stretch with arm bent.

Figure 7-27 Triceps stretch.

Triceps Brachii The last stretch is for the triceps brachii. Have the client reach straight out in front of his or her body with the palm facing up (Fig. 7-27). Have the client bend the elbow. While exhaling, the client should reach over the shoulder as far as he or she can. At the end of the movement, assist the client by standing at his or her side. Placing one hand on the wrist to keep the arm bent and the other hand under the elbow, continue the motion, keeping the arm bent and the shoulder moving straight back. Return to the starting position, and then repeat for 5 to 10 repetitions. Once the triceps has been stretched directly backward, repeat the process with the elbow swung out to 45° so that the client is reaching down his or her back at an oblique angle. Assist the client for 5 to 10 repetitions, returning to the starting position each time.

Biceps Brachii Tendonopathy

Background

Injuries to different parts of the tendon of the long head of the biceps brachii can occur for a variety of reasons. Although injury can occur to both the short and long heads of the muscle, this section addresses pathology involving the tendon of the long head of the biceps. In order to understand the pathology of this tendon, we must first understand its role in the overall functioning of the shoulder.

The tendon of the long head of the biceps plays an important role in the properly functioning shoulder. It arises from inside the glenohumeral joint at the supraglenoid tubercle and superior labrum, where the glenohumeral ligaments converge (see Fig. 7-4) (Beall et al., 2003). The tendon travels at

an oblique angle over the humeral head. It exits the joint capsule at the level of the humeral neck and moves inferiorly through the bicipital groove, continuing down the groove until it merges with the tendon from the short head coming off the coracoid process. The tendon is surrounded by a synovial sheath and is held in the groove by the coracohumeral ligament.

Since the biceps brachii is one of several muscles that cross two joints, it makes sense that the muscle performs functions at both locations. At the elbow, its primary function is supination; it contributes to flexion as a secondary function. Its function at the shoulder joint, however, is less clear (Levy et al., 2001). While studies agree that the long head of the biceps is important in shoulder function, it generally functions as a stabilizing structure and not a movement generator. Electromyographic studies performed on the shoulder showed minimal or no activity of the biceps during various shoulder motions. Based on these studies, as well as cadaveric research, the role of the long head of the biceps seems to be that it stabilizes the anterior and superior portions of the glenohumeral joint and assists in maintaining a normal relationship between the humeral head and glenoid fossa (Beall et al., 2003). This role increases as the stability of the glenohumeral joint decreases (Morag et al., 2005).

Practical Tip

The stabilizing role of the shoulder muscles increases as the joint stability decreases.

Because of this, injuries to the long head of the biceps are usually associated with other pathological processes in the shoulder. Isolated injuries to the tendons occur primarily from blunt traumas causing a primary injury to the tendon or from congenital factors affecting the groove through which the tendon runs. As the tendon passively slides within the groove, the friction it creates causes the tendon to become irritated and inflamed. This leads to tendonitis.

Injury to the biceps tendon often occurs as a result of a related shoulder pathology, the most common of which is impingement of the rotator cuff. The primary mechanism of injury is repetitive motion that includes overhead movement or activity. The biceps tendon and the rotator cuff structures make contact with the coracoacromial arch. This type of tendonopathy is classified as **impingement tendonosis,** wherein the intracapsular portion of the tendon is compressed against various structures.

impingement tendonosis Pathology of the biceps tendon in which the intracapsular portion of the tendon is compressed against various structures.

Another classification of tendonopathy is known as **attrition tendonosis,** which is the result of a narrow bicipital groove and affects the extracapsular portion of the tendon.

attrition tendonosis Pathology of the biceps tendon caused by a narrow bicipital groove and resulting in irritation of the extracapsular portion of the tendon.

Despite the cause, clients will generally present with vague anterior shoulder pain with a possible radiation to the proximal upper arm or deltoid insertion (Pfahler et al., 1999). There may be focused discomfort over the bicipital groove during internal and external rotation. This often makes it difficult to distinguish the difference between a biceps tendon injury and impingement.

Additional damage to the tendon can occur as the associated condition worsens. Continued damage to the rotator cuff will increase compression of the biceps tendon and further the pathologic process, which can result in partial tearing of the tendon. If the process is not resolved, a complete rupture of the tendon of the long head may occur. This will result in a "Popeye" deformity due to the distal displacement of the belly of the biceps.

Another condition that can arise from untreated associated pathologies is the subluxation or dislocation of the tendon from the groove. The

primary structures holding the tendon in the groove are the coracohumeral ligament and the insertion tendon of the subscapularis. The tendon may become displaced if these structures are damaged. Repeated subluxations can fray the tendon and will also lead to its eventual rupture.

As the shoulder loses stability from underlying pathology, a superior labrum anterior to posterior (SLAP) lesion can occur. This affects the labrum and typically begins where the biceps tendon inserts into the labrum at the supraglenoid tubercle. With increasing instability comes an increase in the severity of the lesion, which eventually makes its way down the superior part of the biceps tendon. Clients with this disorder typically present with shoulder pain but have a distinct clicking within the joint on movement. This injury is beyond the scope of this text; if it is suspected, the client should be referred to another health care provider.

Assessment

Tendonopathy of the long head of the biceps brachii can be difficult to discern. Since it can present with the same symptoms as rotator cuff injuries, and is often caused by associated shoulder pathology, practitioners should perform a thorough assessment of the area, including the neck if warranted.

Condition History Inquire about the following when taking the client's history:

Question	*Significance*
What is the client's age?	Biceps tendonopathy in a young client may be the result of trauma or improper mechanics during overhead activities or an anatomical anomaly.
What was the mechanism of injury?	Since isolated injuries to the biceps tendon don't often occur, the nature of the injury can lend useful information.
Are there any movements that cause pain?	Overhead movements will typically cause pain.
Is there any sound or sensation?	A popping sound or sensation can indicate a rupture of the tendon.
Where is the pain?	Biceps injury may present more anterior pain.
How long has the client had the problem?	Long-standing pain can indicate a more severe problem.

Visual Assessment Make sure the client is disrobed to the appropriate level. Observe the client's functional capacity during movement. Note dysfunctional movement patterns and the quality of the client's movement. Check for obvious swelling, bruising, or muscle atrophy along with

passive and active ranges of motion. From the front, observe the overall position of the head and neck in relation to the shoulders. Notice any excessive rotation of the shoulders, which could indicate a possible underlying pathology. Check the biceps brachii for any obvious deformity that would suggest a rupture.

Palpation Begin by checking the overall shoulder for hypertonicity of the musculature. Check the sternoclavicular and acromioclavicular joints, and make sure the scapulae sit evenly on the thoracic spine. Focus your attention over the bicipital groove and the greater and lesser tuberosities, being careful not to exacerbate any discomfort in the area. Palpate the coracoid process and the short head of the biceps tendon. Concentrate on the structures listed earlier in the chapter, expanding the area as necessary.

Orthopedic Tests Biceps tendonopathy typically arises as a result of additional shoulder pathology; therefore, it is necessary to perform the orthopedic tests for impingement and rotator cuff tears. Table 7-3 shows the orthopedic tests and how to perform them.

Table 7-3 Orthopedic Tests for Biceps Brachii Tendonopathy

Orthopedic Test	How to Perform
Speed's test  *Note:* This test was first described by J. Spencer Speed when he experienced pain in the proximal shoulder while he was performing a straight-leg-raise test on a patient. He was subsequently diagnosed with bicipital tendonitis and the test has been used ever since (Bennett, 1998).	Have client flex the shoulder to 90° and fully extend the elbow. Place one hand on the bicipital groove and the other hand on the client's distal forearm. Force the client's arm into shoulder extension while he or she resists. *Note:* Placing the client's arm in this position and applying an eccentric load forces the biceps tendon to act as a suspensor cable from its insertion. The presence of inflammation will cause pain, which is considered a positive sign. An alternate method is to flex the client's arm to 60°. Resist forward flexion. *Note:* This position will create upward force and may cause the biceps tendon to impinge into the acromion or other structures, subsequently causing pain. The presence of pain is considered a positive test.

Table 7-3 Orthopedic Tests for Biceps Brachii Tendonopathy *(Continued)*

Orthopedic Test	How to Perform
Yergason's test  *Note:* Although both tests are helpful, Speed's test has shown to be more reliable at detecting pathology.	Have the client flex his or her elbow to 90° while keeping it stabilized against the torso and pronating the forearm. Place one hand on the client's forearm, and instruct him or her to simultaneously supinate the forearm, externally rotate the shoulder, and flex the elbow while you resist. Pain is an indicator of a positive test, as is the tendon snapping out of its groove.
Ludington's test  *Note:* This test is used for detecting a rupture in the tendon of the long head of the biceps.	Have the client clasp his or her hands on top of or behind the head, using the fingers to support the weight of the head. Place your fingers on the biceps tendon in the groove. Have the client alternately contract the biceps while you feel for the contraction. There is likely a rupture if you do not feel a contraction, which is a positive sign.

Soft Tissue Treatment

Since bicipital tendonopathy may have arisen as a result of other pathologies, it is necessary to address those conditions before the pathology with the biceps tendon can be resolved. Treatment will be based first on the underlying pathology. For example, if the underlying pathology is a rotator cuff tear, use the soft tissue treatments for that particular condition, followed by the techniques for biceps tendon pathology. Be aware of the phase of the injury to the tendon. It may be necessary to use more conservative treatments until the injury has moved out of the acute phase. Make sure to thoroughly treat any areas that are contributing to the dysfunction.

Connective Tissue Dysfunctional posture patterns can be an underlying factor in this condition. Since connective tissue plays a major role in postural patterns, treating it can offer significant benefit.

Prone Position In addition to the general treatment of the shoulder and associated areas, treatment of the triceps can also be performed effectively in the prone position. Moreover, the triceps is an important muscle to treat since it is the antagonist to the biceps brachii.

Hang the arm off the side of the table, and assess the superficial connective tissue of the posterior arm and shoulder in various directions. Move into any restrictions until they are cleared. As you move deeper, strip out the border between the long head of the triceps and the posterior deltoid.

Supine Position Assess the superficial tissue of the anterior arm and shoulder in various directions. Grasp the wrist with one hand to control the arm, and incorporate movement while moving into any restrictions. Separate the biceps brachii from the underlying muscles, and strip out each head of the muscle. Create separation between the anterior deltoid and the biceps. Use caution, as it is likely this area will be tender. Perform direct connective tissue treatment to the biceps tendon if the tissue can tolerate it. Strip out any restrictions around the tendon, and remove any adhesions. Strip out underneath the insertion of the pectoralis major to remove any restrictions between the two tendons.

Side-Lying Position Use this position to treat the deltoids directly. Stand at the head of the table facing inferiorly. Place the client's arm at his or her side, and strip out each head of the deltoids.

Tissue Inconsistencies Trigger points should be addressed in all the associated muscles, depending on the underlying pathology involved. Specific points that should be addressed are in the biceps brachii, anterior deltoid, pectoralis minor, and pectoralis major.

Muscle Concerns

The elimination of the underlying pathology that is contributing to the formation of bicipital tendonitis should be addressed. The emphasis should be on restoring normal shoulder kinematics. Remove any excess tension through the tendon as it passes through the groove to lessen the pressure on the structures involved.

Prone Position Focus on the triceps in this position by hanging the arm off the table to optimize the work to the muscle. Both active and passive movements can easily be incorporated while the arm is in this position. Apply perpendicular compressive effleurage while the client extends his or her arm. Use parallel thumb stripping starting at the olecranon process to strip out the borders of the three heads of the triceps while the client actively flexes and extends his or her arm. Be sure to address the posterior shoulder girdle using the techniques described for treating impingement syndrome.

Supine Position The biceps tendon can be directly treated in this position. Take the client's wrist with one hand to control the arm, and work

deep into the biceps brachii from distal to proximal, easing the pressure as you pass over the anterior shoulder. Perpendicular compressive effleurage is a good stroke to use in this position. Make sure the biceps is facing up, and work proximally and distally.

Movement can also be easily incorporated into the work for the biceps. Parallel thumb stripping while the client is extending the arm will separate the heads of the biceps and remove any restrictions. Working under the anterior deltoid at its border with the biceps will remove adhesions between the two muscles. This border may be painful, so it is important to warm it up properly. Address the associated muscles of the trunk such as the pectoralis major and minor to remove restrictions.

Side-Lying Position This position is effective for treating the deltoids directly. Place the client's arm along his or her side, and work down onto the lateral shoulder. The pectoralis minor may be accessed from this position. Stand in front of the client, and support his or her arm while abducting it in front. Work along the lateral border of the pectoralis major, sliding behind it onto the pectoralis minor. You can have the client move while you are applying pressure to increase the effectiveness of the stroke.

Stretching

As with the other treatments of this condition, it is beneficial to stretch the entire shoulder girdle to address any underlying conditions that may be contributing to problems with the biceps tendon. Use the stretches for impingement syndrome to address the shoulder, placing special emphasis on the anterior shoulder and biceps, as seen in Figs. 7-19 to 7-27.

Anterior Shoulder To stretch the anterior shoulder, have the client sit up straight and place the arms at the sides (see Fig. 7-21). Without bending at the waist, the client should extend the arms as far back as possible, keeping them close to the sides with the elbows locked, while exhaling. At the end of the range, assist gently in the same direction by grasping the forearms, and then return to the starting position. Repeat for 10 repetitions.

For a similar stretch, have the client interlace the fingers behind the back with palms facing away from the body (see Fig. 7-22). While exhaling, the client should lift the arms upward as far as possible. At the end of the range, gently assist in the same direction by grasping under the forearms and returning the client to the starting position. Make sure the client does not lean over to compensate. The client may also flex his or her neck 15° for comfort. Repeat for one to two sets of 10 repetitions.

Figure 7-28 Anterior shoulder stretch.

Biceps Brachii To stretch the biceps brachii, have the client sit up straight, abduct his or her arms 90° to the side, and turn the thumbs down (Fig. 7-28). With the palms facing each other, horizontally abduct the arms and adduct the scapula. At the end of the range, gently assist in the same direction as the client exhales. Hold for 2 seconds and release. If the client cannot raise the arms to 90°, have him or her raise them as far as possible, gradually raising them higher as they loosen. Repeat for 5 repetitions per level. Make sure the anterior shoulder is sufficiently loose before performing this stretch.

Adhesive Capsulitis (Frozen Shoulder)

Background

The term *frozen shoulder* has been used as a catchall term for a variety of clinical conditions, including subacromial bursitis, calcifying tendonitis, and rotator cuff tears (Pearsall et al., 1998). Shoulder problems are the third-largest segment of musculoskeletal disorders seen in primary health care, trailing lower-back and neck disorders (Wiffen, 2002). Adhesive capsulitis constitutes almost 50% of stiff shoulders in a shoulder clinic and affects between 2% and 5% of the general population. Although various terms are employed to describe frozen shoulder, they all describe the same condition: the painful restriction of both active and passive motions of the glenohumeral and scapulothoracic joints (Pearsall et al., 1998). There are many conditions that will result in a stiff and painful shoulder, but movement is limited only by pain and not by capsular contraction as it is with adhesive capsulitis.

Frozen shoulder was first described by Codman in 1934 as a "class of cases which I find difficult to define, difficult to treat, and difficult to explain from the point of view of pathology. Yet these cases form a fairly distinct clinical entity" (Bunker, 1998). Even though he could not explain the entire pathological process, Codman recognized that clients with this condition had numerous things in common. These points are summarized in Table 7-4.

Table 7-4 Codman's Characteristics of Frozen Shoulder

Slow onset
Pain near the deltoid insertion
Inability to sleep on the affected side
Painful and incomplete elevation and external rotation
Both spasmodic and adherent restrictions
Atrophy of the rotator cuff
Little local tenderness

It was not until 1945 that Neviaser coined the term "**adhesive capsulitis**" and tried to explain the pathologic anatomy. He described adhesive capsulitis as an "insidious condition that begins with pain, then gradual restriction of all planes of movement in the shoulder" (Mitsch et al., 2004). Neviaser believed that an inflammatory process in the capsule and synovium of the joint led to the formation of adhesions within the shoulder joint, and he identified four stages of adhesive capsulitis, described in Table 7-5.

adhesive capsulitis An insidious condition that begins with pain and progresses to a loss of motion in all planes.

In 1969, Lundberg created two classifications for adhesive capsulitis based on pain and motion requirements. Primary frozen shoulder is idiopathic in nature, and clients have no significant findings in the history, clinical examination, or radiographic information to explain the loss of motion or pain. If a client has a predisposing condition such as a

Table 7-5 Four Stages of Adhesive Capsulitits

Stage	Characteristics
1	Clients present with pain described as achy at rest and sharp at end ranges of motion, similar to the presentation of impingement syndrome. Symptoms are present for fewer than 3 months, and a loss of motion begins in flexion, internal rotation, and abduction. This loss of range is due to pain levels rather than capsular restrictions.
2	Clients present with symptoms that they have experienced for 3 to 9 months. Their pain is a result of the inflammation of the synovium and a reduction in capsular volume. These patients show a continued reduction in the range of motion in the same directions as stage 1.
3	Client's symptoms have been present for 9 to 14 months. The painful phase is over, but the shoulder is still stiff due to capsular adhesions.
4	This final stage is also known as the *thawing phase.* Symptoms have usually been present for 15 to 24 months. This stage is characterized by slow progressive improvement of the client's range of motion in response to the use of the shoulder and arm. Full range may never be regained, but normal everyday activities are possible.

trauma or surgery to explain his or her symptoms, the client is classified as having secondary frozen shoulder.

The etiology of adhesive capsulitis remains elusive; however, several predisposing factors can increase the occurrence of the condition:

- The incidence of adhesive capsulitis in the diabetic population increases to 10% to 20% and up to 36% in insulin-dependent diabetics.
- Other conditions that have shown a higher rate of frozen shoulder include thyroid disease, stroke or myocardial infarction, autoimmune diseases, cervical disk disease, chest or breast surgery, hormonal changes, and any condition that requires long periods of immobilization.
- There is an association between frozen shoulder and another fibrosing condition, Dupuytren's disease, wherein there is a contracture of the palmar fascia. This relationship was first recognized in 1936 by Schaer when he discovered that 25% of patients with frozen shoulder also had Dupuytren's. One study reported a 58% rate of correlation (Smith et al., 2001).

- The prevalence of frozen shoulder is greater in women than men, and the nondominant side is more typically involved. The most common age range affected is 40 to 70, and there is a 20% to 30% chance that patients will develop symptoms in the opposite shoulder.

Disagreement exists as to whether the underlying pathologic process of adhesive capsulitis is inflammatory or fibrosing in nature. Recently, there has been significant evidence indicating that the pathologic processes are an initial synovial inflammatory condition with the subsequent occurrence of capsular fibrosis, making adhesive capsulitis both an inflammatory and a fibrosing condition. To understand this pathology, we must look at the healing process. In Chapter 3, we described the three stages of healing: inflammatory, repair and regeneration, and remodeling and scar formation. The initial inflammatory trigger is not known for frozen shoulder. This inflammation causes a hypertrophy and increased vascularity of the synovial membrane, resulting in pain and loss of motion. It is the last two stages of healing that hold the key to the dysfunction of the biology of frozen shoulder.

Contractures can occur as a result of physiologic or pathologic processes. An example of a physiologic process occurs when the edges of a healing wound pull together. A pathologic process includes an imbalance between scar formation and remodeling, resulting in the abnormal formation of a contracture (Bunker, 1998). Recall that the main cell of scar tissue formation is the fibroblast. Fibroblast activity is controlled by a certain type of cell messenger called *cytokines.* Cytokines are involved in the initiation and termination of scar tissue formation and remodeling (Hannafin et al., 2000). There seem to be elevated levels of cytokines and fibrogenic growth factors in frozen-shoulder tissue. An increase in scar tissue formation is only one side of the coin. The other side is the failure of tissue remodeling. The task of remodeling is left to a family of enzymes that act as collagenases and are now referred to as *matrix metaloproteinases (MMPs)* (Bunker, 1998). It seems that in adhesive capsulitis these enzymes are inhibited and a failure of the remodeling of the scar tissue takes place, leaving contractures that restrict shoulder motion.

Assessment

Depending on whether adhesive capsulitis is primary or secondary, there may be other underlying conditions that have caused the pathology. Two aspects need to be assessed in all clients: pain and contracture (Bunker, 1998). Performing a thorough assessment, using the various pieces, and integrating the results into an overall picture of the condition will ensure that the proper treatment is given. Remember, your assessment may differ depending on what stage the frozen shoulder is in. You may need to expand the assessment to associated areas if it is determined that they are involved.

Condition History Prior to the physical assessment, inquire about the following when taking the client's history:

Question	*Significance*
What is the client's age?	Frozen shoulder tends to favor a certain age group (40 to 70).

Question	*Significance*
When did the symptoms start, and how long have they been there?	This will help identify what stage the pathology is in.
Was there any trauma to the shoulder?	This can lend information about whether the condition is primary or secondary.
Does the client have any other health problems?	This will determine any associated conditions.
Where is the pain located?	This will help identify involved structures.
Are there any positions or motions that increase or decrease the pain?	This will help identify involved structures.
Is there any radiculopathy?	This will help determine neurologic involvement.
What is the loss of function?	This can help identify reductions in common movement patterns.

Visual Assessment Ensure that the client is disrobed to the appropriate level. You can observe the client in a seated or standing position. Notice the positions of the arm and the head and neck. Depending on the stage, the shoulder may be elevated to guard against the pain. In later stages, a common appearance is the loss of the normal axillary fold due to the contracture. Check for muscle atrophy or obvious deformity, along with any swelling and discoloration. Assess active and passive ranges of motion, and note abnormalities.

Palpation Areas may or may not be tender, depending on the stage of the condition. Later stages will show more hypertonicity in the musculature. Generally, there is not a lot of point tenderness in the shoulder area, although the biceps brachii tendon may be tender to direct palpation (Beam, 2000). Begin with the neck, and work your way down onto the shoulder girdle, palpating the anterior side first. Include the structures discussed earlier in the chapter, and be sure to use a systematic approach, noting any tenderness, tightness, swelling, or bruising.

Orthopedic Tests To ensure a complete assessment, include tests for associated shoulder conditions, such as the Hawkins-Kennedy and empty-can tests (see Table 7-2 on pages 244 and 245). To fully understand frozen shoulder, it is important to realize that shoulder function involves both the scapulothoracic articulation and the glenohumeral joint (Pearsall et al., 1998). The primary symptom of frozen shoulder is the progressive loss of range of motion. It stands to reason that special orthopedic tests for the condition assess range of motion.


capsular pattern
A proportional motion restriction that is unique to every joint that indicates irritation of the entire joint.

There is a consistent pattern of motion loss referred to as a **capsular pattern**. "A capsular pattern is a proportional motion restriction that is unique to every joint that indicates irritation of the entire joint" (Mitsch et al., 2004).

Adhesive capsulitis causes the most restriction in external rotation, followed by abduction and then internal rotation. The therapist should assess each movement individually; however, Apley's scratch test will provide a quick scan of the entire shoulder girdle movement at once. Table 7-6 explains how to perform this test.

Table 7-6 Orthopedic Test for Adhesive Capsulitis

Orthopedic Test	How to Perform
Apley's scratch test (see Fig. 7-6 on page 225) • The test combines internal rotation with adduction and external rotation with abduction. *Note:* This test will provide valuable information about the functional capacity of the client and whether he or she can perform certain tasks.	Have the client reach behind his or her head and down the back as far as possible with one hand, while you assess external rotation and abduction. Have the client reach up behind the back as far as possible while you assess internal rotation and adduction. Record the level for each hand, and repeat for the opposite side. Reduced range of motion that affects functioning is considered a positive test.

Soft Tissue Treatment

The primary objectives for treatment should be to relieve pain and restore motion (Pearsall et al., 1998). The techniques used may vary depending on the stage of the condition. The goal for stage 1 is to interrupt and control the inflammatory process and limit pain. Methods such as rest and ice should be implemented to reduce discomfort and facilitate healing. Stage 2 goals include reversing and preventing motion restrictions. Once the client has reached stage 3, emphasize treating the significant loss of motion and abnormal scapulohumeral rhythm.

Connective Tissue As the pathology progresses, connective tissue can play a larger role in the dysfunction; therefore, it is important to address it.

Prone Position Assess the superficial fascia of the back from superior to inferior, from medial to lateral, and at various angles as described earlier. The incorporation of active and passive movements is effective in this area.

Once you have addressed the superficial fascia, move into the deeper layers and begin to strip out the borders of the muscles in the area. Pay special attention to the posterior rotator cuff.

Supine Position Addressing the connective tissue in this position helps treat underlying pathologies that are contributing to the loss of range of motion. Begin by assessing the superficial fascia of the chest, anterior shoulder, and upper arm, including any associated areas as necessary. The use of movement is also beneficial in this position. Make sure you stay within the client's comfort level, depending on his or her restrictions. Use the techniques described for the earlier conditions.

Once you have addressed the superficial restrictions, strip out the individual muscles that are involved in the shoulder. A good area to define is the inferior border of the clavicle and sternoclavicular joint. Defining this area will remove any restrictions around the joint and address the clavicular attachment of the pectoralis major. Finally, make sure the border between the lateral scapula and the rib cage is stripped out. This will

address the portion of the rotator cuff and teres major that may not have been worked on in the prone position.

Side-Lying Position The subscapularis and the serratus anterior are best accessed in this position. These two muscles contribute a great deal to shoulder girdle motion and often get stuck together; therefore, removing their restrictions is very beneficial. Once the superficial restrictions have been assessed, move into them until they release. Both active and passive movements are effective in this position as well. Since they lie under the scapula, the subscapularis and serratus anterior are not completely accessible. Support the humerus with one hand, and find the lateral border of the scapula with the other using your fingertips or thumb. Because this area can be tender, a more comfortable approach for the client may be to leave your hand stationary and protract the shoulder onto your thumb or fingertips. Move up and down the border of the scapula, and use passive movement pulling the arm at different angles.

Tissue Inconsistencies Because of the long duration of this condition, excessive guarding of the musculature is typical. This will, however, lead to the presence of trigger points in just about every muscle of the shoulder girdle. Use figures 7-8 to 7-17 to identify the muscles that should be treated. Incorporating motion can increase the effectiveness of your pressure. It will also help reeducate the muscles' firing patterns.

Muscle Concerns

The synergistic relationship of the muscles in the shoulder girdle can be easily upset, and this imbalance is a major contributor to adhesive capsulitis. Addressing the involved muscles and restoring the normal biomechanics to the area should be a major part of the overall treatment procedure.

Prone Position The focus of this work should be to remove any restrictions in the posterior rotator cuff and the lateral border of the scapula. Abduct the arm as far as it will go. Use a loose fist, starting at the spine of the scapula and working perpendicularly across the scapula toward the lateral border. Try to incorporate as many strokes with movement as possible. The area has typically been immobile for a long period of time, and the client's active participation will help with the neurologic input to the muscle.

Another technique that works well in this position is to place the hand in the small of the back and let the elbow fall to the table. If the client is not able to place the hand on the lumbar spine, slide the hand up the side of the body as far as it will go. Cup the anterior shoulder with one hand, and lift up. The medial edge of the scapula should swing, and you can grasp it with your other hand. Distract the scapula as much as possible, and perform various movements with it to help break up any adhesions between the scapula and the thorax. This will also improve its mobility.

Supine Position Focus on the muscles that control the position of the shoulder, such as the pectoralis major and minor and the anterior deltoid. Once they have been addressed, work the lateral border of the scapula thoroughly, again incorporating as much movement as possible.

Side-Lying Position This position allows the best access to the serratus anterior and subscapularis. Have the client abduct the arm as far as possible or flex it forward and rest it on the table. Work between the axillary border of the scapula and the lateral border of the pectoralis major; this will directly address the serratus anterior. Side lying is also the position for stripping out the muscles that run along the lateral scapula. To access the deeper parts of the subscapularis and serratus anterior, support the client's arm with your hand and place your thumb along the lateral border of the scapula, just anterior to the teres major and latissimus dorsi. Passively protract the client's arm onto your thumb, staying within the client's comfort level. You can change the angle of pull to address different portions of the muscle. If tolerable, the client can perform active motions while you hold pressure on the muscle. If you focus your pressure upward into the scapula, you will affect the subscapularis muscle; if you direct the pressure down onto the rib cage, you will affect the serratus anterior.

Stretching

Adhesive capsulitis results in the global loss of mobility in the shoulder. Perform all the stretches discussed for the previous conditions in order to restore balance to the musculature. For maximum results, be sure the client always contracts the muscle opposite the one being stretched.

Shoulder Extensors There are some additional stretches that can be beneficial for this condition. While the client is in the seated position, have the client lock the elbows with the palm facing the body (Fig. 7-29). Stabilize the same-side shoulder with your hand so that it does not shrug, and have the client forward flex the arm while exhaling. At the end of the range of motion, gently assist in the same direction for 2 seconds, and then return to the starting position. Repeat this for one to two sets of 10 repetitions.

Shoulder Adductors For a similar stretch, place the client in the seated position. Have the client lock the elbow with the palm facing forward while you place your hand on the same-side shoulder to stabilize it (Fig. 7-30). Instruct the client to abduct the arm as far as possible while exhaling. At the end of the range of motion, gently assist at the elbow in the same direction. Return to the starting position, and then repeat for 10 repetitions.

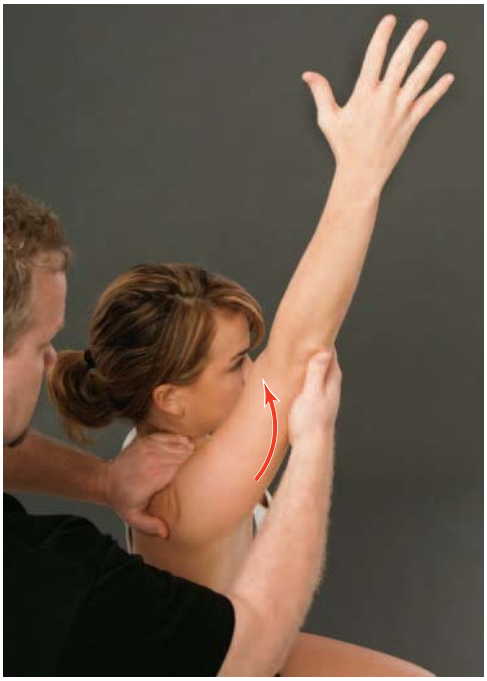


Figure 7-29 Shoulder extensor stretch.

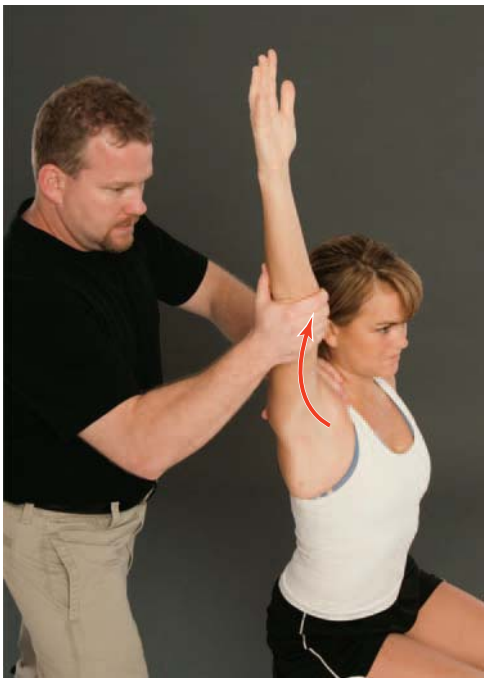


Figure 7-30 Shoulder adductor stretch.

SUMMARY

The shoulder is a very complex region of the body, with several different structures that must act in a symbiotic relationship to provide us with the freedom of motion that we enjoy. The anatomical review at the

beginning of the chapter listed all the various structures involved in the region and explained how to palpate them. The next section discussed the movements of the areas, pointing out that the motion actually comes from four separate joints working in unison. The chapter presented several conditions that can affect the shoulder, as well as the assessment and treatment techniques for each. It showed how the various structures are interrelated, and it emphasized that dysfunction in one structure leads to dysfunction in all.

REVIEW QUESTIONS

1. What bones make up the shoulder girdle?
2. What is the size of the humeral head compared to that of the glenoid fossa?
3. What function does the glenoid labrum perform?
4. What are the three ligaments of the glenohumeral joint, and which one provides the most stability?
5. What is the most vulnerable position of the shoulder?
6. What is the scapulohumeral rhythm?
7. What muscles make up the rotator cuff?
8. What are the three variations of acromion shapes, and how does the shape affect the shoulder?
9. What is the painful arc?
10. What is the function of the long head of the biceps brachii at the shoulder?
11. What is a SLAP lesion?
12. What are Codman's characteristics of frozen shoulder?
13. What is the condition that involves the palmar fascia and is associated with frozen shoulder?
14. What is the capsular pattern of a joint?

CRITICAL-THINKING QUESTIONS

1. Discuss how the increased range of motion available in the shoulder results in a decrease in stability.
2. Discuss the importance of the scapulohumeral rhythm.
3. Discuss the importance of the proper functioning of the rotator cuff.
4. Describe the process of the progression from shoulder impingement to a rotator cuff tear.
5. What is the importance of correcting postural concerns when treating shoulder conditions?
6. Why is an isolated chronic injury to the biceps tendon rare?
7. Discuss the process involved in the progressive loss of range of motion in adhesive capsulitis.

QUICK REFERENCE TABLES

Bony Structures of the Shoulder Girdle

Spine of the scapula	This part of the scapula is on the posterior shoulder girdle. It is in the upper half of the bone and runs in a transverse direction at a slight upward angle. The medial end is in line with T3, and the lateral end is the acromion process. Place the palm of your hand on the upper half of the scapula, and palpate in a vertical fashion to find the edge. Use your fingertips to trace its borders.
Medial border of the scapula	This border runs along the spinal column. Trace the spine of the scapula to its medial edge, and move up and down along the border. To make it easier to find, place your client's hand in the small of his or her back.
Superior angle of the scapula	Trace the spine of the scapula to its medial edge. Trace superior and slightly lateral to the superior angle.
Inferior angle of the scapula	This is the inferior tip of the bone. It is found by tracing the spine to the medial edge and running in an inferior direction until the inferior corner is felt.
Greater tuberosity of the humerus	This structure lies on the superior lateral humerus and may be difficult to find. Using the acromion process, move inferior and a little lateral until you find a large, bony prominence. Use your fingers to palpate its borders.
Intertubercular (bicipital) groove	This groove runs in a vertical fashion between the greater and lesser tuberosities of the humerus. Have your client put the arm at the side and bend the elbow to 90°. Locate the greater tuberosity, and laterally rotate the arm. Your finger should fall off the greater tuberosity into a groove and, as you continue to rotate the arm, will come up onto the lesser tuberosity. Rotate the arm medially and laterally to find the groove between the tuberosities.
Lesser tuberosity of the humerus	This structure is smaller and deeper than the greater. From the bicipital groove, move medially onto the bump, which is the lesser tuberosity. You may need to laterally rotate the arm to help locate this structure.
Coracoid process	This bone part lies on the scapula and is located about 1 inch medial to the acromion and about ½ inch inferior to the clavicle. It feels like a small marble or a pea and will most likely be tender.
Humeral head	Abduct the humerus to the end range. Palpate in the axilla with your palm to find the round head of the humerus.
Humeral shaft	The shaft runs from the head of the humerus to the epicondyles. It can be palpated midway down the inside of the arm, in between the biceps brachii and the triceps brachii.
Suprasternal notch	This is the notch or indentation at the top of the sternum. It is also known as the *jugular notch.*
Sternoclavicular joint	Using the suprasternal notch, move just lateral and you will feel the medial edge of the clavicle. You can also trace the clavicle medially until the joint space is found. It sits a little superior on the sternum. In order to make the joint easier to feel, place a finger on the joint and have your client protract and retract the shoulders.
Manubrium	This is the most superior portion of the sternum. The top of this structure is the suprasternal or jugular notch. The first ribs attach on either side below the clavicle.

QUICK REFERENCE TABLE

Bony Structures of the Shoulder Girdle *(Continued)*

Clavicle	This is an S-shaped bone anterior to posterior and runs between the sternum and the scapula. It has a convex curve medially and a concave curve laterally. The lateral end is larger and flatter and forms a joint with the acromion process of the scapula. Trace the bone from the sternum to the scapula.
Acromioclavicular joint	Trace the clavicle to its lateral edge. You should feel a space where it meets the acromion process. You can also locate the acromion process and work your way medially until you feel a "step" up to the clavicle. The space before the step is the joint. You can have your client protract and retract the shoulders to feel the joint move.
Acromion process	Place the palm of your hand on the lateral tip of the shoulder, and move it in a circular fashion. You will feel a flat, bony surface. Use your fingertips to trace the borders. If you are unsure, have your client move the shoulder. If you are on the process, it should not move. If it moves, you are probably on the AC joint or head of the humerus.
Sternal angle (angle of Louis)	Start at the suprasternal notch and move in an inferior direction. You will feel a ridge of bone about 1 inch to 1½ inches down. This is the junction between the manubrium and the body of the sternum. It is a landmark for the second rib.
Body of the sternum	This is the largest portion of the sternum and runs inferiorly to the tip. The last true rib attaches here via the costal cartilage.
Xiphoid process	This process is the end tip of the sternum. It differs in size and can point internally or externally or remain neutral. Trace the sternum in an inferior direction to its end, and press in.

QUICK REFERENCE TABLE

Soft Tissue Structures of the Shoulder Girdle

Brachial artery	This artery lies along the medial humerus, in between the biceps and triceps brachii.
Cephalic vein	This vein runs along the delto-pectoral interval, lateral to the biceps brachii and down the lateral humerus.
Basilic vein	This vein runs along the medial humerus, in between the biceps and triceps brachii.
Median cubital vein	This vein runs along the cubital crease and connects the cephalic and basilic veins.
Medial epicondyle of the humerus	Locate the cubital crease, and trace in a medial direction until you find a round, bony structure.
Medial supracondylar line of the humerus	Locate the medial epicondyle of the humerus, and palpate in a superior direction along a ridge.
Epitrochlear lymph nodes	These nodes lie above the medial epicondyle, along the medial supracondylar line. Use your fingers in a circular fashion to palpate this structure.

Muscles of the Shoulder Girdle

Muscle	Origin	Insertion	Action	How to Palpate
Posterior Muscles				
Trapezius	External occipital protuberance; ligamentum nuchae; spinous processes C7-T12	Lateral third of the clavicle, spine, and acromion process of the scapula	Upper fibers: elevation of the scapula; lateral flexion of the head to same side; rotation of the head to opposite side; exorotation of the scapula; bilateral extension of the head Middle fibers: retraction of the scapula Lower fibers: depression and exorotation of the scapula	Client in prone or standing position; resist shoulder elevation for the upper trapezius, shoulder retraction for the middle trapezius, and shoulder depression for the lower trapezius
Rhomboids	Spinous processes C6-T5	Vertebral border of the scapula from the spine to the inferior angle	Elevation, retraction, and endorotation of the scapula	Client in prone position; retract the shoulders and palpate between the medial border of the scapula and the spine
Levator scapulae	Transverse processes C1-C4	Superior angle and superior part of vertebral border of the scapula	Unilateral: elevation of the scapula; lateral flexion of the head and neck; rotation of the head and neck to same side; endorotation of the scapula Bilateral: extension of the head and neck	Client in prone position; find the superior angle of the scapula, have client shrug shoulder, trace the muscle toward the first four cervical vertebrae
Supraspinatus	Supraspinous fossa of the scapula	Greater tuberosity of the humerus	Abduction of the arm at the shoulder (first 15°); stabilization of the humerus in the glenohumeral joint	Client in seated position; palpate deep to the upper trapezius during slight shoulder abduction
Infraspinatus	Infraspinous fossa of the scapula	Greater tuberosity of the humerus	Adduction, lateral rotation, extension, and horizontal abduction of the arm at the shoulder	Client in prone position; abduct shoulder and elbow to 90°, resist external rotation, and palpate just inferior to the spine of the scapula

Muscle	Origin	Insertion	Action	How to Palpate
Posterior Muscles (Continued)				
Teres minor	Axillary border of the scapula	Greater tuberosity of the humerus	Adduction, lateral rotation, extension, and horizontal abduction of the arm at the shoulder	Client in prone position; abduct shoulder and elbow to 90°, resist external rotation, and palpate between the teres major and the infraspinatus
Subscapularis	Subscapular fossa	Lesser tuberosity of the humerus	Internal rotation of the humerus	Client in side-lying position; palpate underneath scapula
Teres major	Inferior angle of the scapula	Lesser tubercle of the humerus	Adduction, medial rotation, and extension of the arm at the shoulder	Client in prone position with the hand in the small of the back; have client lift hand off the back, and palpate at the inferior angle of the scapula
Serratus anterior	Ribs, upper 8 or 9 pair	Vertebral border of the scapula and costal surface of the subscapular fossa	Protraction of the shoulder girdle; abduction of the arm by exorotation of the scapula	Client in side-lying position; resist protraction of shoulder girdle
Latissimus dorsi	Spinous processes of lower 6 thoracic vertebra, thoracolumbar aponeurosis, posterior iliac crest, lower 3 to 4 ribs, and inferior angle of the scapula	Medial lip of the bicipital groove of the humerus	Adduction, extension, and medial rotation of the arm at the shoulder	Client in prone position; abduct arm to 90°, and hang it off the table; resist adduction and internal rotation of the arm
Anterior Muscles				
Pectoralis major	Medial half of the clavicle; sternum; and cartilage of the first 6 ribs	Lateral lip of the bicipital groove of the humerus	Adduction, flexion, medial rotation, and horizontal adduction of the arm at shoulder Lower fibers: extension of the arm at shoulder	Client in supine position; abduct the arm to 90°, and flex the elbow to 90°; resist horizontal adduction of arm at shoulder

Muscle	Origin	Insertion	Action	How to Palpate
Anterior Muscles (Continued)				
Pectoralis minor	Anterior surface of the 3rd through 5th ribs	Coracoid process of the scapula	Protraction, depression, and endorotation of the scapula	Client in supine position; palpate through pectoralis major while client protracts and depresses the shoulder
Arm Muscles				
Deltoids	Anterior: lateral third of the clavicle Middle: acromion process Posterior: spine of the scapula	Deltoid tuberosity of the humerus	Anterior: flexion, medial rotation, and horizontal adduction of the shoulder Middle: abduction of the shoulder Posterior: extension, lateral rotation, and horizontal abduction of the shoulder	Client in seated or side-lying position Anterior deltoid: resist flexion of the shoulder Middle deltoid: resist abduction of shoulder Posterior deltoid: resist extension of the shoulder
Biceps brachii	Supraglenoid tubercle through bicipital groove (long head); coracoid process of the scapula (short head)	Radial tuberosity and bicipital aponeurosis	Flexion of the supinated elbow; supination of the forearm and flexion of the arm at the shoulder	Client in supine position; resist flexion of a supinated forearm at the elbow
Triceps brachii	Infraglenoid tubercle of the humerus (long head) and proximal end (lateral head) and distal end (medial head) of the shaft of the humerus	Olecranon process of the ulna	Extension of the forearm at the elbow; extension of the arm at the shoulder	Client in prone position; hang the arm off of the table; resist extension of the arm at the elbow
Coracobrachialis	Middle of the humeral shaft on the medial surface	Coracoid process of the humerus	Flexion and adduction of the arm at the shoulder	Client in supine position; abduct the arm to 90°, and externally rotate it; flex the elbow to 90°, and resist horizontal adduction

Trigger Points of the Shoulder Girdle

Muscle	Trigger-Point Location	Referral Pattern	Chief Symptom
Trapezius	1. Upper fibers: one anterior and the other posterior 2. Middle trapezius: one occurs anywhere in the middle part of the muscle; the other is an attachment trigger point near the acromion 3. Lower: one central point halfway along the lower border of the muscle	1. Anterior: behind, up, and over the ear in a ram's-horn pattern Posterior: up back of neck to behind the ear 2. Belly: superficial burning pain; stay local to the point Attachment: top of the shoulder or acromion 3. Sharply to the high cervical paraspinals, mastoid process area, and acromion; deep ache in the suprascapular region	1. Major contributors to tension headaches 2. Induces other trigger points in the upper back and neck
Rhomboids	1. Level where the spine of the scapula meets the vertebral border 2. Inferior to each other, about halfway down the vertebral border	Pain concentrates around the vertebral border; does not radiate too far away	Superficial aching pain at rest, not influenced by movement; snapping or crunching noises
Levator scapulae	1. Superior angle of the scapula 2. Halfway up the muscle	Posterior shoulder and medial scapular border	Pain at the angle of the neck; stiffness preventing turning head fully to either side
Supraspinatus	Two in belly of muscle: one close to the medial border; the other farther lateral Third point in proximal tendon	Deep ache centering on the middle deltoid; can extend down the lateral side of the arm to lateral epicondyle of the elbow	Referred pain that is usually felt strongly during abduction of the arm and dully at rest
Infraspinatus	Three located centrally in belly, under the spine of the scapula Fourth farther inferior and medial to the other three	Refer pain deep into anterior shoulder and possibly down the anterior and lateral aspect of the arm, lateral forearm, and radial aspect of the hand Refer to adjacent rhomboid area along the medial border of the scapula; may be difficult to distinguish from trapezius pain	All contribute to inability to internally rotate and adduct arm; can result in trouble sleeping

Trigger Points of the Shoulder Girdle *(Continued)*

Muscle	Trigger-Point Location	Referral Pattern	Chief Symptom
Teres minor	Midbelly along muscle and relatively prominent	Refers just proximal to deltoid tuberosity	Posterior shoulder pain that feels like inflamed bursa
Subscapularis	Two lateral points located above one another, with superior point lying inferior to the coracoid process and inferior point halfway up lateral border of scapula Medial point close to superior medial edge of the muscle	Posterior shoulder; spillover into posterior arm and elbow; strap-like area of pain that encircles the wrist, with the posterior side more painful than the anterior	Significant contributor to "frozen shoulder"; pain both at rest and in motion; initially, clients are able to reach forward but not backward; abduction becomes severely restricted
Latissimus dorsi	1. Superior portion of muscle at posterior axial fold 2. Midregion of the muscle	Pain down back of shoulder, along medial forearm to the ulnar side of hand Anterior shoulder and lateral aspect of the trunk over iliac crest	Constant aching to the inferior angle of the scapula and the surrounding thoracic region
Teres major	1. Medially along muscle near origin 2. Midmuscle in posterior axillary fold 3. Lateral musculocutaneous junction	Posterior shoulder and over the long head of the triceps	Pain primarily produced during movement and usually mild at rest
Deltoids	1. Anterior: along medial border, close to the cephalic vein 2. Middle: almost anywhere 3. Posterior: along lateral border of the muscle, closer to the insertion	Anterior: refer to the anterior deltoid; spillover into middle head Middle: refer central to the region with some spillover to adjacent areas Posterior: refer over posterior shoulder and possibly into the arms	Pain on shoulder motion; weakness on abduction

Trigger Points of the Shoulder Girdle *(Continued)*

Muscle	Trigger-Point Location	Referral Pattern	Chief Symptom
Serratus anterior	Middle of any of its digitations but usually at about the 5th or 6th rib along the midaxillary line	Anterolateral thorax; pain projected down inside of the arm to palm and ring finger; interscapular pain over the distal half of the scapula	Chest pain; shortness of breath
Biceps brachii	Midbelly in either head	Primarily in superior direction to front of shoulder; can also travel to suprascapular region and antecubital space	Pain during arm elevation above shoulder level; other presentations include aching over the anterior arm and possible weakness
Triceps brachii	1. Central belly of the long head of the muscle 2. Lateral portion of the medial head of the muscle 3. Lateral head 4. Attachment point created from other points 5. Medial portion of the medial head of the muscle	1. Upward over the posterior arm and shoulder, sometimes extending into the upper trapezius and down the posterior forearm 2. Lateral epicondyle of the elbow 3. Centrally around the point over the posterior arm; sometimes down the posterior forearm into the 4th and 5th fingers 4. Olecranon process 5. Medial forearm and palmar surface of the 4th and 5th fingers	Diffuse pain posteriorly in the shoulder and upper arm; can affect movement but is often overlooked by the client because of compensatory movements
Pectoralis major	1. Clavicular head of the muscle along lateral edge 2. Sternal portion of the muscle along midclavicular line 3. Lateral border of the muscle about halfway between origin and insertion 4. Medial sternum	1. Pain over anterior deltoid 2. Intense pain to anterior chest and down inner aspect of arm 3. Breast area; can cause tenderness and hypersensitivity of nipple and intolerance to clothing 4. Pain locally over sternum but will not cross over to the opposite side	Can be mistaken for a cardiac episode; associated with contributing to certain cardiac arrhythmias; interscapular back pain; pain in the anterior shoulder

Trigger Points of the Shoulder Girdle *(Continued)*

Muscle	Trigger-Point Location	Referral Pattern	Chief Symptom
	5. Only on the right side, just below 5th rib midway on line between sternal margin and nipple		
Pectoralis minor	1. In belly, close to insertion 2. In belly, close to the origin	Strongly over anterior deltoid and down the medial arm, forearm, and hand	Pain with no distinction between that of pectoralis major

Orthopedic Tests for the Shoulder Region

Condition	Orthopedic Test	How to Perform	Positive Sign
Shoulder impingement	Neer shoulder impingement test *Note:* With this particular arm position, the greater tuberosity of the humerus will be "jammed" into the anterior inferior acromion.	Client is in the seated position. Standing at the client's side, use one hand to stabilize the posterior shoulder and grasp the client's arm at the elbow with the other. Internally rotate the arm passively, and then flex it forcibly to its end range.	Pain with motion, especially at the end of the range, indicates a positive test. This also indicates a possible impingement of the supraspinatus or long head of the biceps tendon.
	Hawkins-Kennedy impingement test *Note:* This test will cause the greater tuberosity of the humerus to contact the anteroinferior surface of the acromion and the coracoacromial arch.	Client is in the seated position. Forward flex the shoulder to 90°, and bend the elbow to 90°. Keeping the shoulder at 90° of flexion, place one hand under the bent elbow to support the arm and place the other at the wrist. Horizontally adduct the arm slightly across the chest, being careful not to lower the arm, and internally rotate the shoulder.	Pain that occurs with this test may indicate shoulder impingement.
Rotator cuff tear	Empty-can test *Note:* This test is specifically for the supraspinatus.	Client is standing. Have the client abduct the arms to 90°. Standing in front of the client, horizontally adduct the arms 30° and internally rotate the arms so that the client's thumbs point toward the floor (empty-can position). Place your hands on the proximal forearms of the client, and apply downward force while the client resists.	Weakness or pain in the shoulder indicates a positive test and a possible tear of the supraspinatus tendon.
	Drop-arm test	Client is in the standing position with his or her arms at 90° of abduction. Instruct the client to slowly lower the arms down to the sides. An alternative test is to place the arms in 90° of abduction and apply downward force at the distal humerus while the client resists.	A positive test is indicated if the client cannot lower the arms smoothly or has increased pain during the motion.

Orthopedic Tests for the Shoulder Region *(Continued)*

Condition	Orthopedic Test	How to Perform	Positive Sign
			Alternative version: A test is positive if the client cannot hold an arm up and drops it to the side. If either variation of test elicits a positive result, this may be an indication of a more severe tear of the supraspinatus tendon.
Biceps tendonitis/tendonosis	Speed's test Note: This test was first described by J. Spencer Speed when he experienced pain in the proximal shoulder while he was performing a straight-leg-raise test on a patient. He was subsequently diagnosed with bicipital tendonitis, and the test has been used ever since (Bennett, 1998).	Have client flex the shoulder to 90° and fully extend the elbow. Place one hand on the bicipital groove and the other hand on the client's distal forearm. Force the client's arm into shoulder extension while he or she resists. *Note:* Placing the client's arm in this position and applying an eccentric load forces the biceps tendon to act as a suspensor cable from its insertion. Alternate method is to flex the client's arm to 60°. Resist forward flexion. *Note:* This position will create upward force and may cause the biceps tendon to impinge into the acromion or other structures, subsequently causing pain.	The presence of inflammation will cause pain, which is considered a positive sign. Alternate version: The presence of pain is considered a positive test.
	Yergason's test *Note:* Although both tests are helpful, Speed's test has shown to be more reliable at detecting pathology.	Have the client flex his or her elbow to 90° while keeping it stabilized against the chest and pronating the forearm. Place one hand on the client's forearm and instruct him or her to simultaneously supinate the forearm, externally rotate the shoulder, and flex the elbow while you resist.	Pain is an indicator of a positive test, as is the tendon snapping out of its groove.

Orthopedic Tests for the Shoulder Region *(Continued)*

Condition	Orthopedic Test	How to Perform	Positive Sign
Biceps tendon rupture	Ludington's test *Note:* This test is used for detecting a rupture in the tendon of the long head of the biceps.	Have the client clasp his or her hands on top of or behind the head, using the fingers to support the weight of the head. Place your fingers on the biceps tendon in the groove. Have the client alternately contract the biceps while you feel for the contraction.	There is likely a rupture if you do not feel a contraction, which is a positive sign.
Adhesive capsulitis	Apley's scratch test The test combines internal rotation with adduction and external rotation with abduction. *Note:* This test will provide valuable information about the functional capacity of the client and whether he or she can perform certain tasks.	Have the client reach behind his or her head and down the back as far as possible with one hand while you assess external rotation and abduction. Have the client reach up behind the back as far as possible while you assess internal rotation and adduction. Record the level for each hand and repeat for the opposite side.	Reduced range of motion that affects functioning is considered a positive test.