



## UPPER EXTREMITIES

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# The Shoulder Girdle—Dynamic Stability for the Shoulder Joint

## LEARNING OUTCOMES

After completing this chapter, you should be able to:

- 4-1** Define key terms.
- 4-2** Identify on the skeleton all bony landmarks of the shoulder girdle.
- 4-3** Label on a skeletal chart all bony landmarks of the shoulder girdle.
- 4-4** Draw on a skeletal chart the muscles of the shoulder girdle and indicate shoulder girdle movements using arrows.
- 4-5** Demonstrate all the movements of the shoulder girdle using a partner.
- 4-6** Palpate the bony landmarks of the shoulder girdle on a partner.
- 4-7** Give examples of agonists, antagonists, stabilizers, and synergists of the shoulder girdle muscles.
- 4-8** Explore the origins and insertions of shoulder girdle muscles on a partner.
- 4-9** Discuss the principles of different forms of stretching.
- 4-10** Practice basic stretching and strengthening appropriate for the shoulder girdle.

## KEY TERMS

Acromioclavicular	Clinical flexibility	Myotatic reflex arc	PNF stretching	Shoulder girdle
Active Isolated Stretching (AIS)	Clinical Flexibility and Therapeutic Exercise (CFTE)	Nerve compression	Rhomboid	Sternoclavicular
Brachial plexus	Flexibility	Nerve entrapment	Scapula	Stretching
Cervical plexus	Levator scapulae	Nerve impingements	Scapulothoracic	Subclavius
Clavicle		Pectoralis minor	Serratus anterior	Trapezius

## Introduction

Although the statement “He carries the weight of the world on his shoulders” is best understood metaphorically as a means of describing someone who assumes an enormous burden or level of responsibility, it certainly reflects the understanding that the shoulders have a fundamental purpose in

the body—to support the spine, neck, and head, as well as to provide a place for the upper extremities to attach. It is no wonder, then, that the shoulder girdle muscles often house chronic tension brought on by “the weight of the world.”

As its name indicates, the shoulder girdle surrounds the trunk and provides dynamic stability for the upper extremity to utilize its ball-and-socket

joint. Simple actions such as waving or fastening a seat belt would be impossible without the cooperation of the many shoulder girdle muscles. In addition to being the foundation of the shoulder joint, the shoulder girdle muscles all act independently to facilitate movements such as reaching for a glass or turning the wheel of a car. To perform these movements, the scapula must elevate and move in upward rotation, assisted by the contractions of the trapezius, serratus anterior, levator scapulae, and rhomboids. Without scapular movement, the shoulder's dynamic range would be extremely limited.

The posture of a kyphotic thoracic spine (rounded or extreme protraction of the shoulders) is common in the general population, as well as in massage therapists and Parkinson patients. The shoulder's antigravity muscles, particularly the rhomboids and trapezius, are designed to hold

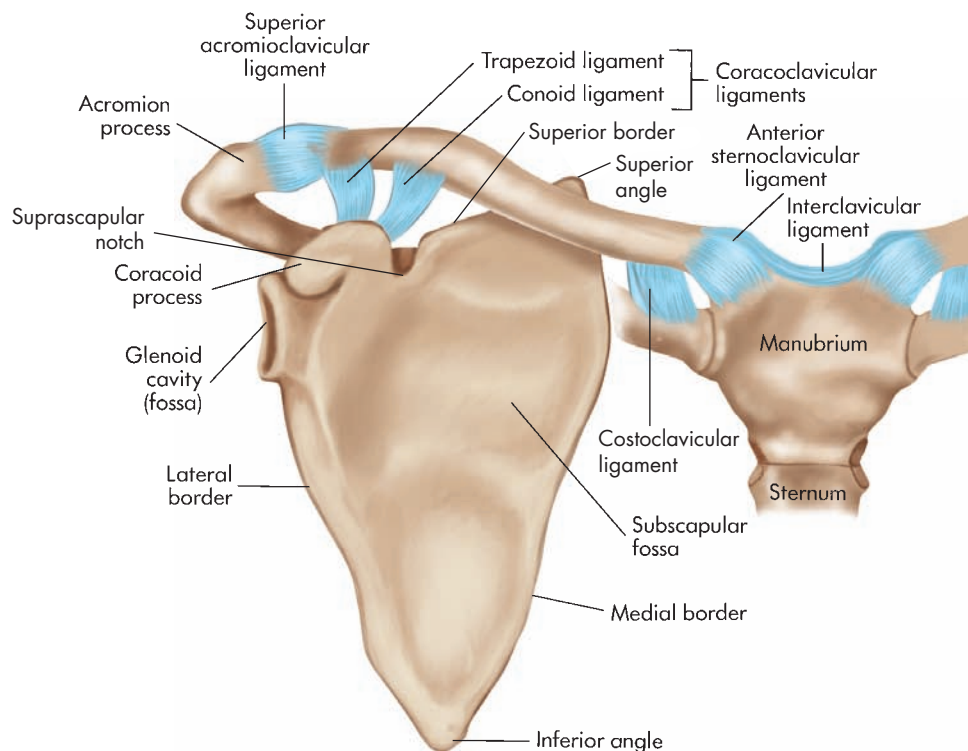
the shoulders in retraction as the body stands or sits in gravitational space. Unfortunately, these muscles often become lengthened and atrophied, unable to adequately perform scapular retraction. This is promoted by the additional workload that the body routinely places on their antagonists, the shoulder girdle protractors, which become disproportionately tighter and stronger. This uneven balance in the shoulder girdle muscles promotes poor posture and often affects the position of the head on the neck. Repetitive actions performed by the upper extremities, such as computer-related work, exhaust the shoulder girdle muscles, leading to fatigued and sore soft tissue.

Brief descriptions of the most important bones in the shoulder region will help students understand the skeletal structure and its relationship to the muscular system.

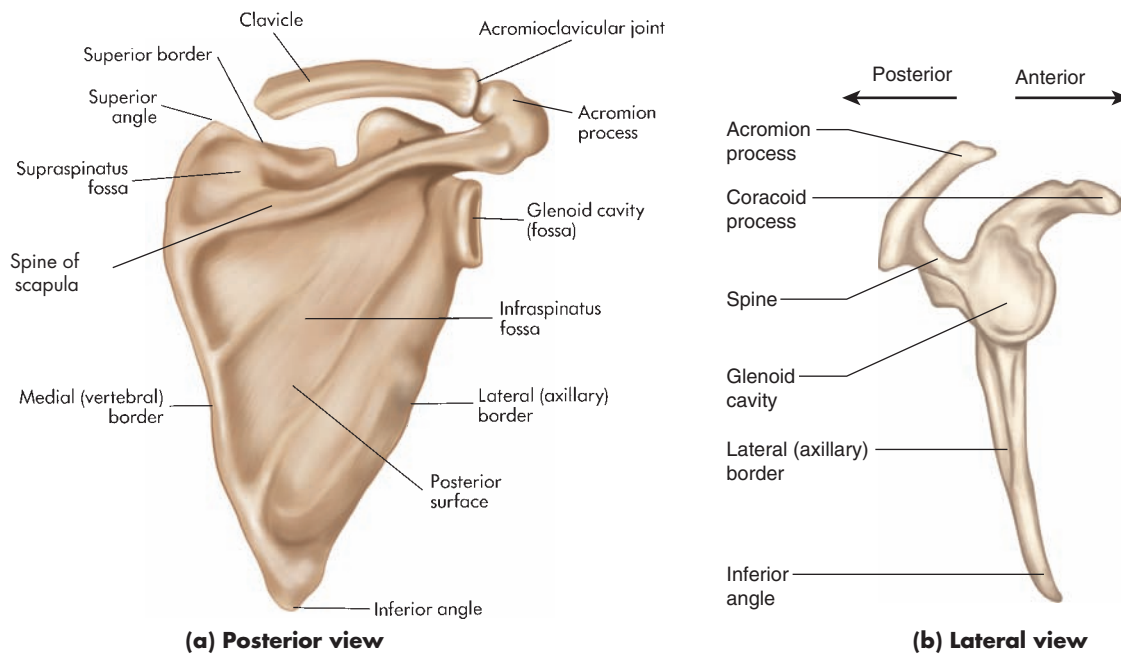
## Bones

The two bones primarily involved in movements of the **shoulder girdle** (figures 4.1 and 4.2) are the **scapula** and the **clavicle**, which together move as a unit. Their only bony link to the axial skeleton is

provided by the clavicle's articulation with the sternum. Key bony landmarks for studying the shoulder girdle are the manubrium, clavicle, coracoid process, acromion process, glenoid fossa, lateral border, inferior angle, medial border, superior angle, and spine of the scapula.



**FIGURE 4.1** Right shoulder girdle, anterior view



**FIGURE 4.2** Right scapula

## Joints

The scapula is actually embedded in muscles and is not physically attached to the rib cage. The movements of the shoulder girdle as the scapula moves in a variety of directions over the rib cage are described as **scapulothoracic** actions. The only two synovial joints are the *arthrodial* (gliding) **sternoclavicular** joint and the less mobile **acromioclavicular** joint. The scapula depends on the gliding actions of the sternoclavicular joint and acromioclavicular joint for its ability to move. (See figures 4.3 and 4.4.)

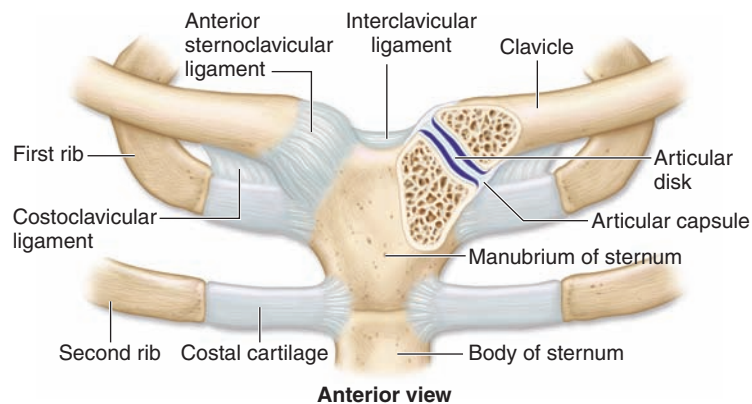
### STERNOCLAVICULAR

The sternoclavicular (SC) joint is classified as a (multiaxial) arthrodial joint. It moves anteriorly

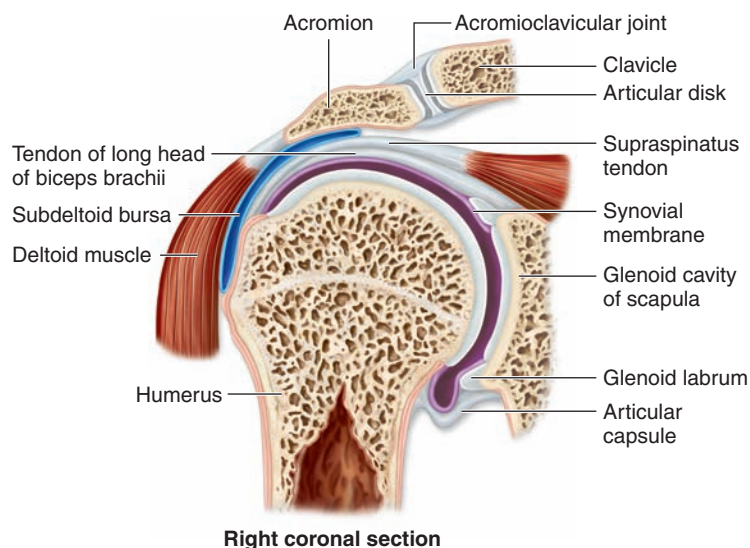
15 degrees with protraction and posteriorly 15 degrees with retraction. It moves superiorly 45 degrees with elevation and inferiorly 5 degrees with depression. Some clavicle rotation along its axis during various shoulder girdle movements results in a slight rotary gliding movement at the sternoclavicular joint. It is supported anteriorly by the anterior sternoclavicular ligament and posteriorly by the posterior ligament. Additionally, the costoclavicular and interclavicular ligaments provide stability against superior displacement.

### ACROMIOCLAVICULAR

The acromioclavicular (AC) joint is classified as an arthrodial joint. It has a 20- to 30-degree total gliding and rotational motion accompanying other



**FIGURE 4.3** Sternoclavicular joint



**FIGURE 4.4** Acromioclavicular joint

shoulder girdle and shoulder joint motions. In addition to the strong support provided by the coracoclavicular ligaments (trapezoid and conoid), the superior and inferior acromioclavicular ligaments provide stability to this often injured joint. The coracoclavicular joint, classified as a syndesmotice-type joint, functions through its ligaments to greatly increase the stability of the acromioclavicular joint.

## SCAPULOTHORACIC

The scapulothoracic joint is not a true synovial joint and does not have regular synovial features; its movement is totally dependent on the sternoclavicular and acromioclavicular joints. Even though scapula movement occurs as a result of motion at the SC and AC joints, the scapula has a total range of 25-degree abduction-adduction movement, 60-degree upward-downward rotation, and 55-degree elevation-depression. The scapulothoracic joint is supported dynamically by its muscles and lacks ligamentous support, since it has no synovial features.

There is no typical articulation between the anterior scapula and the posterior rib cage. Between these two osseous structures is the serratus anterior muscle, which originates off the upper nine ribs laterally and runs just behind the rib cage posteriorly to insert on the medial border of the scapula. Immediately posterior to the serratus anterior is the subscapularis muscle (see Chapter 6) on the anterior scapula.

## CLINICAL NOTES

### Scapulohumeral Rhythm

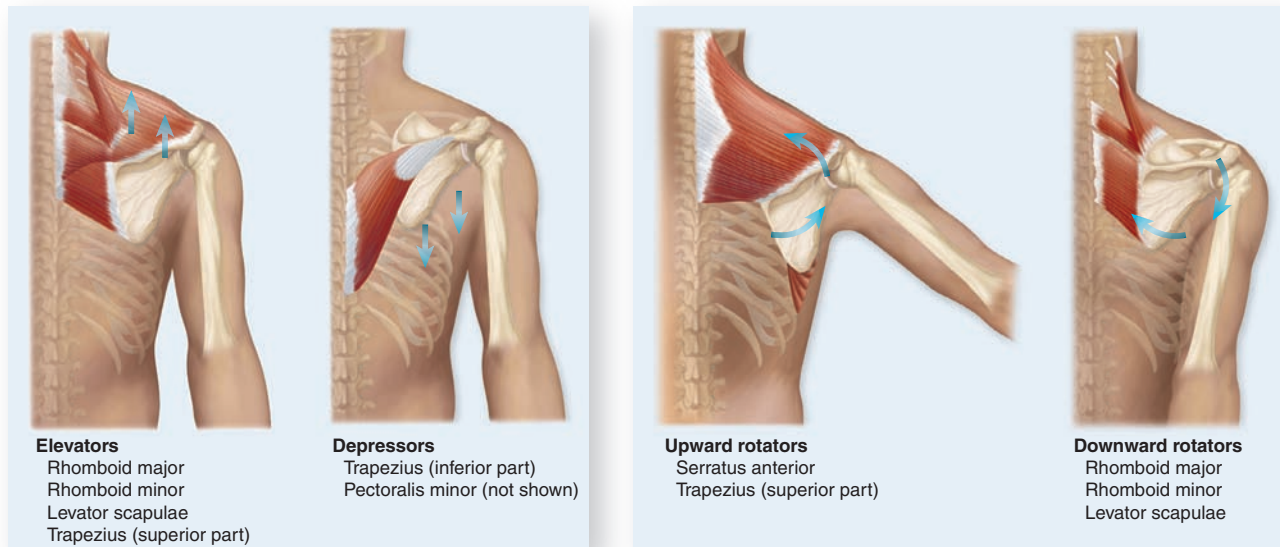
The scapulothoracic joint and its ability to move may be affected by the glenohumeral joint's free range of movement. For example, if the ball-and-socket joint is restricted in abduction, the glenohumeral adductors may develop shortened fibers and the scapulothoracic elevators and upward rotators may compensate with additional activity to assist in total overhead motion of the extremity. Similarly, if the scapulothoracic joint is restricted in movement such as retraction, the glenohumeral joint external rotators may become stretched to assist in moving the entire upper extremity behind the body. This synergistic movement of the scapulothoracic joint with the shoulder joint is known as the *scapulohumeral rhythm*. The scapulohumeral rhythm can be examined by observing the scapula's position as a person lifts the arm into abduction and flexion. This is discussed more later in the chapter.

## Movements

In analyzing shoulder girdle movements (figure 4.5), it is often helpful to focus on a specific scapular bony landmark, such as the inferior angle (posteriorly), the glenoid fossa (laterally), and the acromion process (anteriorly). All these movements have their pivotal point where the clavicle joins the sternum at the sternoclavicular joint. For palpation purposes, place two fingers on the sternoclavicular joint and repeat the movements; the gliding motion of the joint will be obvious.

Movements of the shoulder girdle can be described as movements of the scapula.





**FIGURE 4.5** Movements of shoulder girdle muscles



## FLEXIBILITY AND STRENGTH

### Movements of the Shoulder Girdle

#### Abduction (protraction)

Movement of the scapula laterally away from the spinal column, as in reaching for an object in front of the body.

#### Adduction (retraction)

Movement of the scapula medially toward the spinal column, as in pinching the shoulder blades together.

#### Upward rotation

Moving the inferior angle superiorly and laterally away from the spinal column and tipping the glenoid fossa upward, as in reaching overhead out to the side.

#### Downward rotation

Returning the inferior angle medially and inferiorly toward the spinal column and the glenoid fossa to its normal position. (Once the scapula has returned to its anatomical position, further downward rotation actually results in the superior angle moving slightly superomedial.)

#### Elevation

Upward or superior movement, as in shrugging the shoulders.

#### Depression

Downward or inferior movement, as in returning to a normal position from a shoulder shrug.

To accomplish some of the above-listed shoulder girdle movements, the scapula must rotate or tilt on its axis. Although they are not primary shoulder girdle

movements, these accessory movements are necessary for the scapula to move normally throughout its *range of motion (ROM)* during the movements.



## FLEXIBILITY AND STRENGTH

### Accessory Movements of the Scapula

#### Lateral tilt (outward tilt)

Consequential movement during abduction in which the scapula rotates around its vertical axis, resulting in posterior movement of the medial border and anterior movement of the lateral border (also known as “winging” of the scapula).

#### Medial tilt (inward tilt)

Return from lateral tilt; consequential movement during extreme adduction in which the scapula rotates around its vertical axis, resulting in anterior movement of the medial border and posterior movement of the lateral border.

#### Anterior tilt (upward tilt)

Consequential rotational movement of the scapula around the frontal axis that occurs during hyperextension of the glenohumeral joint, resulting in the superior border moving anteroinferiorly and the inferior angle moving posterosuperiorly.

#### Posterior tilt (downward tilt)

Consequential rotational movement of the scapula around the frontal axis that occurs during hyperflexion of the glenohumeral joint, resulting in the superior border moving posteroinferiorly and the inferior angle moving anterosuperiorly.

## SYNERGY WITH THE MUSCLES OF THE GLENOHUMERAL JOINT

The shoulder joint and shoulder girdle work together in performing upper-extremity activities. It is critical to understand that movement of the shoulder girdle is not dependent on the shoulder joint and its muscles. However, the shoulder girdle muscles are essential to providing a scapula-stabilizing effect; muscles of the shoulder joint must have a stable base from which to exert force for powerful movement involving the humerus. Consequently, the shoulder girdle muscles contract to maintain the scapula in a relatively static position during many shoulder joint actions.

As the shoulder joint goes through more extreme ranges of motion, the scapular muscles contract to move the shoulder girdle so that its glenoid fossa will be in a more appropriate position from which the humerus can move. Without the accompanying movement of the scapula, the humerus can raise only into approximately 90 degrees of total shoulder abduction and flexion. This scapulohumeral rhythm (see Clinical Notes, above) should work in a 2-to-1 ratio; for every 2 degrees of glenohumeral joint abduction or flexion, there is 1 degree of upward rotation at the scapulothoracic joint. Without this rhythm, the shoulder cannot move correctly. The appropriate muscles of both joints work cooperatively in synergy to accomplish the desired action of the entire upper extremity. For example, if a person abducts her hand out to the side laterally as high as possible, the serratus anterior and trapezius (middle and lower fibers) muscles upwardly rotate the scapula as the supraspinatus and deltoid initiate glenohumeral abduction. This synergy between the scapula and shoulder joint muscles enhances the movement of the entire upper extremity. If the shoulder joint muscles are not functioning to full capacity because of capsule inflammation, injury, or pathologic conditions, the shoulder girdle muscles are likely to shorten and further inhibit the movement of the scapula on the rib cage. Further discussion of the interaction and teamwork between these joints is provided at the beginning of Chapter 6, in Table 6.1, which lists the shoulder girdle movements that usually accompany shoulder joint movements.

### CLINICAL NOTES

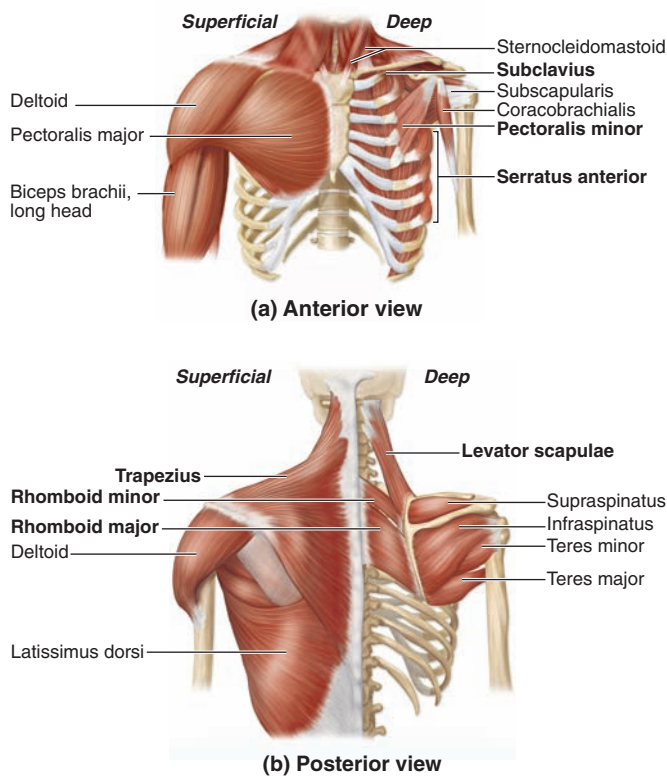
#### Possible Impingement

Even when the scapula has free range of motion, sometimes the head of the humerus comes into contact with the acromion. This can occur if arthritic conditions exist on the acromion and the already tight space becomes narrower. With the humerus

in about 90 degrees of abduction, this extreme position forces the head into the glenoid fossa. Impingement of the rotator cuff often occurs when the tendons of these muscles become inflamed. See Chapter 6 on the shoulder joint and rotator cuff for further details.

## Muscles

There are five muscles (figure 4.6) primarily involved in shoulder girdle movements. These muscles insert on the scapula and clavicle; all have origins on the axial skeleton. Shoulder girdle muscles do not attach to the humerus, nor do they cause actions of the shoulder joint, a key point for understanding the actions of either the shoulder girdle or the shoulder joint. The only shoulder joint muscles that insert on the humerus are those that initiate and complete actions with the humerus. Shoulder joint actions, however, impact the position of the scapula. As the humerus abducts, the scapula upwardly rotates so that the humerus can operate optimally in full range of motion. When the humerus adducts, the scapula rotates down into its anatomical position.



**FIGURE 4.6** Muscles that move the shoulder girdle, anterior and posterior views

The **pectoralis minor** and **subclavius** are located anteriorly in relation to the trunk. The subclavius muscle is a stabilizer and is not regarded as a primary mover in any shoulder girdle actions. The **serratus anterior** is located anteriorly to the scapula but posteriorly and laterally to the trunk. The **trapezius** (superficial), **rhomboid**, and **levator scapulae** are located posteriorly to the trunk.

The shoulder girdle muscles are essential in providing dynamic stability of the scapula and providing foundational support to all shoulder joint activities such as throwing a Frisbee, hitting a golf ball, shoveling snow, or raking leaves.

### Shoulder Girdle Muscles— Location and Action

#### MUSCLE SPECIFIC

#### Anterior

*Pectoralis minor:* abduction, downward rotation, and depression

*Subclavius:* stabilization of the sternoclavicular joint, depression; draws the clavicle forward as the scapula abducts

#### Posterior and laterally

*Serratus anterior:* abduction and upward rotation, stabilization of the scapula

#### Posterior

*Trapezius:*

*Upper fibers:* elevation and extension of the head, stabilization of the scapula

*Middle fibers:* elevation, adduction, and upward rotation, stabilization of the scapula

*Lower fibers:* adduction, depression, and upward rotation, stabilization of the scapula

*Rhomboid:* adduction and slight elevation as it adducts, downward rotation, stabilization of the scapula

*Levator scapulae:* elevation, stabilization of the scapula

It is important to understand that muscles may not necessarily be active throughout the full range of motion for which they are noted as agonists.

Table 4.1 provides a detailed breakdown of the muscles responsible for primary shoulder girdle movements.

## Nerves

The shoulder girdle muscles are innervated primarily from the nerves of the **cervical plexus** and **brachial plexus**, as illustrated in figures 4.7 and 4.8. The trapezius is innervated by the spinal accessory nerve and from branches of C3 and C4. In addition to supplying

the trapezius, C3 and C4 also innervate the levator scapulae. The levator scapulae receives further innervation from the dorsal scapula nerve originating from C5. The dorsal scapula nerve also innervates the rhomboid. The long thoracic nerve originates from C5, C6, and C7 and innervates the serratus anterior. The medial pectoral nerve arises from C8 and T1 to innervate the pectoralis minor.

### CLINICAL NOTES

### Possible Nerve Impingements

The brachial plexus is vulnerable to **nerve impingements**, or “pinched nerves,” from several perspectives. The bundles of nerves exit the cervical vertebrae in very specific, small areas. Osteoarthritis, a pathologic condition causing abnormal bony growth, can press on the nerves and cause **nerve compression**. Soft-tissue structures can apply pressure to nerves and cause **nerve entrapment**. Nerves that are compressed or entrapped from the brachial plexus adversely affect actions, soft-tissue tone, and strength in the entire upper extremity.

## Clinical Flexibility and Therapeutic Exercise

Since the muscular system is susceptible to various dysfunctions, it is important to maintain a healthy range of motion (ROM) within the joints, as well as optimal strength. When a joint has limited movement, other muscle groups usually compensate as the body attempts to correct the poor movement. For example, if the scapula cannot upwardly rotate with abduction and flexion of the shoulder, the upper trapezius will elevate the scapula in an attempt to move the humerus into abduction. **Clinical Flexibility and Therapeutic Exercise (CFTE)** is a modality composed of stretching and strengthening the muscles of the body. It is designed to improve human movement and prevent current or past dysfunctions from worsening. The discussion on CFTE exercises will start with the shoulder girdle muscles and will be interspersed throughout the remainder of the text. See Chapters 12 and 21 for upper- and lower-extremity exercises.

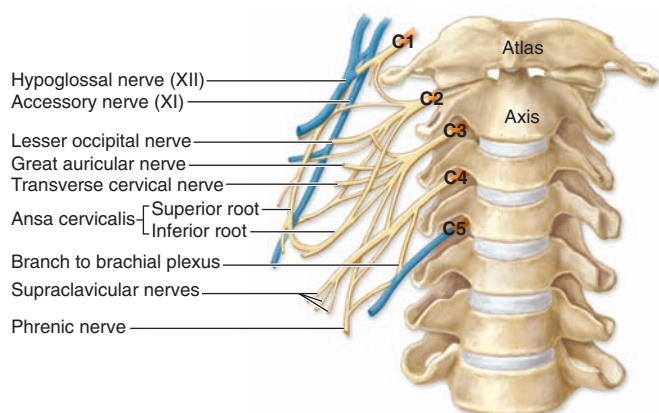
### BASIC STRETCHING IDEAS

The shoulder has a dynamic range of motion, and it allows the body to perform complex movements in sports and in daily living. To maintain this dynamic range and help prevent injuries, the shoulder must be stretched and strengthened. Muscles should always be stretched before any resistance is applied so that the

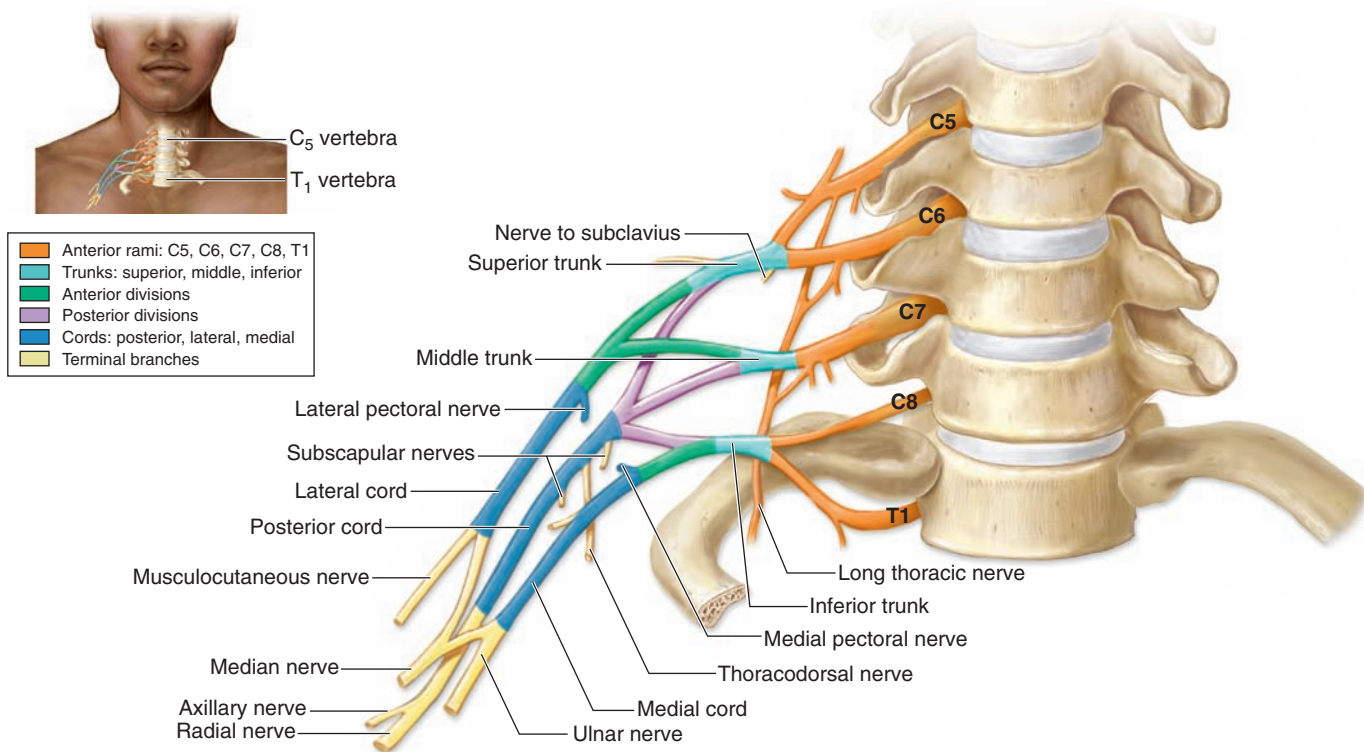


**TABLE 4.1** Agonist Muscles of the Shoulder Girdle

Name of Muscle	Origins	Insertion	Actions	Innervations
Trapezius	<i>Upper:</i> occiput, ligamentum nuchae <i>Middle:</i> spinous processes of C7, T1–T3 <i>Lower:</i> spinous processes of T4–T12	<i>Upper:</i> lateral clavicle <i>Middle:</i> spine of scapula, acromion <i>Lower:</i> root of spine of scapula	<i>Upper:</i> elevation, upward rotation of scapula <i>Middle:</i> adduction, elevation, upward rotation <i>Lower:</i> depression, upward rotation of scapula, and adduction bilateral extension of spine	Accessory nerve (CN XI), branches of C3, C4
Levator scapulae	C1–C4 transverse processes	Vertebral border of scapula (medial) from superior angle to root of spine	Elevation of scapula	Dorsal scapular nerve (C5, C4, and C3)
Rhomboid major	T2–T5 spinous processes	Vertebral border of scapula below root of spine	Adduction (retraction), elevation accompanying adduction, downward rotation of scapula	Dorsal scapular nerve (C5)
Rhomboid minor	C7, T1 spinous processes	Root of spine of scapula	Same	Same
Serratus anterior	Surface of the upper nine ribs at the side of the chest	Anterior aspect of the whole length of the medial border of scapula	Abduction, upward rotation	Long thoracic nerve (C5–C7)
Pectoralis minor	Anterior surfaces of the 3rd to 5th ribs	Coracoid process of scapula	Abduction, downward rotation as it abducts, depression from upward rotation	Medial pectoral nerve (C8–T1)
Subclavius	Superior aspect of 1st rib at its junction with its costal cartilage	Inferior groove in the midportion of clavicle	Stabilization of sternoclavicular joint, depression; draws clavicle down as shoulders abduct	Nerve fibers from C5 and C6

**FIGURE 4.7** Cervical plexus

muscle fibers will perform optimally for the task. The shoulder area is often overlooked in both a flexibility focus and a strength focus. While it is important to strengthen the larger, prime movers of the shoulder, restoring the smaller antigravity muscles is also vital. For example, if an individual is strengthening his pectoralis major twice per week, he must also strengthen the rhomboids, serratus anterior, and trapezius. Because of the large fibers and powerful forward pull the pectoralis has on the shoulders, the opposite muscles of the posterior shoulder will become lengthened when an imbalance is present. Yet the pectoralis must also be stretched to allow the shoulders to return to a neutral position.



**FIGURE 4.8** Brachial plexus

## Understanding Flexibility

Flexibility is an important component in sports and general fitness, and it should not be overlooked in the study of kinesiology. Increasing proper range of motion—the total movement of which a joint is capable—by increasing flexibility has been shown to help improve poor posture, increase sports performance, and reduce wear and tear on the joints. **Flexibility** is defined as the end motion of a segment, and it can occur by active contraction of the *agonist* (active range of motion) or by motion of an external force (passive range of motion). **Stretching** is taking a muscle in its resting length and expanding it. Ligaments, in their supportive roles as joint protectors, restrict range of motion and flexibility at the end movement. Someone who is “double-jointed” in the knee joint (also known as *genu recurvatum*), for example, has ligaments with greater amounts of plasticity that allow for more range of motion. Many factors, such as obesity, muscle imbalance, and hypertrophy, contribute to poor flexibility, but muscle tissue has the ability to increase its resting length if the correct flexibility protocols are followed.

Two of the main influences on flexibility are the physical length of the *antagonist* muscle and the neurologic innervation of the muscle being stretched. When a muscle is stretched, so is the muscle spindle, which records the change in length and how fast the

muscle is stretched. In a muscle stretch, there are two important neurologic properties to consider. To protect a muscle from being overstretched, a primary afferent neuron initiates a stretch reflex (**myotatic reflex arc**, see Chapter 2), which causes a contraction of the muscle being stretched. This mechanism fires in response to a stretch, and its response is proportional to the amount of force placed on the stretch. Because this reflex is so powerful, someone without adequate flexibility could easily cause injury to the muscle being stretched, especially if extreme force is applied into the stretch. This is one of the reasons ballistic stretching (see “Types of Flexibility,” below) is precarious at best. While some research suggests that muscle spindles habituate to new muscle lengths with specific training (which explains why certain yoga postures are possible), the chance of injury for most individuals, especially those with existing conditions, is greater if long holds or ballistic-type motions are used.

Another factor with a stretched muscle is the *Golgi tendon organ*, or *GTO* (see Chapter 2). The GTO response occurs mostly in an active stretch—when the knee is extended and the hamstrings are being lengthened, for example—and when pressure is applied to tendons. The GTO initiates an inverse stretch reflex, which relaxes the muscle being stretched. Again, this component is a safety valve so that the muscle being stretched is not injured from

excessive contraction of the myotatic reflex arc or lengthened muscle fibers.

## Types of Flexibility

### BALLISTIC STRETCHING

Ballistic stretching involves the use of bouncing or rhythmic motions to increase range of motion. It is sometimes employed in sports such as gymnastics and martial arts; however, it is rarely recommended in a health care setting because of its unsafe, forceful technique. Because of the nature of its forceful movement, the stretch reflex responds with dangerous contraction.

### PASSIVE STRETCHING

Passive stretching is often used in the health care field, particularly with stroke or paralysis patients or those whose injury prevents the use of an extremity. The movement is usually assisted by a therapist, and the individual makes no contribution or active contraction in carrying out the stretch. The hold at the end movement is generally 30 seconds to 1 minute in duration.

### STATIC STRETCHING

Static stretching is used in yoga and has been popularized by fitness programs. It is generally a slow stretch with holds of 10 to 30 seconds.

### PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION STRETCHING

**Proprioceptive neuromuscular facilitation (PNF) stretching** utilizes the components of muscle physiology to obtain an increased amount of flexibility in muscles. It also utilizes the fact that a muscle contraction is usually followed by relaxation of the opposite antagonistic muscle(s). Active PNF stretching involves taking a motion to its end point and then following that with a maximum isometric contraction of the counteracting muscles with resistance from a therapist. This is followed by a stretch that is usually held 10 to 30 seconds. Like many stretch protocols, PNF stretching techniques vary.

### ACTIVE ISOLATED STRETCHING

Active Isolated Stretching (AIS) is used in this text as part of the *Clinical Flexibility and Therapeutic Exercise* modality. While active stretching has been in existence for some time, the Active Isolated protocol used today was pioneered by kinesiologist Aaron L. Mattes and has become widely popular among clinicians, athletes, and the general public. **Active Isolated Stretching (AIS)** involves the use of the body's

natural movements (flexion, extension, rotation, etc.) and physiology to achieve greater range of motion. It uses the principles of Sherrington's law (reciprocal innervation, see Chapter 2) as well as short, 2-second holds. To achieve a stretch, an agonist muscle contracts to move a body segment, and the antagonist muscle is lengthened, held in a short stretch, and then returned to the starting position. This is repeated in repetitions, with several sets, depending on muscle tightness (see Chapter 12, Table 12.1). This method theorizes that the short holds do not violate the stretch reflex and therefore minimize muscle-tissue injury. Additionally, AIS movements are performed with the body in an advantageous position. For example, to lengthen the hamstring group, the body is supine, with no isometric contraction holding the body up in gravity. This allows the hamstring group to be lengthened in a relaxed state, without the interference of another contraction.

### THE IMPORTANCE OF “CLINICAL” FLEXIBILITY

**Clinical flexibility** is defined as stretching used in a clinical setting, and it is usually assisted by a therapist. A clinical setting is anywhere a health care provider works, whether an actual clinic, a hospital, or the client's home. Since physical therapists, athletic trainers, and massage therapists generally provide care for clients suffering from pain and injury issues, utilizing a safe stretching protocol helps prevent further injury and aids in recovery. There are many reasons that the AIS approach is best suited for the health care worker's toolbox:

1. The active component and client contribution increase blood flow, and muscle reeducation occurs with each repetition.
2. The method involves the use of natural joint movements and reciprocal innervation.
3. Short holds help avoid the myotatic reflex arc contraction. Less force is placed on injured areas.
4. AIS is easily taught to clients for self-care.
5. Specific isolation of muscle groups allows for dynamic stretching of dysfunctional areas.

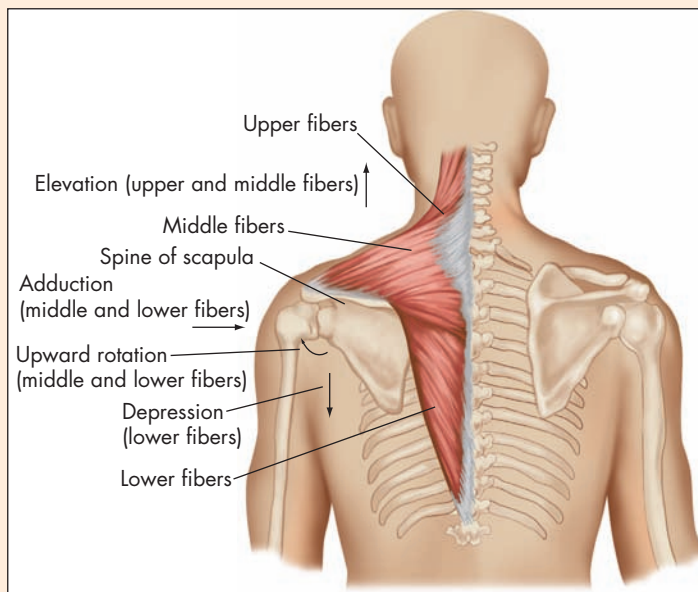
The exercises presented later in this chapter consist of upper-extremity AIS, followed by strengthening for the same muscles that were stretched (antagonists). This makes understanding the functional actions of the agonist and antagonist easier. Table 4.2 shows the protocol for performing AIS. It should be noted that these AIS exercises are presented mainly for students to attempt so that they can better understand functional anatomy and movement. These exercises can be shown to clients only if the clinician is within the scope of his or her practice.

**TABLE 4.2** Active Isolated Stretching Protocol

1. Use agonist muscles to stretch antagonists.
2. Perform 8 to 10 repetitions and 2 to 3 sets.
3. Return to the start position with each repetition.
4. Hold the stretch approximately 2 seconds.
5. Exhale on work phase; inhale on relaxation phase.
6. Position the body to perform the stretches comfortably, using core muscles to assist.

## Individual Muscles of the Shoulder Girdle

**OIAI MUSCLE CHART** TRAPEZIUS (tra-pe'zi-us) Named for its shape—irregular four-sided figure



Name of Muscle	Origins	Insertion	Actions	Innervations
Trapezius	<i>Upper:</i> occiput, ligamentum nuchae	<i>Upper:</i> lateral clavicle	<i>Upper:</i> elevation, upward rotation of scapula	Accessory nerve (CN XI), branches of C3, C4
	<i>Middle:</i> spinous processes of C7, T1–T3	<i>Middle:</i> spine of scapula, acromion	<i>Middle:</i> adduction, elevation, upward rotation	
	<i>Lower:</i> spinous processes of T4–T12	<i>Lower:</i> root of spine of scapula	<i>Lower:</i> depression, upward rotation of scapula, adduction  bilateral extension of spine	



## TRAPEZIUS MUSCLE

### Palpation

*Upper fibers:* The upper fibers can be palpated halfway between occipital protuberance to C6 and laterally to acromion, particularly during elevation and extension of the head at the neck. Lift the shoulder, and then place a thumb under the upper trap inserting at the clavicle and an index finger on top, effectively making a pincer palpation of the upper trapezius.

*Middle fibers:* The middle fibers can be palpated from C7 to T3 and laterally to acromion process and scapula spine, particularly during adduction.

*Lower fibers:* The lower fibers can be palpated from T4 to T12 and medial aspect of scapula spine, particularly during depression and adduction.

See Chapter 5 for additional palpation techniques and the location of the upper, middle, and lower trapezius.

### CLINICAL NOTES

#### Common Muscle Factors

The sternocleidomastoid and trapezius share the same innervation of the spinal accessory nerve. This is noteworthy, as these two muscles oppose each other in flexion and extension of the head. As paired opposites, the muscles are caught in balancing the head on the neck. If the head is in a prolonged head-forward posture, the sternocleidomastoid shortens and the upper trapezius endeavors to hang on to the posterior head attachment with other posterior cervical muscles. Also, the accessory nerve can become entrapped by the sternocleidomastoid fibers and, in turn, make the trapezius weak. This means that the practitioner must treat both the sternocleidomastoid and the trapezius to unwind the chronic tension in the upper and middle trapezius. The trapezius is often involved in stiff neck, flexion and extension whiplash, repetitive actions, head-forward posture positions, and compensatory changes due to injury. Stretching of all the neck muscles is helpful for establishing better blood flow.

### Muscle Specifics

Aptly named for its shape, the trapezius acts as its own all-in-one agonist and antagonist muscle. Thanks to its shape and attachments, the trapezius balances elevation with depression. Of the two actions, elevation is the stronger because it has to go against gravity and carry the extremities around as extra weight. The trapezius often has lengthened or stretched fibers, as the upper and middle trapezius may be kept in a constant state of elevation or shortening along with the levator

scapulae. Unilaterally, one side of the trapezius may be shortened if one extremity is injured and in a sling. The active extremity will torque on the ipsilateral side of the entire trapezius and shoulder girdle muscles, while the injured contralateral side will be passively shortened.

The upper fibers are a thin and relatively weak part of the muscle; however, the muscle is thick and twisted where it attaches to the clavicle. The muscle must spirally attach in this way so that the head can fully rotate to the opposite side. The fibers assist the middle trapezius and levator scapulae in clavicle elevation, as well as elevation and upward rotation of the scapula.

Due to their origin on the base of the skull, the upper fibers assist in bilateral head extension and unilateral rotation. Ipsilaterally, the trapezius laterally flexes the head.

The middle fibers are stronger and thicker, and they provide strong elevation, upward rotation, and scapular adduction (retraction). The middle fibers are stronger because they position the shoulder for function and posture. As a result, the area is often a source of tenderness, discomfort, and chronic tension, usually caused by head-forward postures, repetitive shortening of the upper and middle fibers, rounded shoulders, or the weight of the upper extremities pulling on the shoulder.

The lower fibers assist in adduction (retraction), depression, and upward rotation of the scapula. The area is typically weak, and the fibers often are lengthened or stretched, particularly in individuals whose posture and activities demand a significant amount of scapular abduction.

When all the parts of the trapezius are working together, they tend to pull upward and adduct at the same time. Fixation of the scapula for deltoid action is a typical function of the trapezius muscle. For example, continuous upward rotation of the scapula permits one to raise the arms over the head; the muscle always prevents the glenoid fossa from being pulled down when the arms are lifting objects; and the muscle action enables one to hold an object overhead. Holding the arm at the side horizontally shows typical fixation of the scapula by the trapezius muscle, while the deltoid muscle holds the arm in that position. The muscle is used strenuously when lifting with the hands, as in picking up the handlebars of a heavy wheelbarrow. The trapezius must prevent the scapula from being pulled downward. Awkward repetitive actions that require frequent reaching in front of the body will shorten the upper and middle trapezius as the scapula abducts, effectively lengthening the lower trapezius. Dental hygienists, computer operators, truck drivers, and landscapers can all lay claim to shortened upper and middle trapezius, abducted scapulae, and lengthened lower trapezius.

### Clinical Flexibility

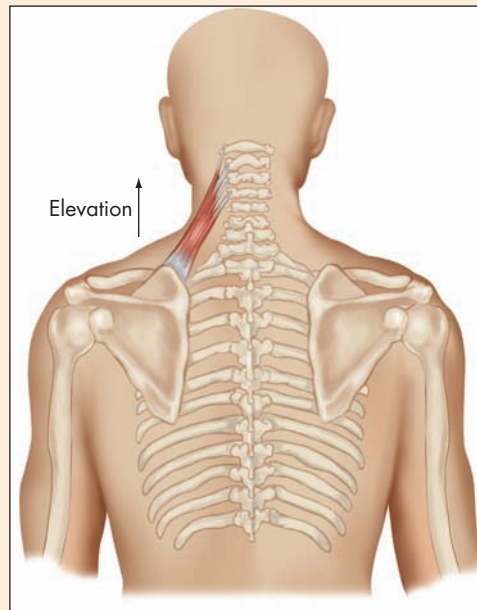
In stretching the trapezius, it is important to remember its attachments and functional actions. The most vital areas to stretch are the upper and middle fibers because of their antigravity functions and history of inflicting chronic tension. The cervical region also is affected by these fibers because of the close proximity of attachments to the occipital bone. Because the middle fibers attach to the medial border of the acromion and upper border of the scapula, and the lower fibers attach to the base of the scapular spine, it is necessary to consider scapular action in stretching these fibers. To stretch these fibers, the scapula must be *protracted*. To achieve this, bring the extended arm across the front of the body (horizontal adduction) just under the chin. Using the other hand, assist by pushing just proximal to the elbow. Apply a gentle stretch for 2 seconds; repeat 8 to 10 times. A variation of this movement that will cause the scapula to protract with rotation, thus increasing the stretch to

the trapezius and rhomboids, is to flex the elbow as it is brought across the body, reaching with the hand to the posterior contralateral shoulder; then apply the same gentle stretch. *Contraindications:* This exercise should be avoided with shoulder arthroplasty. Impingement, tendonitis, and other dysfunctions will benefit from this exercise, but movement must be slow and controlled.

### Strengthening

Strengthening the upper and middle fibers can be accomplished through a *forward-circle* shoulder-shrugging exercise that consists of a forward, up, and back sequence to cause scapular retraction. This exercise also helps strengthen the rhomboids at the same time. The middle and lower fibers can be strengthened through bent-over rowing and shoulder-joint horizontal abduction exercises from a prone position. See Chapter 12 for more information. *Contraindications:* These exercises are safe with controlled movement.

#### OIAI MUSCLE CHART LEVATOR SCAPULAE (le-va'tor scap'u-lae) The lifter



Name of Muscle	Origins	Insertion	Actions	Innervations
Levator scapulae	C1–C4 transverse processes	Vertebral border of scapula (medial) from superior angle to root of spine	Elevation of scapula	Dorsal scapular nerve (C5, C4, and C3)

## LEVATOR SCAPULAE MUSCLE

### Palpation

Deep to the trapezius, the levator scapulae is difficult to palpate posteriorly; it is best palpated at its insertion just medial to the superior angle of the scapula, particularly during slight elevation. Locate the insertion on the anterior scapula by approaching from under the middle and upper trapezius. For better access, passively shorten the upper and middle trapezius by lifting the inferior angle and elevating the scapula.

### CLINICAL NOTES

#### Common Problems

In addition to the upper and middle trapezius, the levator scapulae is a common site for tightness, tenderness, discomfort, and chronic-tension (stiff-neck) conditions. Poor body mechanics such as head-forward posture, a nonergonomic computer station, and excessive lateral head tilt with a phone can contribute to dysfunction.

### Muscle Specifics

The levator scapulae acts as a bilateral guy wire that runs from the upper four vertebrae to the scapula. If head movement is compromised or the muscle is shortened in any way, it upsets the balance with its connections to the transverse processes of C1, which it can easily rotate. It is important for therapists to remember this relationship when planning to release muscles prior to manipulation by another appropriate health care professional.

### Clinical Flexibility

To stretch the levator scapulae, perform the same horizontal adduction stretch as that for the trapezius. Also, since the muscle has attachments along the cervical spine, the head can be moved contralaterally to facilitate a good stretch. Start with the head in the neutral position, eyes straight ahead. Leave one hand above the head to help assist in the stretch. Move the head in lateral flexion to the opposite shoulder, and apply a gentle stretch using the other hand. Return to the neutral position, and repeat 8 to 10 times. *Contraindications:* Use caution with cervical herniations.

### Strengthening

Shrugging the shoulders involves the levator scapulae muscle, along with the upper and middle trapezius. Since fixation of the scapula by the pectoralis minor muscle allows the levator scapulae muscles on both sides to extend the neck or to flex it unilaterally, the levator scapulae should be strengthened the same way

it is stretched—by flexion and extension of the neck. For the flexors, lie on one side, with head and arm off a therapy table or bed. Begin the movement with the lower ear toward the ground (lateral flexion). Lift the head into flexion to the opposite shoulder, and then gently return to the lower position. Extension can be performed in the prone position, lifting the head back into extension. Repeat 8 to 10 times. *Contraindications:* Use caution with disk herniations.

## RHOMBOID MUSCLES: MAJOR AND MINOR

### Palpation

Deep to the trapezius are the rhomboids. Though difficult, they may be palpated through the relaxed trapezius during adduction. This is best accomplished by placing the client's ipsilateral hand behind the back (glenohumeral medial rotation and scapula downward rotation), as this relaxes the trapezius and brings the rhomboid into action when the client lifts the hand away from the back. The rhomboid major makes a small triangle that is visible and superficial just medial to the inferior angle of the scapula. The lower trapezius slopes away from the scapula in its angle from the root of the spine to the spinous processes of the vertebrae.

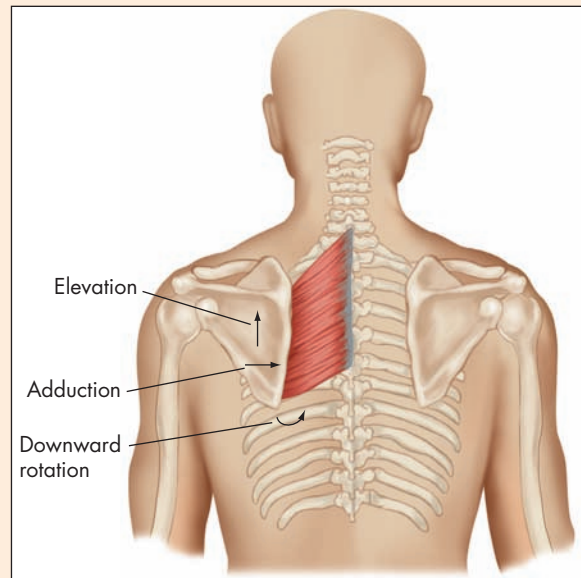
### CLINICAL NOTES

#### Postural Problems

Rounded shoulders may lead to a superficial ache in the rhomboids, particularly in the trigger points located around the medial border of the scapula. While the pectoralis minor and serratus anterior lock and hold the scapulae in abduction, the rhomboids in turn lengthen. Since the rhomboids are often weak, this muscle struggles to pull the scapulae back into an adducted position. This posture often leads to a head-forward position, causing torque and anterior wedging on the cervical and midthoracic vertebrae. Self-care could include using a tennis ball for ischemic compression, creating ergonomically correct computer stations, and maintaining postural awareness. A lumbar pillow can help support the upper body and maintain the curve in the lower back. The rhomboids should also be strengthened on a weekly basis, and the pectoralis minor and major should be stretched to facilitate scapular retraction.

### Muscle Specifics

In the average person, the rhomboid muscles spend a disproportionate amount of time in lengthened (stretched) positions. The rounded-shoulder posture usually starts in elementary school, where heavy backpacks increase thoracic kyphosis. Because the rhomboids are antigavity muscles, and the opposite pectoralis major is developed and powerful, the

**OIAI MUSCLE CHART** RHOMBOIDS MAJOR AND MINOR (rom 'boyd) Bilateral Christmas tree; means "diamond shaped"

Name of Muscle	Origins	Insertion	Actions	Innervations
Rhomboid major	T2–T5 spinous processes	Vertebral border of scapula below root of spine	Adduction (retraction), elevation accompanying adduction, downward rotation of scapula	Dorsal scapular nerve (C5)
Rhomboid minor	C7, T1 spinous processes	Root of spine of scapula	Same	Same

rhomboids tend to become lengthened and atrophied. In a fitness program, they are one of the most overlooked muscles to strengthen because they lose favor over the “shapely” prime movers.

### Clinical Flexibility

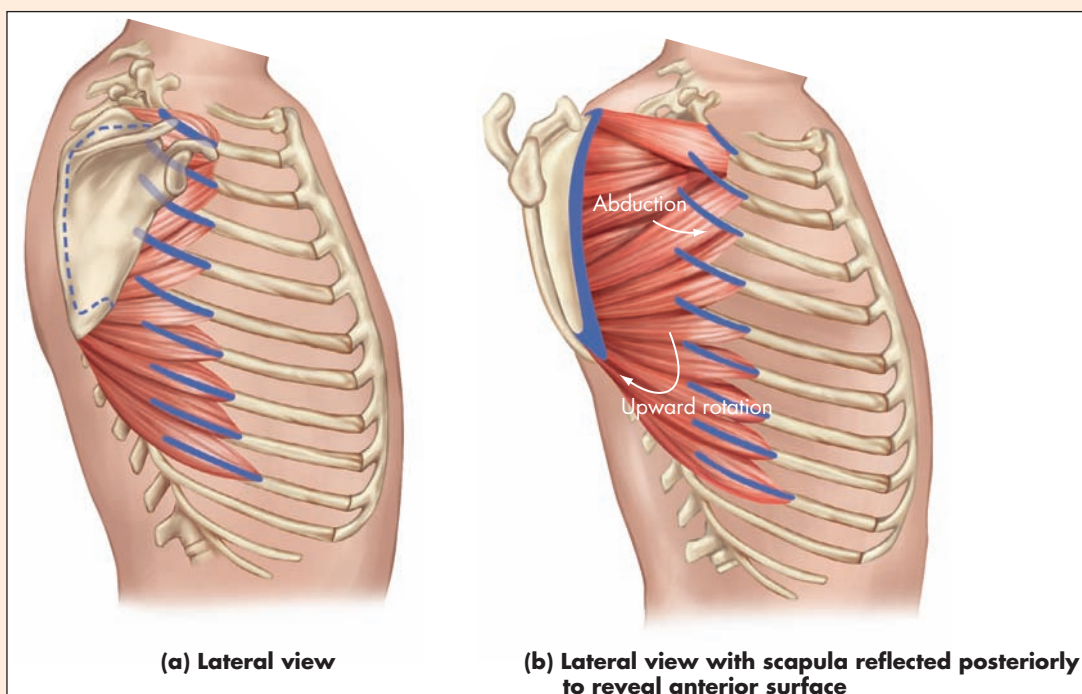
The rhomboids are extremely important muscles to stretch. Since their pain patterns are wide, often spreading into the occipital area or down the lower back, stretching can help restore blood flow and release trigger or energy points. The rhomboids are scapular retractors and therefore must be stretched with scapular *protraction*. The horizontal adduction stretches are excellent for this, as the rhomboids are stretched by passively moving the scapula into full protraction while maintaining depression. *Contraindications:* These stretches should be avoided with shoulder arthroplasty. Impingement, tendonitis, and

other dysfunctions will benefit from this exercise, but movement must be slow and controlled.

### Strengthening

The rhomboid muscles fix the scapula in adduction (retraction) when the shoulder joint muscles adduct or extend the arm. These muscles are used powerfully during chin-up exercises. As one hangs from the horizontal bar, suspended by the hands, the scapula pulls away from the top of the chest. When the chin-up movement begins, the rhomboid muscles rotate the medial border of the scapula down and back toward the spinal column. The rhomboid also works in a similar manner to prevent scapula winging. The trapezius and rhomboid muscles working together produce adduction with slight elevation of the scapula. The latissimus dorsi muscle opposes this action, as it adducts or extends the humerus.



**OIAI MUSCLE CHART** SERRATUS ANTERIOR (ser-a'tus an-tir'e-or) Named for shape and location—the saw in front

Name of Muscle	Origins	Insertion	Actions	Innervations
Serratus anterior	Surface of the upper nine ribs at the side of the chest	Anterior aspect of the whole length of the medial border of scapula	Abduction, upward rotation	Long thoracic nerve (C5–C7)

The rhomboids must be isolated in order to strengthen them. In the prone position on an exercise bench, with arms off the edge, hold dumbbells; then flex the elbows and wrist to form a “ball.” With the head lowered completely so that there is no action in the upper trapezius, bring the elbows back as the scapula is retracted very tightly and hold for 2 seconds; then lower the weight to the starting position. Repeat 8 to 10 times. To see photos of this exercise, see Chapter 12. *Contraindications:* This exercise is generally safe with controlled movement.

### SERRATUS ANTERIOR MUSCLE

#### Palpation

Palpate the serratus anterior on the front and lateral side of the chest below the 5th and 6th ribs just proximal to their origin during abduction, which is best accomplished from a supine position with the glenohumeral joint in 90 degrees of flexion. The upper

fibers may be palpated in the same position between the lateral borders of the pectoralis major and latissimus dorsi in the axilla. See the side-lying techniques in Chapter 7 to locate and palpate the serratus anterior easily.

#### CLINICAL NOTES

#### Painful Actions of the Serratus Anterior

Often forgotten as an accessory respiratory muscle, the serratus anterior comes from the upper nine ribs and thus interdigitates with the external oblique. Any actions that preclude abducted shoulder positions may shorten serratus anterior fibers. Running, scrubbing floors, and even repetitive massage techniques can lead to debilitating myofascial pain in the serratus anterior that could refer down the upper extremity. A point of tenderness is often found in the axilla region between the ribs. The serratus anterior is easily accessed in a side-lying position. See Chapter 7 for positions and techniques.

### Muscle Specifics

Named for its shape, the serratus anterior muscle is used commonly in movements drawing the scapula forward with slight upward rotation, such as throwing a baseball, punching in boxing, shooting and guarding in basketball, and tackling in football. As a shoulder girdle anterior stabilizer, it helps prevent winging of the scapula. For this reason, it should not be overlooked in a strength and stretching program.

### Clinical Flexibility

The serratus anterior can be stretched by reversing its action. Since it abducts the scapula, it can be stretched by causing the scapula to adduct. With arms at the sides in the fundamental position, lift one arm into abduction with the palms turned out, continuing into sideward elevation, with the arm passing just behind the head. Use the opposite hand to help stretch by pulling at the elbow for 2 seconds. Repeat 8 to 10 times. *Contraindications:* Impingement, tendonitis, and other dysfunctions will benefit from this exercise, but movement must be slow and controlled.

### Strengthening

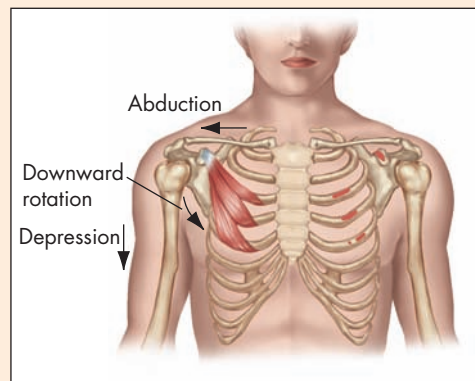
The serratus anterior muscle is used strongly in doing push-ups, especially in the last 5 to 10 degrees of motion. The bench press and overhead press are good exercises for this muscle. A winged scapular condition (lateral tilt of the scapula) usually results from weakness of the rhomboid or the serratus anterior. Serratus anterior weakness may result from an injury to the long thoracic nerve. Another way to strengthen this muscle is to lie on the floor supine, arms extended in front holding 5-pound weights. Keeping the arms extended, push up to the ceiling, protracting the scapula all the way. Repeat 8 to 10 times. *Contraindications:* These exercises are generally safe with controlled movement.

## PECTORALIS MINOR MUSCLE

### Palpation

The pectoralis minor is difficult to palpate, but it can be palpated under the pectoralis major muscle and just inferior to the coracoid process during resisted depression. This may be enhanced by placing the client's hand behind the back and having her actively lift the hand away, which brings the protractors into action.

### OIAI MUSCLE CHART PECTORALIS MINOR (pek-to-ra'lis mi'nor) Brachial plexus entrapper—*pectus* means "chest"



Name of Muscle	Origins	Insertion	Actions	Innervations
Pectoralis minor	Anterior surfaces of 3rd to 5th ribs	Coracoid process of scapula	Abduction, downward rotation as it abducts, depression from upward rotation	Medial pectoral nerve (C8–T1)

**CLINICAL NOTES**

**Entrapment of the Brachial Plexus**

Sometimes people experience numbness or tingling in either parts of or the entire upper extremity if they sleep with the arm positioned over the head all night. The large nerve structure of the brachial plexus runs under the tendinous attachment of the pectoralis minor at the coracoid process. If the upper extremity is placed over the head, this position may be conducive to entrapping the brachial plexus, particularly the lateral cord that leads into the median nerve as well as the axillary artery, possibly diminishing a pulse at the wrist. In addition to sleeping in this position, incorrectly wearing an overly laden backpack compresses the pectoralis minor and can entrap the brachial plexus. Stretching the pectoralis minor and major can help “open” the thoracic space and is very helpful for thoracic outlet syndrome.

**Muscle Specifics**

The pectoralis minor muscle is used, along with the serratus anterior muscle, in true abduction (protraction) of the scapula without rotation, particularly in movements such as push-ups or rounding the shoulders. The serratus anterior draws the scapula forward with a tendency toward upward rotation, and the pectoralis minor pulls the scapula forward with a tendency toward downward rotation. The two pulling together give true abduction, which is necessary

in many humeral flexed positions such as push-ups. These muscles work together in most movements that involve pushing with the hands.

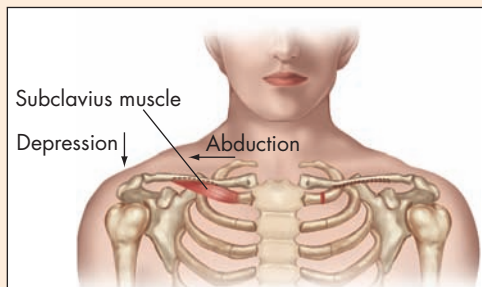
**Clinical Flexibility**

The pectoralis minor is most used in depressing and rotating the scapula downward from an upwardly rotated position, as in pushing the body upward on dip bars. The pectoralis minor is often tight due to overuse in activities involving abduction, such as gardening or working at a desk. The result is often forward and rounded shoulders. It is also involved in thoracic kyphotic patterns and brachial plexus dysfunctions. To stretch the pectoralis minor, lift both arms up in flexion, palms facing each other, to about a 90-degree angle. Using the muscles on the posterior upper back, bring the arms back into horizontal abduction. The scapulae should retract in this movement. As you lift back, tighten the abdominals to prevent back hyperextension. Hold for 2 seconds, and repeat 8 to 10 times. *Contraindications:* Shoulder arthroplasty patients; client should move into only 70 degrees of horizontal abduction. Impingement, tendonitis, and other dysfunctions will benefit from this exercise, but movement must be slow and controlled.

**Strengthening**

The pectoralis minor can be strengthened by a standard chest fly, except the angle of the arms must be

**OIAI MUSCLE CHART** SUBCLAVIUS (sub-klá-ve-us) The stabilizer below the clavicle



Name of Muscle	Origins	Insertion	Actions	Innervations
Subclavius	Superior aspect of 1st rib at its junction with its costal cartilage	Inferior groove in the midportion of clavicle	Stabilization of sternoclavicular joint, depression; draws clavicle down as shoulders abduct	Nerve fibers from C5 and C6

changed to better isolate the pectoralis minor. Lying supine on the floor or table with the arms flexed in front of the chest, bring the weight slowly out to the sides (horizontal abduction), keeping a 90-degree angle on the arms. Slowly return to the starting position. Repeat 8 to 10 times. *Contraindications:* This exercise is generally safe with controlled movement.

## SUBCLAVIUS MUSCLE

### Palpation

The subclavius is difficult to distinguish from the pectoralis major, but it may be palpated just inferior to the middle third of the clavicle with the client in the side-lying position. The clavicle is in an upward-rotated position, and the humerus is supported in a partially, passively flexed position. Slight active depression and abduction of the scapula may enhance palpation.

### CLINICAL NOTES

#### Subclavius—the Stabilizer

Although the subclavius is not a major prime mover, its stabilizing feature makes it a working muscle that almost never rests. If the scapulae are abducted and perpetuated in rounded shoulders, the subclavius fibers may shorten and develop trigger points with a painful referred pattern. This pattern might refer down the upper extremity distally toward the hand and wrist.

### Muscle Specifics

The subclavius pulls the clavicle anteriorly and inferiorly toward the sternum. In addition to assisting in abduction and depression of the clavicle and the shoulder girdle, it has a significant role in protecting and stabilizing the sternoclavicular joint during upper-extremity movements.

### Clinical Flexibility

The subclavius muscle can be stretched much like stretching the pectoralis minor, by starting with the arms flexed in front of the chest, palms facing each other. Using the muscles on the posterior shoulder, retract the scapula and bring the arms back into horizontal abduction. Hold 2 seconds, and repeat 8 to 10 times. This stretch also targets the pectoralis major. *Contraindications:* This exercise is generally safe with controlled movement.

### Strengthening

The subclavius may be strengthened during activities in which there is active depression, such as dips, or active abduction, such as push-ups. A standard fly (explained earlier) is an effective way to strengthen this muscle. *Contraindications:* This exercise is generally safe with controlled movement.

## CHAPTER summary

### Introduction

- ✓ The shoulder girdle is a two-bone structure that surrounds the axial skeleton and provides dynamic stability for the shoulder joint.

### Bones

- ✓ The two bones that make up the shoulder girdle are the clavicle and the scapula. Bony landmarks provide attachments for muscles to pull on and cause movement when contracting.

### Joints

- ✓ The sternoclavicular joint is a gliding articulation that is formed by the sternum and the clavicle. The acromioclavicular joint is also a gliding joint, but with less motion than the sternoclavicular joint. The scapulothoracic joint is not a true synovial joint but moves over the rib cage with contractions of its muscles.

### Movements

- ✓ The movements of the shoulder girdle include elevation, depression, abduction (protraction), adduction (retraction), upward rotation, and downward rotation. There are accessory tilt movements as well.
- ✓ The shoulder joint and shoulder girdle work together in performing upper-extremity activities. It is critical to understand that movement of the shoulder girdle is not dependent on the shoulder joint and its muscles.

### Muscles

- ✓ The pectoralis minor, subclavius, and serratus anterior are located anteriorly, while the trapezius, rhomboids, and levator scapulae are located posteriorly.

### Nerves

- ✓ The nerves for the shoulder girdle muscles stem primarily from the cervical plexus and brachial plexus.



### Clinical Flexibility and Therapeutic Exercise

- ✓ The shoulder girdle muscles should be stretched and strengthened to help maintain their dynamic range of movement.
- ✓ Muscles should always be stretched before any resistance is applied.
- ✓ Strengthening the antigavity muscles of the shoulder is necessary to facilitate proper scapular movement.
- ✓ The synergistic movement in the shoulder joint between the glenohumeral joint and the scapulothoracic joint is known as the *scapulohumeral rhythm*.

### Understanding Flexibility

- ✓ Flexibility is an important component in sports and general fitness, and it should not be overlooked in the study of kinesiology.
- ✓ Proper range of motion by increased flexibility has been shown to help poor posture, increase sports performance, and reduce wear and tear on joints.
- ✓ Flexibility is defined as the end motion of a segment, and it can occur by active contraction of the agonist (active range of motion) or by motion of an external force (passive range of motion).
- ✓ To protect a muscle from being overstretched, a primary afferent neuron initiates a stretch reflex (myotatic reflex arc, see Chapter 2), which causes a contraction of the muscle being stretched.
- ✓ This mechanism has been measured to fire after 1 to 2 seconds of a stretch hold, and its response is proportional to the amount of force placed on the stretch.
- ✓ Another important component of a stretched muscle is the Golgi tendon organ, or GTO (see Chapter 2).
- ✓ The GTO response occurs mostly in an active stretch, such as when the knee is extended and the hamstrings are being lengthened, and when pressure is applied to tendons.
- ✓ The GTO initiates an inverse stretch reflex, which relaxes the muscle being stretched.

### Types of Flexibility

- ✓ There are many different types of stretching; these include ballistic, passive, static, proprioceptive neuromuscular facilitation (PNF), and Active Isolated Stretching (AIS).
- ✓ Active Isolated Stretching is used in this text as part of the *Clinical Flexibility and Therapeutic Exercise* modality.
- ✓ Active Isolated Stretching involves the use of the body's natural movements and physiology to achieve greater range of motion.

- ✓ AIS uses the principle of reciprocal innervation (Sherrington's law, see Chapter 3) as well as short, 2-second holds.
- ✓ To achieve a stretch in AIS, an agonist muscle contracts to move a body segment; then the antagonist muscle is lengthened, held in a 2-second stretch, and then returned to the start position.
- ✓ Clinical flexibility is defined as flexibility used in a clinical setting, and it is usually assisted by a therapist.
- ✓ A clinical setting can be anywhere a health care provider might work, whether it is a clinic, a hospital, or a client's home.
- ✓ Since physical therapists, athletic trainers, and massage therapists usually provide care for clients with pain and injury issues, utilizing a safe stretching protocol helps prevent further injury and aids in recovery.
- ✓ There are many reasons that the AIS approach is best suited for the clinic or the health care worker's toolbox.

### Individual Muscles of the Shoulder Girdle

- ✓ *Trapezius* is a four-sided superficial posterior muscle that is divided into three sections: upper, middle, and lower. The trapezius lifts and depresses the clavicle and scapula and adducts and upwardly rotates the scapula. Bilaterally it extends the head, and unilaterally it can rotate and laterally flex the head to the ipsilateral side.
- ✓ *Levator scapulae* lifts the scapula. It lies underneath the trapezius and spans from the cervical vertebrae to the superior angle of the scapula.
- ✓ *Rhomboids*, major and minor, are deep to the trapezius. Shaped like a bilateral Christmas tree, the rhomboids connect the spinous processes of the thoracic spine to the vertebral edge of the scapula. Their major functions are adduction and downward rotation.
- ✓ *Serratus anterior* runs from the upper nine ribs and inserts into the anterior medial scapula. It abducts and upwardly rotates the scapula. Serratus anterior is also an accessory muscle of respiration.
- ✓ *Pectoralis minor* is an anterior muscle that originates on the ribs and inserts on the coracoid process of the scapula. It abducts and depresses the scapula. Pectoralis minor is an accessory respiratory muscle.
- ✓ *Subclavius* is a stabilizer and protects the sternoclavicular joint.

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# CHAPTER review

## Worksheet Exercises

As an aid to learning, for in-class or out-of-class assignments, or for testing, tear-out worksheets are found at the end of the text, page 000.

## True or False

Write true or false after each statement.

1. The bones of the shoulder girdle include the tibia, clavicle, and humerus.
2. For the shoulder girdle bones to move, the muscles must insert on the ulna.
3. The pectoralis minor and serratus anterior are the primary abductors of the scapula for the shoulder girdle.
4. The trapezius acts as its own agonist and antagonist with the actions of elevation and depression.
5. The scapulothoracic joint is a true synovial joint.
6. The acromioclavicular joint is an arthrodiar (gliding) joint.
7. The levator scapulae and the lower trapezius lift the scapula.
8. The rhomboids insert on the medial border of the scapula.
9. The serratus anterior originates on the upper nine ribs.
10. The subclavius is more of a stabilizer muscle for the shoulder girdle than a prime mover.
11. Strengthening the rhomboids will help correct rounded-shoulder posture.
12. By stretching the neck in lateral flexion, one can help stretch the levator scapulae.

## Short Answers

Write your answers on the lines provided.

1. Name the muscles that adduct the scapula.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. Name the gliding joint that connects the clavicle to the sternum.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. What is the joint called that connects the clavicle to the scapula?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. Why do you use the serratus anterior when you flex your upper extremity in front of the body?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. Name the muscles that elevate the scapula.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. Name the origin of the pectoralis minor.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. What nerve structure might be entrapped by the pectoralis minor?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. Name the insertion of the lower trapezius.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. Name the origin of the levator scapulae.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. What is the action of the lower trapezius that is the antagonist for the upper trapezius?

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11. Name three muscles that affect posture on the posterior shoulder.

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12. Describe the agonist and antagonist of horizontal flexion.

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### Multiple Choice

Circle the correct answers.

1. The muscle(s) that stabilizes the sternoclavicular joint, assists in depression, and draws the clavicle down as the shoulders abduct is the:

- a. pectoralis minor
- b. subclavius
- c. trapezius
- d. rhomboids

2. The muscle(s) that often lengthens with a rounded-shoulder posture is the:

- a. serratus anterior
- b. upper trapezius
- c. rhomboids
- d. pectoralis minor

3. Pectoralis minor inserts on the:

- a. coracoid process
- b. styloid process
- c. anterior ribs 3 to 5
- d. clavicle

4. The actions of the serratus anterior are:

- a. adduction and elevation
- b. elevation and depression
- c. abduction and upward rotation
- d. downward rotation and adduction

Stiff neck muscles could be:

- e. the levator scapulae and upper trapezius
- f. the pectoralis minor and upper trapezius
- g. the levator scapulae and rhomboids
- h. none of the above

5. The origin of the rhomboid minor is the:

- a. transverse processes of C1–C4
- b. spinous processes of C7 and T1
- c. vertebral border of the scapula
- d. root of the spine of the scapula

6. The trapezius can contract bilaterally to cause:

- a. flexion of the neck
- b. abduction of the scapula
- c. extension of the neck
- d. none of the above

7. CFTE is a modality composed of:

- a. stretching and strengthening the muscles of the body
- b. just stretches
- c. just strengthening
- d. therapeutic massage techniques

8. Muscles that cause downward rotation of the scapula are the:

- a. pectoralis minor and serratus anterior
- b. pectoralis minor and rhomboids
- c. lower trapezius and serratus anterior
- d. subclavius and serratus anterior

9. An accessory movement of the scapula could be:

- a. downward rotation
- b. upward rotation
- c. lateral tilt
- d. abduction

10. The nerve that stimulates the trapezius is the:

- a. accessory nerve
- b. dorsal thoracic
- c. sciatic nerve
- d. brachial nerve

11. The stretch reflex is known as:

- a. the Golgi tendon organ
- b. the myotatic reflex arc
- c. GTO
- d. plyometrics

12. Sherrington's law exemplifies which neuromuscular principle?

- a. reciprocal innervation
- b. nerve conduction
- c. agonist contraction
- d. stretch reflex

13. Flexibility and strength for the entire body are important for:

- a. athletes only
- b. children in elementary school
- c. everyone regardless of sports involvement
- d. people over 50

**EXPLORE**  
& *practice*

1. Locate the following prominent skeletal features on a human skeleton and on a subject:

**a. Scapula:**

- 1. Medial border
- 2. Inferior angle
- 3. Superior angle
- 4. Coracoid process
- 5. Spine of the scapula
- 6. Glenoid cavity
- 7. Acromion process
- 8. Supraspinatus fossa
- 9. Infraspinatus fossa

**b. Clavicle:**

- 1. Sternal end
- 2. Acromial end

**c. Joints:**

- 1. Sternoclavicular joint
- 2. Acromioclavicular joint

2. Palpate the following muscles on a human subject:

- a. Serratus anterior
- b. Trapezius

- c. Rhomboid major and minor
- d. Levator scapulae
- e. Pectoralis minor

3. Palpate the sternoclavicular and acromioclavicular joint movements and the muscles primarily involved while demonstrating the following shoulder girdle movements:

- a. Adduction
- b. Abduction
- c. Rotation upward
- d. Rotation downward
- e. Elevation
- f. Depression

4. Locate the origins and insertions of the muscles of the shoulder girdle on a skeleton and on a human subject.

5. *Muscle analysis chart:* Fill in the chart below by listing the muscles primarily involved in each movement.

Abduction	Adduction
Elevation	Depression
Upward rotation	Downward rotation



6. *Antagonistic muscle action chart:* Fill in the chart below by listing the muscle(s) or parts of muscles that are antagonists in their actions to the muscles in the left column.

Agonist	Antagonist
Serratus anterior	
Trapezius (upper fibers)	
Trapezius (middle fibers)	
Trapezius (lower fibers)	
Rhomboid	
Levator scapulae	
Pectoralis minor	