the SHOULDER JOINT complex

Most therapists have at least a few clients with some sort of shoulder problem. This article is meant to give a foundational understanding of the structure and function of this intricate joint.

By Dr. Joseph E. Muscolino

The upper extremity of the human body is

created for movement. Through the combined movements of all the joints of the upper extremity, we are able to place our hand in almost any position. It can be argued that it is our unique ability to "manipulate" the world with our hands that sets us apart from the rest of the animal kingdom. Of all the upper extremity joints, the shoulder is the most mobile. In fact, it is the most mobile joint of the entire human body. As such, it is often overused and injured.

Massage therapists who work in clinical, rehab or sports settings are ideal allied health-care practitioners to deal with musculoskeletal injuries and conditions, and will often be confronted with the challenge of treating clients with shoulder joint problems. To work on these clients, a clear and thorough understanding of the structure and function of the shoulder joint is needed. Equipped with this knowledge, massage therapists can greatly increase the effectiveness of their treatment of clients with shoulder joint pathologies.

The Shoulder Joint

When we speak of the "shoulder joint," we are usually referring to the glenohumeral joint, which is located between the glenoid fossa of the scapula and the head of the humerus. (See *Figure 1*, page 69.) The glenohumeral joint is the most mobile joint in our body, and is a triaxial, ball-and-socket joint that allows the arm to move in all three planes (sagittal, frontal and transverse). (See *Figure 2*, pages 70 and 71.) However, as mobile as this joint is, the arm rarely moves in isolation. Accompanying almost every movement of the arm is movement of the shoulder girdle. Therefore, to work on arm problems, it is important that the structure and function of the shoulder girdle are understood.

Structure Of The Shoulder Girdle

The shoulder girdle consists of two bones—the scapula and the clavicle—and motion of the shoulder girdle can occur at four joints (see *Figure 3*, page 72). The scapula and clavicle articulate with each other at the acromioclavicular (AC) joint, so named because the acromion process of the scapula meets the distal end of the clavicle. Although this joint does not allow a tremendous amount of motion, the AC joint is a synovial joint that allows some independent motion of the scapula relative to the clavicle. As a unit, the shoulder girdle attaches to the sternum of the trunk at the sternoclavicular (SC) joint, a synovial joint that allows the clavicle to move relative to the sternum.

Another joint exists between the anterior side of the scapula and the rib cage; this joint is called the scapulocostal. (The word "cost" refers to "rib.") The scapulocostal joint is not a true anatomical joint because the scapula and rib cage are not joined directly to each other by connective tissue. However, motion of the scapula relative to the rib cage does occur here; therefore, it is considered to be a functional joint. The fourth joint that allows motion of the shoulder girdle is the glenohumeral joint. Although movement at this joint is usually looked at as the humerus of the arm moving relative to the scapula, the "reverse" action can occur—that is, the scapula can be moved toward the humerus.[1] While most massage therapists have a fairly solid understanding of the structure, function and related musculature of the arm moving at the glenohumeral joint, the coordination of shoulder girdle movement with arm movement at the glenohumeral joint is often not well understood.

Functions Of The Shoulder Girdle

One function of the shoulder girdle is to stabilize the upper extremity of the body by connecting it to the trunk. Other

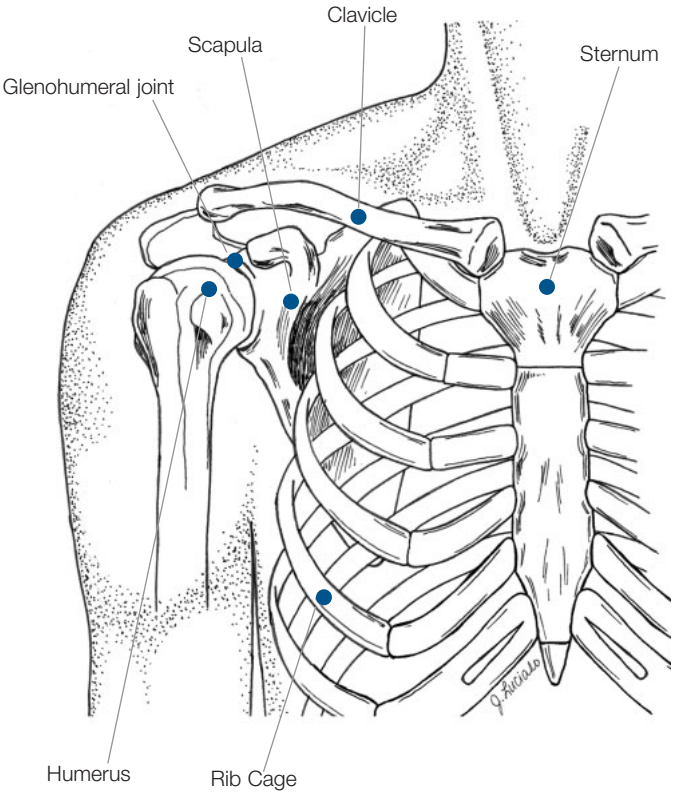

Figure 1.
The glenohumeral joint (the "shoulder joint") is located between the glenoid fossa of the scapula and the head of the humerus.

than two muscles[2] that attach from the arm directly to the trunk, all connections of the arm to the trunk that stabilize the upper extremity occur via the shoulder girdle; the clavicle of the shoulder girdle then attaches to the trunk. Osseously, this attachment occurs at only one spot, the SC joint. (Remember, the scapulocostal joint is not a true osseous, anatomical joint.) Indeed, the concept of stabilization is inherent in the term shoulder "girdle." The word "girdle" refers to an article of clothing that is worn to hold in (stabilize) the abdomen. But to stabilize effectively, girdles are supposed to completely encircle the body. The pelvic girdle of the lower extremity forms a complete circle and functions effectively as a girdle, stabilizing the lower extremity. However, the right and left shoulder girdles do not completely encircle the body. Although anteriorly they may be considered to be skeletally connected via the sternum, posteriorly, they have no skeletal connection. The scapulae posteriorly are only connected to each other indirectly by soft tissue musculature. As one of my students once pointed out, the shoulder girdles show more similarity to a corset than they do to a girdle.[3]

Stabilization of the upper extremity is one function of the shoulder girdle. The other function of the shoulder girdle— movement—is equally important. Movement of the shoulder girdle can occur as a whole—that is, the scapula and clavicle can move together as one unit. As mentioned, movement of the shoulder girdle can occur relative to the sternum at the SC joint, relative to the rib cage at the scapulocostal joint and relative to the arm at the glenohumeral joint. Movement *within* the shoulder girdle also can occur; independent motion of the scapula relative to the clavicle may occur at the AC joint.

Massage therapists who work in clinical, rehab or sports settings are ideal allied health-care practitioners to deal with musculoskeletal injuries and conditions.

The joints of the shoulder joint complex must work together in a smooth and coordinated manner for full and proper stabilization of the upper extremity.

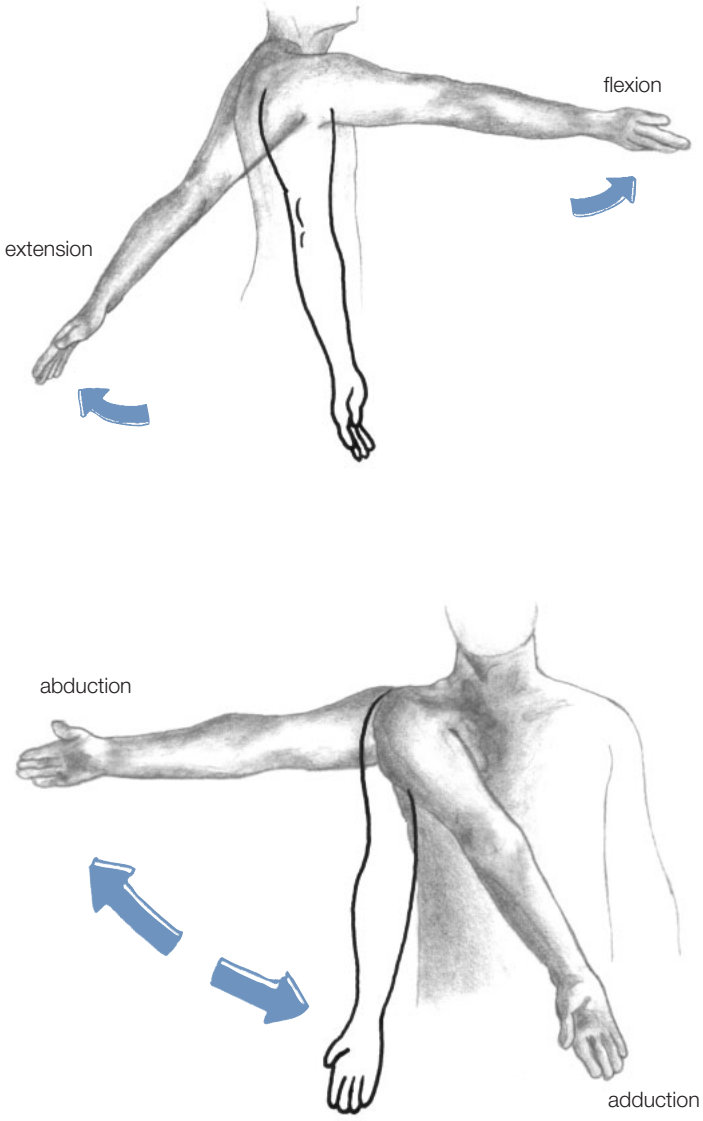

Figure 2a. (Top)
This illustrates the sagittal plane movements of flexion and extension of the arm at the shoulder joint.

Figure 2b. (Bottom)
This illustrates the frontal plane movements of abduction and adduction of the arm at the shoulder joint.

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Additionally, when the humerus moves, the shoulder girdle also must move. This motion occurs as both movement of the shoulder girdle as a unit, as well as motion within the shoulder girdle. Thus, when discussing shoulder movement, we must consider the arm and the shoulder girdle together.

Therefore, we see that the "shoulder joint" is actually a complex of joints. For this reason, the term "shoulder joint complex" is a more accurate term to use when looking at how the shoulder functions. The joints of the shoulder joint complex must work together in a smooth and coordinated manner for full and proper stabilization of the upper extremity, and for full and proper movement of the upper extremity. The term that is used to describe this coupled movement of the arm with the shoulder girdle is "scapulohumeral rhythm."[4]

Scapulohumeral Rhythm Of The Shoulder Joint Complex: Abduction Of The Arm

It is not possible for us to comprehensively cover the interrelationship between the arm and the shoulder girdle for every motion of the shoulder joint complex. Instead, we will look at one motion as an example—abduction of the arm at the glenohumeral joint—and examine the role that the shoulder girdle has in this motion. Looking at an individual that abducts his or her arm at the shoulder joint, it seems that the range of motion is 180 degrees. (See *Figure* 4, page 73.)

However, not all of this motion is the arm abducting relative to the scapula at the glenohumeral joint. Of the 180 degrees of apparent motion, only 120 degrees of this movement occur as a result of the arm abducting at the glenohumeral joint itself. The remaining 60 degrees are due to movement of the scapula relative to the rib cage; this movement of the scapula is upward rotation of the scapula at the scapulocostal joint. Hence, of the 180 degrees of arm movement relative to the trunk, 120 degrees occur with the arm abducting relative to the scapula at the glenohumeral joint, and 60 degrees occur as a result of the scapula upwardly rotating relative to the trunk at the scapulocostal joint. (See *Figure* 5, page 73.)

The actual mechanics of scapulohumeral rhythm of arm abduction are a bit complicated, but worth investigating for a moment. In the first phase of humeral abduction (the first 90 degrees), the humerus abducts 60 degrees at the glenohumer-

al joint and the scapula upwardly rotates 30 degrees relative to the rib cage at the scapulocostal joint. The 30 degrees of scapular upward rotation occur in two ways. First, 25 degrees of it are due to clavicle elevation at the SC joint. This causes the scapula to move with the distal end of the clavicle, upwardly rotating it relative to the rib cage. The other 5 degrees of scapular upward rotation occur by the scapula upwardly rotating relative to the clavicle at the AC joint. As a result, the scapula also upwardly rotates relative to the rib cage.

In the second phase of humeral abduction (the second 90 degrees), the humerus abducts another 60 degrees at the glenohumeral joint, and the scapula upwardly rotates another 30 degrees relative to the rib cage at the scapulocostal joint. These final 30 degrees of scapular upward rotation occur due to an additional 5 degrees of clavicular elevation at the SC joint, and another 25 degrees of upward rotation of the scapula relative to the clavicle at the AC joint. However, it must be pointed out that this additional AC joint motion can only occur if the clavicle itself first upwardly rotates 35 degrees at the SC joint.

Although one might get lost in the numbers, the big picture should remain in focus. For a person to raise his or her hand out to the side all the way up toward the sky (180 degrees of abduction of the arm *relative to the trunk*), an action that happens all the time, a number of joints and muscles must function in a healthy manner. The glenohumeral, AC, SC and scapulocostal joints all must be healthy and able to allow these movements. Muscle-wise, movers of humeral abduction, scapular upward rotation, clavicular elevation and clavicular upward rotation must be strong and healthy, able to create actions of each joint. Furthermore, the antagonistic muscles of the preceding actions must be healthy and loose to lengthen sufficiently to allow these actions to occur. If any of these links are compromised, one will be unable to fully raise his or her arm to the side without experiencing pain.

What does this mean to a massage therapist who has a client that comes in complaining of arm pain, or perhaps worse, inability to raise his or her arm to the side? Hopefully, the answer to this question is clear. It may not be enough to simply check the movers of humeral abduction. The following structures all may need to be examined to see if they are working properly:

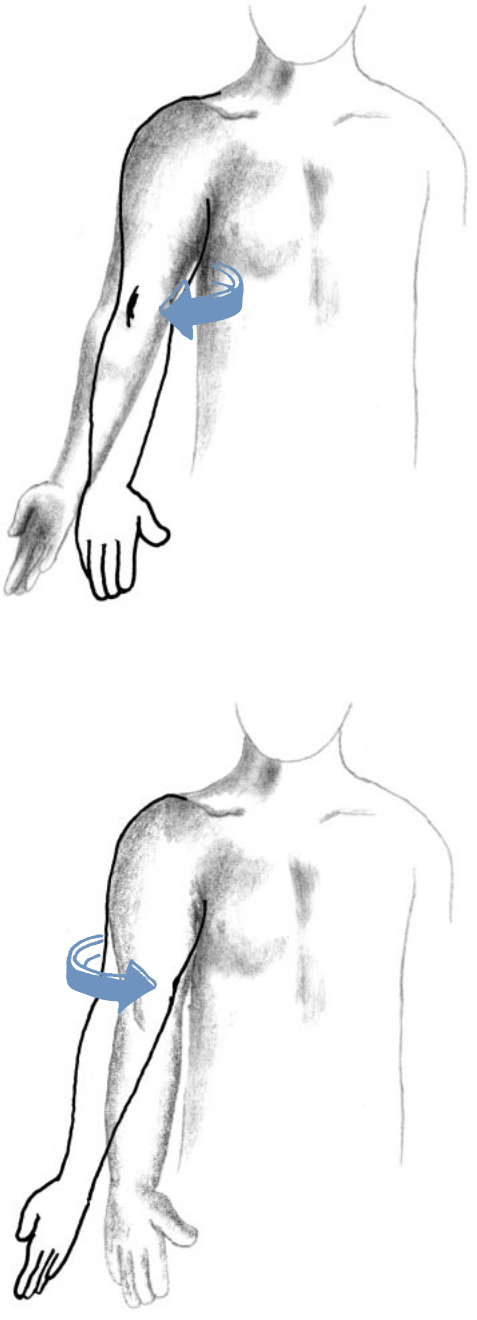

Figure 2c. (Top)
This illustrates the transverse plane movement of lateral rotation of the arm at the shoulder joint.

Figure 2d. (Bottom)
This illustrates the transverse plane movement of medial rotation of the arm at the shoulder joint.

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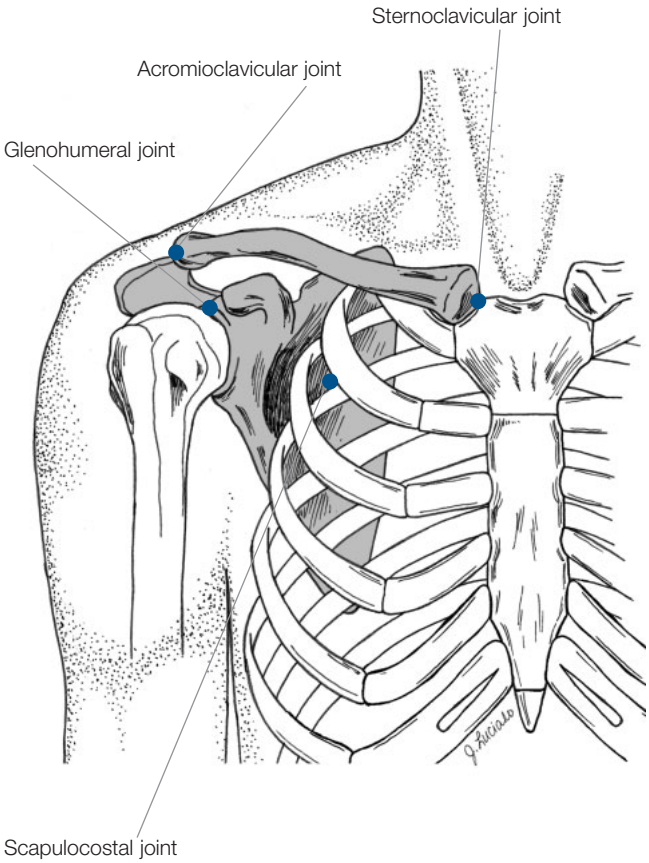

Figure 3.
The shoulder girdle is made up of the scapula and clavicle. Movements of the shoulder girdle may occur relative to the sternum at the sternoclavicular joint, relative to the rib cage at the scapulocostal joint and relative to the humerus at the glenohumeral joint. Movement within the shoulder girdle (movement of the scapula relative to the clavicle and vice versa) may occur at the acromioclavicular joint.

Movers

- Movers of humeral abduction, i.e., deltoid, supraspinatus, and the clavicular head of the pectoralis major.[5] Are these movers strong and healthy, able to create abduction of the humerus?
- Movers of scapular upward rotation, i.e., serratus anterior, upper and lower trapezius, and teres major. Are these movers strong and healthy, able to create upward rotation of the scapula?
- Movers of clavicular elevation and upward rotation, i.e., sternocleidomastoid and upper trapezius. Are these movers strong and healthy, able to create elevation and upward rotation of the clavicle?

Antagonists

- Antagonists of humeral abduction (adductors of the humerus), i.e., pectoralis major, latissimus dorsi, teres major, coracobrachialis, short head of biceps brachii, long head of triceps brachii and teres minor. Are any of these muscles excessively tight, restricting the humerus from abducting?
- Antagonists of scapular upward rotation (scapular downward rotators), i.e., rhomboids, levator scapulae, pectoralis minor. Are any of these muscles excessively tight, restricting the scapula from upwardly rotating?
- Antagonists of clavicular elevation and upward rotation (clavicular depressors and downward rotators), i.e., subclavius, anterior deltoid and pectoralis major. Are either of these muscles excessively tight, restricting the clavicle from elevating and upwardly rotating?

Joints

- Healthy range of motion of the glenohumeral, AC, SC and scapulocostal joints. Are these joints able to go through their full range of motion in a pain-free manner?

Most shoulder joint pathologies are due to the most likely culprit, an injured and functionally weak abductor of the humerus at the shoulder joint, probably the deltoid. But when a more difficult client does walk through your door, will you have the knowledge and ability to investigate a bit further? You won't be able to alleviate every shoulder problem. But equipped with a better understanding of how the shoulder joint complex works, you may be able to help a few more clients than you could before.

Most shoulder joint pathologies are due to the most likely culprit, an injured and functionally weak abductor.

Dr. Joseph Muscolino is a licensed chiropractic physician, and has been an instructor of musculoskeletal and visceral anatomy, physiology, kinesiology and pathology courses for the past 17 years. Muscolino also runs numerous advanced study workshops, including deep tissue workshops, kinesiology seminars and cadaver labs. An NCBTMB-approved provider toward certification renewal, he is the author of *The Muscular System Manual; The Skeletal Muscles of the Human Body*, and *The Musculoskeletal Anatomy Coloring Book*. He can be contacted at: jemredd@optonline.net.

Author Footnotes

1. A "reverse action" is a joint action in which the attachment that usually stays fixed, moves—and the attachment that usually moves, stays fixed. In origin/insertion terminology, a reverse action is when the origin moves and the insertion stays fixed. With regard to the glenohumeral joint, the usual action is movement of the humerus relative to the scapula; the reverse action is when the humerus stays fixed and the scapula moves at the glenohumeral joint, relative to the humerus.

2. Pectoralis major and latissimus dorsi.

3. Both girdles and corsets function to stabilize/hold in a part of the body, but a girdle completely encircles the body part, whereas a corset requires lacing to encircle the body part that it covers. The "shoulder girdle" is open in back and the musculature that attaches from the medial border of the two scapulas to the spine can be viewed as the lacing of a corset. For this reason, the term "shoulder corset" might be more appropriate.

4. Since the clavicle is very much a part of the coupled movements between the humerus and the shoulder girdle, perhaps a better name would be "scapuloclaviculohumeral" rhythm.

5. The clavicular head of the pectoralis major is only an abductor of the arm when the arm is already abducted to approximately 100 degrees or more.

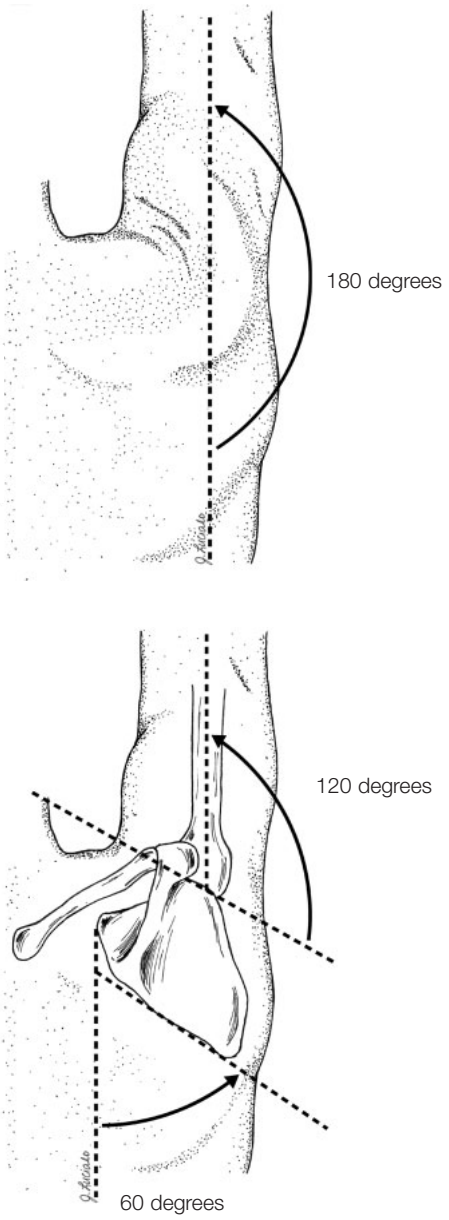

Figure 4. (Top)
This depicts a person who has raised his arm to the side until the hand is pointing straight up. The arm has abducted 180 degrees in the frontal plane relative to the trunk of the body.

Figure 5. (Bottom)
This illustrates that of the 180 degrees of abduction of the arm relative to the trunk, only 120 degrees of that motion are actually due to abduction of the arm at the glenohumeral joint. The remaining 60 degrees of motion are due to the upward rotation of the scapula at the scapulocostal joint. Hence, motion of the shoulder girdle is intimately linked to motion of the arm at the shoulder joint.