# Body Mechanics

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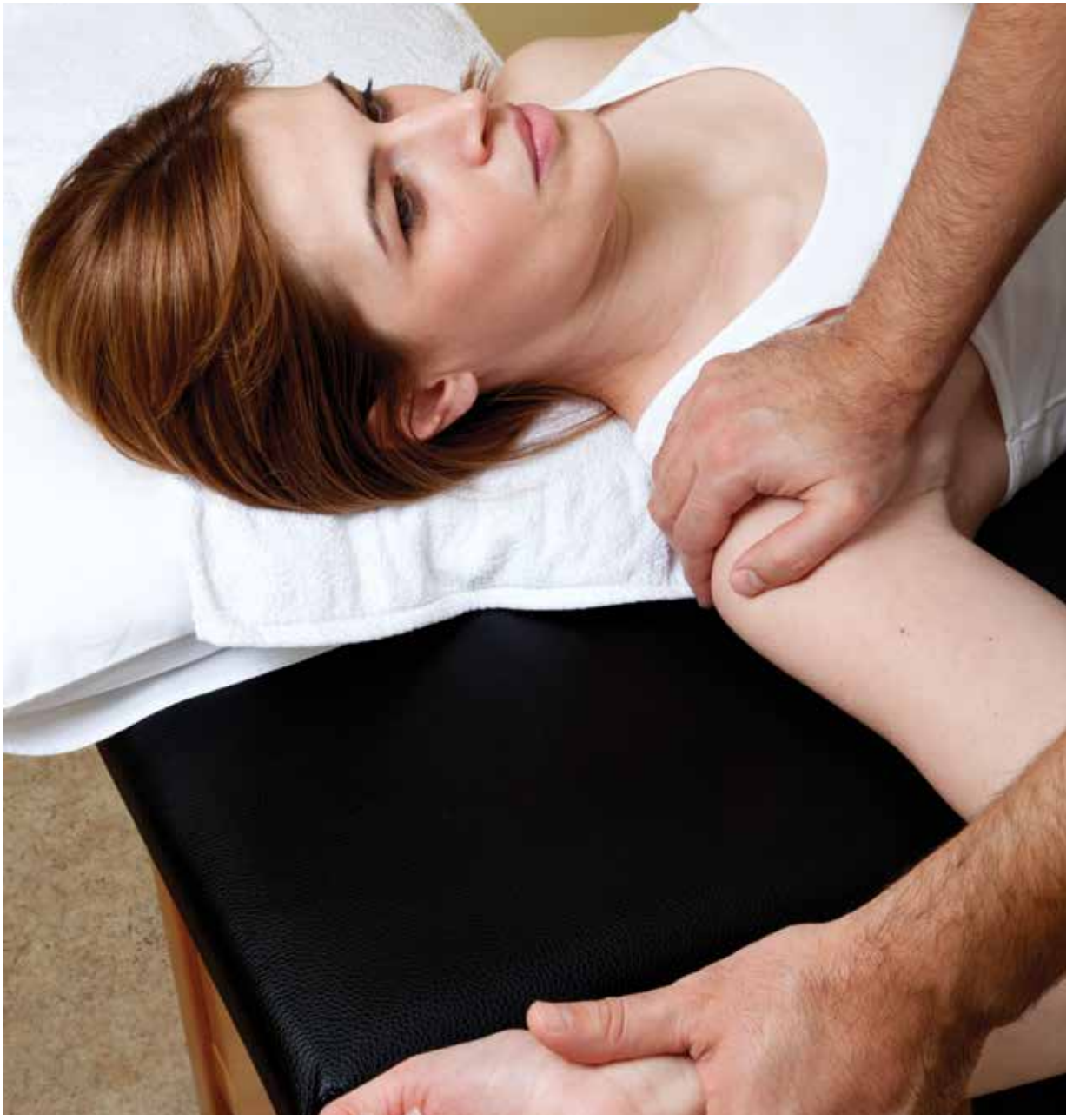

# Rotator Cuff Injury

## WORKING WITH CLIENTS AFFECTED BY THIS COMMON CONDITION

### ROTATOR CUFF GROUP

The four rotator cuff muscles are the supraspinatus, infraspinatus, teres minor, and subscapularis (Figure 1). These muscles are described as the rotator *cuff* group because their distal tendons blend and attach together in a cuff-shape across the greater and lesser tubercles on the head of the humerus. Although all four rotator cuff muscles have specific concentric mover actions at the glenohumeral (GH) joint, their primary functional importance is to contract isometrically for GH joint stabilization. Because

Before practicing any new modality or technique, check with your state's or province's massage therapy regulatory authority to ensure that it is within the defined scope of practice for massage therapy.

the rotator cuff group has both mover and stabilization roles, it is extremely functionally active and therefore often physically stressed and injured. In fact, after neck and low back conditions, the shoulder is the most commonly injured joint of the human body.

## ROTATOR CUFF PATHOLOGY

The three most common types of rotator cuff pathology are tendinitis, tendinosus, and tearing. Excessive physical stress placed on the rotator cuff tendon can cause irritation and inflammation of the tendon, in other words, *tendinitis*. If the physical stress is chronic, the inflammatory process often subsides and degeneration of the fascial tendinous tissue occurs; this is referred to as *tendinosus*. The degeneration of tendinosus results in weakness of the tendon's structure, and with continued physical stress, whether it is overuse microtrauma or a macrotrauma, a rotator cuff tendon *tear* might occur.

## CAUSES

As stated, each of the four rotator cuff muscles has its own concentric GH joint action(s) for humeral motion: the supraspinatus abducts and flexes; the infraspinatus and teres minor laterally rotate; and the subscapularis medially rotates. However, as a group, the rotator cuff muscles are primarily important for isometric stabilization at the GH joint. Whenever the distal end of the humerus is moved upward, which occurs with flexion, extension, abduction, and adduction from anatomic position, the proximal end, the head of the humerus, must be stabilized down into the glenoid fossa of the scapula. The rotator cuff muscles are primarily responsible for this proximal stabilization. An example of this involving humeral abduction is shown in Figure 2. An isolated contraction of the deltoid to abduct the humerus actually results in a vertical pulling force upon the humerus and approximation of the humeral head against the acromion process above (Figure 2A). Downward stabilization of the humeral head by the rotator cuff musculature prevents approximation of the two bones when the deltoid contracts (Figure 2B). Therefore, between mover and stabilization functions, the rotator cuff musculature contracts with most every motion of the GH joint. It is this extremely heavy workload that commonly results in overuse and injury of the rotator cuff musculature.

## REPETITIVE OVERUSE MICROTRAUMA

Injury of the rotator cuff group often takes the form of repetitive overuse microtrauma. This is especially true for people whose jobs involve continual use of the GH joint, such as house cleaners, assembly line workers, and carpenters. Athletes that heavily rely on upper ex-

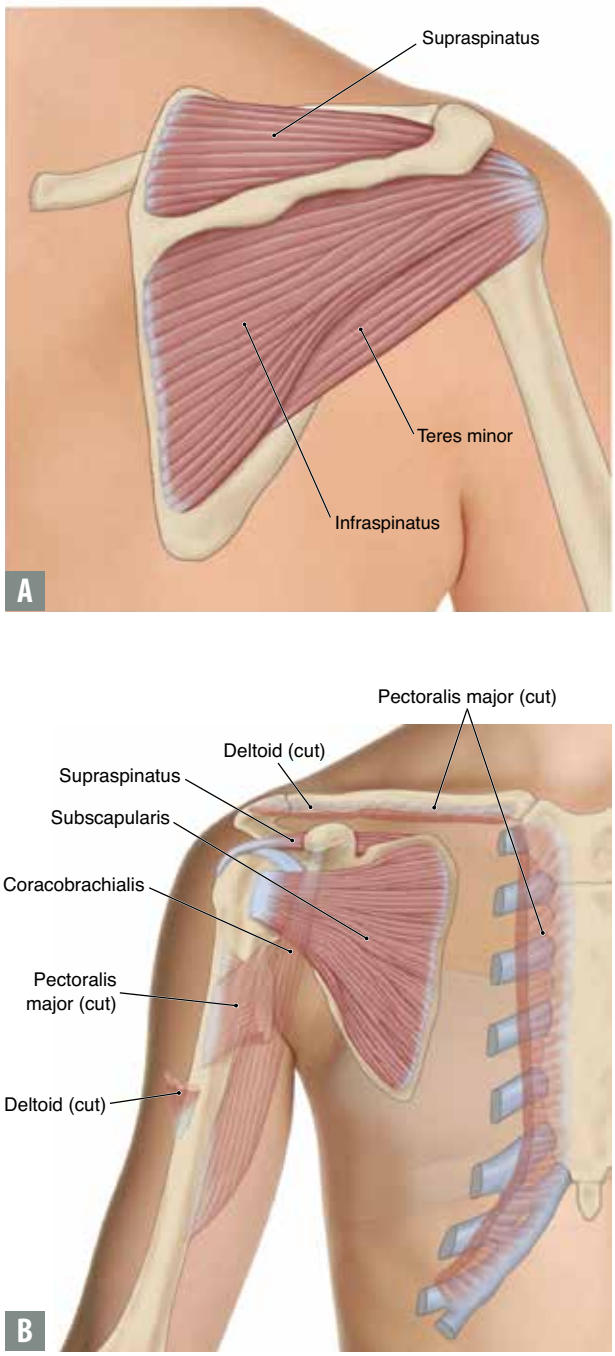


**FIGURE 1.** The rotator cuff group is composed of the supraspinatus, infraspinatus, teres minor, and subscapularis. A, Posterior view. B, Anterior view.

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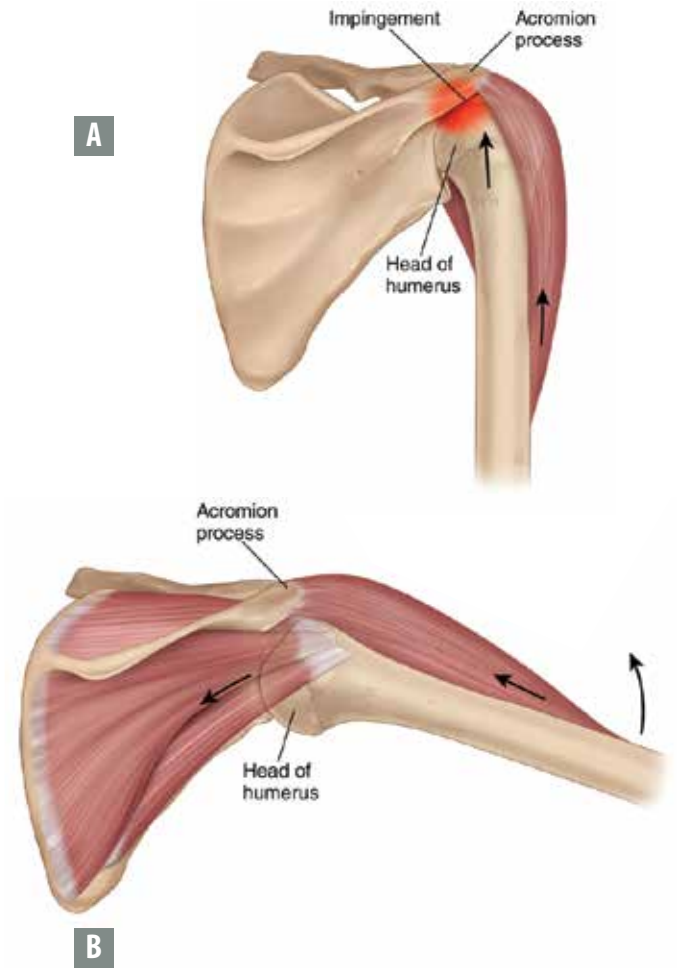


**FIGURE 2.** A, An isolated contraction of the deltoid results in approximation of the humeral head against the acromion process above. B, Downward stabilization of the humeral head by the rotator cuff musculature prevents this.

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tremity motion, such as swimmers, tennis players, and baseball players, are also prone to repetitive overuse rotator cuff injury. These overuse patterns involve repeated microtrauma to the distal rotator cuff tendon that might result in tendinitis, or if extremely chronic, tendinosus or even tearing.

## MACROTRAUMA

A macrotrauma is also a common cause of rotator cuff injury. Examples include a bad fall, lifting a very heavy object, or a motor vehicle accident. A macrotrauma can result in tendinitis; or if the trauma is severe enough, tearing. One of the most common causes of rotator cuff tearing occurs when a client who has an existing condition of rotator cuff tendinosus (and may not even be aware of it), experiences a macrotrauma. In these cases, even if the macrotrauma is only mild to moderately severe, because the tendon is already degenerated and weakened, tearing results.

## THE CRITICAL ZONE

The entire rotator cuff group is often overused and injured. However, due to its location, the most commonly injured region of the rotator cuff distal tendon is the supraspinatus tendon. The distal tendon of the supraspinatus travels between the acromion process of the scapula and the head of the humerus. Whenever the arm is lifted into abduction, the supraspinatus tendon can become impinged between these two bony structures. Indeed, this region of the rotator cuff tendon is so often injured that it is often referred to as the *critical zone*. This is prevalent in clients who repeatedly or chronically have their arms raised to the side, such as barbers/hair stylists, artists, house painters, and people who sleep with their arm(s) above their head.

## DYSFUNCTIONAL KINEMATICS

Impingement of the supraspinatus tendon between the head of the humerus and the acromion process of the scapula most often occurs with improper kinematics (motion patterns) of humeral abduction. There are three common dysfunctional kinematic patterns involving humeral abduction. One is humeral abduction coupled with humeral medial rotation; another is humeral abduction coupled with scapular downward rotation; and another is humeral abduction with decreased inferior glide of the humeral head.

## COUPLED HUMERAL MEDIAL ROTATION

If the arm is medially rotated as it is abducted, the greater tubercle of the humerus becomes aligned in the frontal plane with the acromion process of the scapula. As a result, when the arm lifts into abduction, the great-

## SHOULD WE ABDUCT THE ARM?

The question of why we would even want to abduct our arm to 90 degrees is a valid one. If we look at functional movement patterns in daily life, we see that abduction of the arm to 90 degrees is not that common or useful a motion. Indeed, pure abduction in the frontal plane to any height is not very functional. Try this: Stand looking straightforward and bring your arm into pure abduction in the frontal plane to 90 degrees. Can you even see your hand? The answer is no. So what purpose would it serve to move our hand to a position where we cannot even see what we are doing with it? We might choose to rotate our head and neck to see it, but we would just as likely, or more likely, rotate from lower in our body to accomplish this; and rotating our trunk toward the arm would effectively take the arm out of the position of pure frontal plane abduction relative to our body. Further, if we were to pick up an object with our arm out at 90 degrees of abduction, the leverage force that would result on our glenohumeral joint would be tremendous, resulting in great physical stress to the joint.

When examining movement of the arm out to the side, it is interesting to note that the hand first comes into view when it is moved forward approximately 30-35 degrees from the frontal plane. So let's now amend our previous exercise: As before, stand looking straightforward and bring your arm into pure abduction in the frontal plane; but now slowly bring your abducted arm anteriorly (horizontally flex) until you can see your hand. As stated, it will be approximately 30-35 degrees off the frontal plane toward the sagittal plane, which happens to be the plane of the scapula. It is unlikely that this is a coincidence. Movement of our arm out to the side is most functional when it within the plane of the scapula, and therefore within our line of sight. The functional significance of movement of the arm within the plane of the scapula is so important that it is often referred to as scaption.

Looking at the larger picture of human motion, we see that the human body is primarily designed to move in the sagittal plane. It also moves well in the transverse plane to change our orientation. However, frontal plane motion is much more limited. Indeed, the elbow, knee, and ankle joints do not even move in the frontal plane. When it comes to the GH joint, it should be pointed out that pure frontal plane abduction to 90 degrees most often occurs during activities that do not involve motions of natural life, but rather motions involved in artificial, human-made activities, usually in the world of sports and the arts. Examples include ballet and tennis. Another example is working out in the gym, which often involves motions in the cardinal planes. It is ironic that gym workouts, which are supposedly designed to improve our health, might actually be injurious, at least when they involve pure frontal plane motions at the GH joint. The sagittal, frontal, and transverse cardinal planes are an excellent way to divide and map space when describing motions of the body. But there is no reason why our workout motions must be carried out within them. We should not become enslaved to moving only within the cardinal planes any more than we should insist on walking perfectly north and then perfectly west, when the easiest direction of motion to walk might be obliquely northwest!

er tubercle will eventually hit the acromion process, obstructing movement and pinching the soft tissues located between these two osseous structures. These soft tissues are the supraspinatus tendon and the subacromial bursa (Figure 3A). (Note: The superior aspect of the GH capsule, coracohumeral ligament, and long head of the biceps brachii tendon may also be impinged in this space.) Impingement of these tissues usually occurs at approximately 90 degrees of abduction. Lateral rotation, however, aligns the lesser tubercle with the acromion process in the frontal plane. Because the lesser tubercle is smaller than the greater tubercle, more room is afforded between the humerus and acromion and the soft tissues are less likely to be pinched (Figure 3B). For this reason, it is extremely important for the arm to be laterally rotated whenever it is abducted to approximately 90 degrees or more.

Unfortunately, many people have a difficult time laterally rotating their arms because they are stuck in humeral medial rotation. This can be due to fascial adhesions in the GH capsule, tight/overly facilitated medial rotator muscles (i.e., pectoralis minor, pectoralis major, subscapularis, latissimus dorsi, teres major), and/or weak/overly inhibited lateral rotator muscles (i.e., infraspinatus, teres minor, posterior deltoid). This muscular imbalance is often a result of a postural dysfunctional pattern known as *rounded shoulders*, which involves protracted shoulder girdles and medially rotated humeri. Rounded shoulders itself is usually part of the larger dysfunctional postural pattern of the body known as *upper crossed syndrome*.

### COUPLED SCAPULAR DOWNWARD ROTATION

During humeral abduction, the scapula must be stabilized to prevent downward rotation. Otherwise, the critical zone of the supraspinatus tendon will become impinged. This is important because when the deltoid contracts to create abduction of the arm at the GH joint, it also pulls the scapula into downward rotation toward the humerus. This would cause impingement of the supraspinatus tendon and subacromial bursa between the head of the humerus and the acromion process; because as the humeral head is lifting upward toward the acromion process, the acromion process is moving downward toward the head of the humerus (Figure 3C). (It is worth noting that this impingement would occur even if the humerus were laterally rotated as it accompanies the humeral abduction.)

If instead, an upward rotator muscle (such as the upper trapezius, lower trapezius, or serratus anterior) contracts along with the deltoid, the scapula will be stabilized, preventing it from downwardly rotating, thereby preventing impingement of the tendon and bursa (Fig-

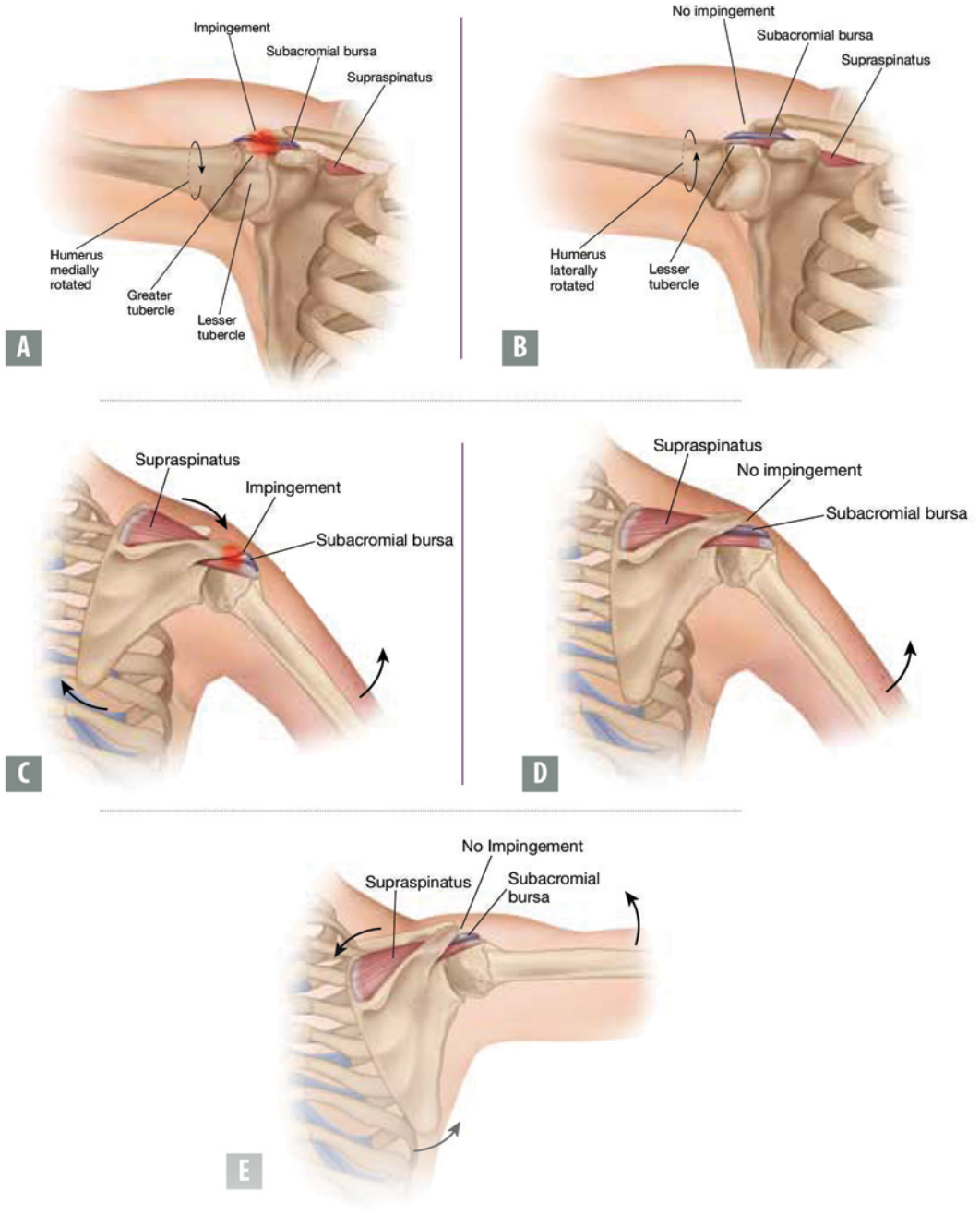


**FIGURE 3.** Relationship between abduction of the humerus and impingement of the supraspinatus tendon and subacromial bursa.

**A**, Abducting a medially rotated humerus likely impinges the tendon and bursa.

**B**, If the humerus is laterally rotated as it abducts, impingement is less likely.

**C**, Abducting the humerus with scapular downward rotation may also cause impingement.

**D**, If the scapula is stabilized from downwardly rotating, impingement is less likely.

**E**, Coupling scapular upward rotation with further humeral abduction allows for greater motion without impingement.

**F**, Upward roll of the humeral head without compensatory inferior glide may also cause impingement.

**G**, Compensa-