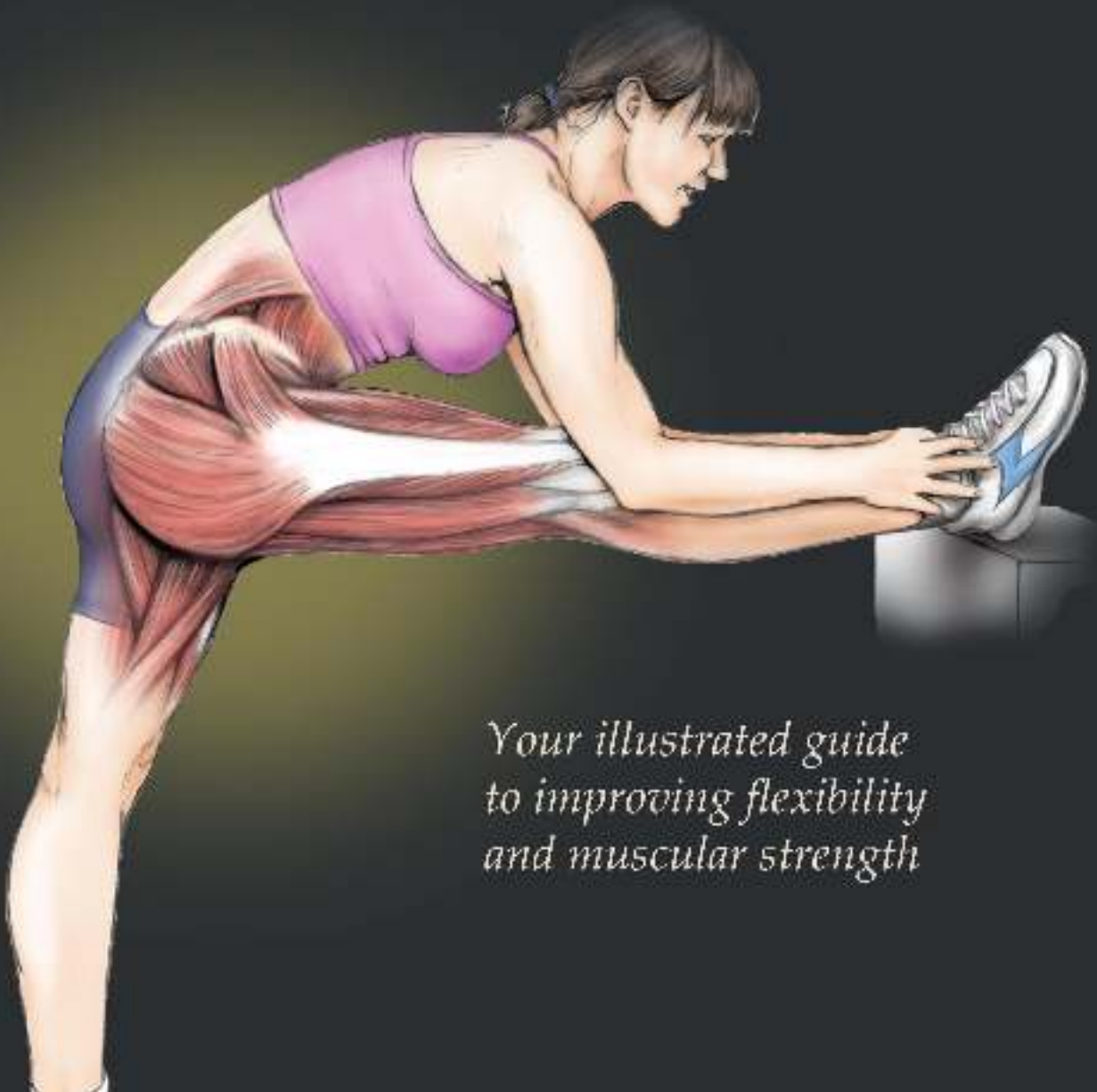


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# STRETCHING Anatomy

ARNOLD G. NELSON  
JOUKO KOKKONEN



*Your illustrated guide  
to improving flexibility  
and muscular strength*



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# **STRETCHING ANATOMY**

**Arnold G. Nelson  
Jouko Kokkonen**

**Illustrated by  
Jason M. McAlexander**



**Human Kinetics**

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# CONTENTS

Introduction v

CHAPTER **1** **NECK** . . . . . 1

CHAPTER **2** **SHOULDERS, BACK,  
AND CHEST** . . . . . 9

CHAPTER **3** **ARMS, WRISTS,  
AND HANDS** . . . . . 25

CHAPTER **4** **LOWER TRUNK** . . . . . 53

CHAPTER **5** **HIPS** . . . . . 69

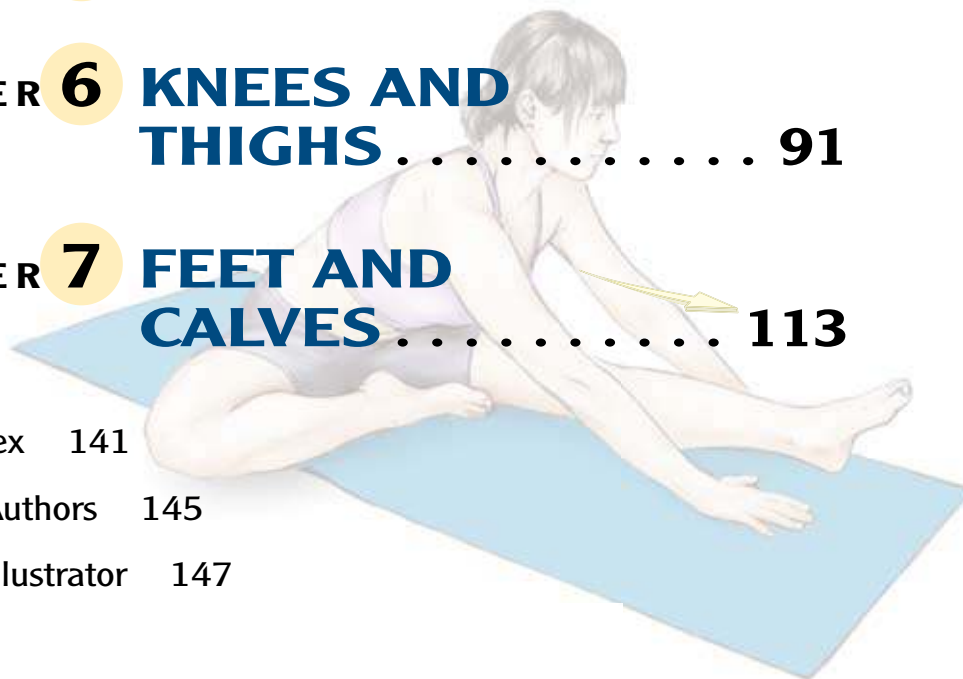
CHAPTER **6** **KNEES AND  
THIGHS** . . . . . 91

CHAPTER **7** **FEET AND  
CALVES** . . . . . 113

Stretch Index 141

About the Authors 145

About the Illustrator 147





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# INTRODUCTION

**G**ood flexibility is known to bring positive benefits in the muscles and joints. It aids with injury prevention, helps to minimize muscle soreness, and improves efficiency in all physical activities. Increasing flexibility can also improve quality of life and functional independence. Good flexibility aids in the elasticity of the muscles and provides a wider range of motion in the joints. It provides ease in body movements and everyday activities. A simple daily task such as bending over and tying shoes is accomplished better with flexibility.

Unfortunately, flexibility is generally not a focus of people wanting to start a fitness program. In fact, many times it is minimally addressed or neglected altogether. While the benefits of regular cardiovascular and strength training exercise are well known, few people realize that flexible joints and regular stretching are also essential for optimum health and activity. Recently, many whole-body fitness and wellness programs, such as yoga and Pilates, which incorporate some flexibility training, have increased in popularity. While these programs may improve the flexibility of individual body segments, their emphasis is not specifically aimed at improving the range of motion of all of the major joints. Yoga emphasizes balance in all areas, seeks to strengthen all muscle groups equally, creates balance between the mental and physical, and encourages moderation in everything. Yoga involves holding static poses while exploring breathing, physical feelings, and emotions. The increase in flexibility comes from holding the body in the desired poses. Pilates, on the other hand, is an exercise program that encourages the use of the mind to control the muscles. It emphasizes strengthening the postural muscles that help keep the body balanced and provide support for the spine. In contrast to traditional strength training programs that involve multiple sets and repetitions of a single exercise, a Pilates workout stresses few repetitions of each exercise and emphasizes doing these movements with precise control and form. The increases in flexibility are primarily accomplished from the ballistic movements used to increase strength.

How much stretching should a person do every day? Usually, most stretching tends to be a very brief routine concentrating on the muscle groups of the lower body. The total time spent in a stretching routine hardly ever exceeds 5 minutes; people tend to stretch a particular muscle group for no more than 15 seconds. Additionally, the stretching usually occurs at the start of the exercise session. Even in sport training, stretching is given minor importance in the overall training programs. An athlete might spend just a little more time stretching than the average person. This is usually because it is part of a warm-up routine. After the workout, however, most athletes are either too tired to do any stretching or simply do not take the time to do it. To be the most effective, however, stretching should be performed both during warm-up before a workout routine and as part of a cool-down after the workout.

For any person, whether an athlete or not, a regular stretching routine can bring some interesting benefits. Research studies on hamstring injuries have shown that those people with the lowest flexibility have the greatest chance of injury. Interestingly, the type of increased flexibility needed for reducing injury did not come from doing stretching exercises right before the activity. Rather, the increased flexibility required for fewer injuries came only from doing weeks of stretch training. Additional research has shown that regular, intense stretching for a minimum of 10 minutes will bring some major beneficial changes in the neuromuscular–tendon units. Increased strength and endurance gains have been reported as well as improved flexibility and mobility.

## Types of Stretching

In general, any movement that requires moving a body part to the point at which there is an increase in the movement of a joint can be called a stretching exercise. Stretching can be done either actively or passively. Active stretching occurs when the person doing the stretch is the one holding the body part in the stretched position. Passive stretching occurs when someone else moves the person to the stretch position and then holds the person in the position for a set time. The four major types of stretches are static, proprioceptive neuromuscular facilitation (PNF), ballistic, and dynamic. The static stretch is used most often. In static stretching, one stretches a particular muscle or group of muscles by slowly moving the body part into position and then holding the stretch for a set time. Since the static stretch begins with a relaxed muscle and then applies the stretch slowly, static stretching does not activate the stretch reflex (the knee jerk seen when the tendon is tapped with a mallet). Activation of the stretch reflex causes the stretched muscle to contract instead of elongate. This contraction of the muscle is directly opposite of the intent of the exercise. PNF stretching refers to a stretching technique in which a fully contracted muscle is stretched by moving a limb through the joint's range of motion. After moving through the complete range of motion, the muscle is relaxed and rested before resuming the procedure. The combination of muscle contraction and stretching serves to relax the muscles used to maintain muscle tone. This relaxation allows for increased flexibility by "quieting" the internal forces in both the muscles that assist and the ones that oppose the movement of the joint in the desired direction. Ballistic stretching uses muscle contractions to force muscle elongation through bobbing movements where there is no pause at any point in the movement. Although the bobbing movement quickly elongates the muscle with each repetition, the bobbing also activates the stretch reflex (or knee jerk) response. Since the stretch reflex stimulates the muscle groups to contract after the stretch is finished, ballistic stretching is usually discouraged. Dynamic stretching refers to the stretching that occurs while performing sport-specific movements. Dynamic stretching is similar to ballistic stretching in that both use fast body movements to cause muscle stretch, but dynamic stretching does not employ bouncing or bobbing. Additionally, dynamic stretching uses only the muscle actions specific to a sport. Practically speaking, dynamic stretching is similar to performing a sport-specific warm-up (that is, performing the movements required for the activity but at a lower intensity).

## Benefits of Stretching

The following are several chronic training benefits gained from using a regular stretching program:

- Improved flexibility, stamina (muscular endurance), and muscular strength. The degree of benefit depends on how much stress is put on the muscle. Medium or heavy stretches are recommended. You can do this by building up to doing long stretches of high intensity (see the next section for a detailed explanation of light, medium, and heavy stretching).
- Reduced muscle soreness, aches, and pains. Use only very light stretches if muscle soreness prevails.
- Improved flexibility with the use of static or PNF stretches. Medium or heavy stretches are recommended.
- Good muscular and joint mobility.
- More efficient muscular movements and fluidity of motion.



- Greater ability to exert maximum force through a wider range of motion.
- Prevention of some lower back problems.
- Improved appearance and self-image.
- Improved body alignment and posture.
- Better warm-up and cool-down in an exercise session.

### General Recommendations

- Try to include all the major muscle groups in any stretching program.
- Do at least two different stretches for each joint movement.
- Before any physical activity, use light stretches as part of the warm-up.
- After an exercise routine, cool down with medium-intensity stretches.
- If muscles are sore after exercising, use only light stretches two or three times with a 5- to 10-second hold for each stretch performed.
- If muscle soreness persists for several days, continue using light stretches two or three times with a 5- to 10-second hold for each stretch performed.
- The majority of the stretches should be static.

### Stretching Programs

The following programs can be prescribed for anyone who is interested in improving flexibility, strength, and strength endurance. To make changes to any of these areas, you need to be involved in a regular stretching program, preferably as a daily routine or as close to that as possible. Changes will not come in a day or two but rather after a dedicated effort of several weeks. You can incorporate these programs with or without any other kind of exercise routine. According to the latest research, heavy stretching, even without any other exercise activity, can bring about changes in flexibility, strength, and muscular endurance.

As in any other exercise program, progression is an integral part of a successful stretching program. The stretching progression should be gradual, going from a lighter load with less time spent on each stretch to a heavier load with more time spent on each stretch. For the programs outlined in this introduction, you should begin with the initial program, or level I, and then progress through to level V. However, you may customize this program according to your current level of experience and flexibility. Generally, working through each level at the recommended speed will result in meaningful and consistent workouts. After such workouts, you will find improved flexibility in the muscles you worked as well as the satisfaction of having done something beneficial.

Intensity is always a critical factor when you want changes and improvements to come from an exercise program. In a stretching routine, intensity is controlled by the amount of pain associated with the stretch. Using a pain scale from 0 to 10, initial pain is light (scale of 1 to 3) and usually dissipates as the time of stretching is extended. Light stretching occurs when you stretch a particular muscle group only to a point where you feel the stretch with an associated light pain. Moderate stretching (scale of 4 to 6) occurs when you start to feel increased, or "medium," pain in the muscle you're stretching. In heavy stretching (scale of 7 to 10), you will initially experience a moderate to heavy pain at the start of the stretch, but this pain slowly dissipates as stretching continues. Research studies have shown that heavier stretches rather than lighter stretches provide greater improvements in flexibility and strength. Thus, you are the key to your own success, and how well you are able to monitor stretch intensity and tolerate the pain level determines how quick and large the improvements will be.

Because of the complexity of muscle attachments, many stretching exercises simultaneously affect a variety of muscle groups in the body and stretch the muscle groups around multiple joints. Thus, a small change in body position can change the nature of a stretch on any particular muscle. To get the maximal stretching benefit in any muscle, it is helpful to know joint movements that each muscle can do. Putting the joint through the full range of each motion allows for maximal stretching.

You can customize the exercises in this book, which will allow for numerous stretch combinations. Also, this book illustrates only a portion of the available stretches. You are encouraged to experiment with these stretches by following the explanations provided. Information is also provided to enable you to explore a variety of positions in order to stretch the muscle by slightly altering the angles and directions of the various body positions. Thus, you can adapt the stretching exercises to fit your individual needs and desires. For example, if you have soreness in only one of the muscles or just a part of the muscle, you can adapt each exercise to stretch that particular muscle. If the explained stretch or particular body position does not stretch a particular muscle as much as you want it to, then experiment by slightly altering the position. Keep making alterations in the position until you reach the desired level of stretch (using a pain scale rating).

In the programs that appear in the following section, specific instructions are given relating to the time to hold the stretch and time to rest between each stretch, as well as the number of repetitions you should do. You should follow these instructions in order to get the benefits described. For example, if the instructions indicate that you should hold a stretch position for 10 seconds, time (or count out) the stretch to ensure that you hold it for the recommended time. Also, you should incorporate only two to four heavier stretching days in each week and have a lighter stretching day in between each of the heavier stretching days.

Finally, for any stretch involving sitting or lying down, you should do the stretch with a cushion underneath you, such as a carpet or athletic mat. Cushioning makes the exercises more comfortable to perform. However, the cushioning should be firm. Too soft of a cushion will reduce the effectiveness of the stretches.

## RECOMMENDED PROGRAMS

The following programs are specific stretching recommendations and are based on your initial flexibility. In addition to following the programs listed, you should follow the general recommendations listed previously. Stay on each level for two to four weeks before going to the next level.

---

### Level I

- Hold the stretching position for 5 to 10 seconds.
  - Rest for 5 to 10 seconds between each stretch.
  - Repeat each stretch two times.
  - Use an intensity level on the scale from 1 to 3, with light pain.
  - Duration is 15 to 20 minutes each session.
  - Stretch two or three times per week.
-

---

## Level II

- Hold the stretching position for 10 to 15 seconds.
- Rest for 10 to 15 seconds between each stretch.
- Repeat each stretch three times.
- Use an intensity level on the scale from 2 to 4, with light to moderate pain, one or two times per week.
- Use an intensity level on the scale from 1 to 2, one or two times per week.
- Duration is 20 to 30 minutes each session.
- Stretch three or four times per week.

## Level III

- Hold the stretching position for 15 to 20 seconds.
- Rest for 15 to 20 seconds between each stretch.
- Repeat each stretch four times.
- Use an intensity level on the scale from 4 to 6, with moderate pain, two or three times per week.
- Use an intensity level on the scale from 1 to 4, two or three times per week.
- Duration is 30 to 40 minutes each session.
- Stretch four or five times per week.

## Level IV

- Hold the stretching position for 20 to 25 seconds.
- Rest for 20 to 25 seconds between each stretch.
- Repeat each stretch five times.
- Use an intensity level on the scale from 6 to 8, with moderate to heavy pain, two or three times per week.
- Use an intensity level on the scale from 1 to 6, two or three times per week.
- Duration is 40 to 50 minutes each session.
- Stretch four or five times per week.

## Level V

- Hold the stretching position for 25 to 30 seconds.
  - Rest for 25 to 30 seconds between each stretch.
  - Repeat each stretch five or six times.
  - Use an intensity level on the scale from 8 to 10, with heavy pain, two or three times per week.
  - Use an intensity level on the scale from 1 to 8, two or three times per week.
  - Duration is 50 to 60 minutes each session.
  - Stretch four or five times per week.
-



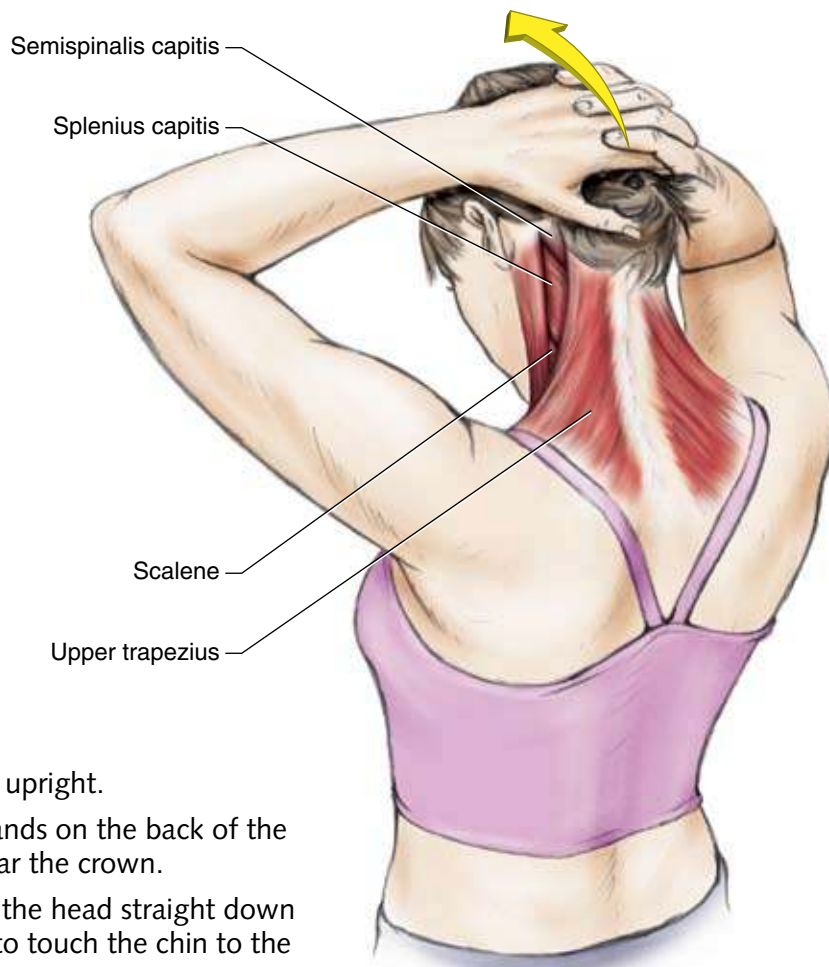
In the neck, the muscles are located in two triangular regions called the anterior and posterior triangles. The borders of the anterior triangle are the mandible (jawbone), the sternum (breast bone), and the sternocleidomastoid muscle. The major anterior muscles are the sternocleidomastoid and scalene. The borders of the posterior triangle are the clavicle (collarbone), sternocleidomastoid muscle, and trapezius muscle. The major posterior muscles are the trapezius, longissimus capitis, semispinalis capitis, and splenius capitis. The muscles in the neck are involved primarily in supporting or moving the head. The head movements are flexion (head tilted forward), extension (head tilted backward), lateral flexion and extension (head up and back sideward), and rotation. Since the muscles in the neck come in right and left pairings, all of the neck muscles are involved with lateral flexion and extension. For example, the right sternocleidomastoid helps perform right lateral flexion, and the left sternocleidomastoid helps perform right lateral extension. Illustrations showing the muscles and movements as well as a chart showing which muscles do a specific movement are located at the end of the chapter (pages 6-7).

When people think about doing stretching exercises, they seldom consider the neck muscles. Neck flexibility probably does not cross your mind until you discover that you have a stiff neck. A stiff neck is commonly associated with sleeping in a strange position (such as on a long flight), but a stiff neck can result from almost any type of physical activity. This is especially true for any activity where the head must be held in a constant stable position. Thus, a stiff neck can also have a negative effect in sports where head position is important (such as golf) or where rapid head movements are important for tracking the flight of an object (such as in racket sports). Poor neck flexibility usually results from holding the head in the same position for long periods. In addition, a fatigued neck muscle can stiffen up after exercise. The following exercises can help keep the neck from stiffening up after exercise, unusual postures, or awkward sleep positions.

Since all of the major muscles in the neck are involved in neck rotation, it is fairly easy to stretch the neck muscles. The first consideration when choosing a particular neck stretch should be whether greater stiffness occurs with flexion or extension. Therefore, the first two exercise groups are concerned with these specific actions. Once you achieve greater flexibility in either pure flexion or pure extension, then you can add a stretch that includes lateral movement. In other words, to increase the flexibility of the neck extensors, start with the neck extensor stretch and then, as flexibility increases, add the neck extensor and rotation stretch.

Remember that overstretching (very hard stretching) causes more harm than good. Sometimes a muscle becomes stiff from overstretching. Stretching can reduce muscle tone, and when tone is reduced, the body compensates by making the muscle even tighter. For each progression, start with the position that is the least stiff and progress only when, after several days of stretching, you notice a consistent lack of stiffness during the exercise. This means that you should stretch both the agonist muscles (the muscles that cause a movement) and antagonist muscles (the muscles that oppose a movement or do the opposite movement). Also, remember that although you may have greater stiffness in one direction (right versus left), you need to stretch both sides so that you maintain proper muscle balance.

## Neck Extensor Stretch



### Technique

Sit or stand upright.

Interlock hands on the back of the head near the crown.

Lightly pull the head straight down and try to touch the chin to the chest.

### Muscles Stretched

**Most-stretched muscle:** Upper trapezius.

**Lesser-stretched muscles:** Longissimus capitis, semispinalis capitis, splenius capitis, scalene.

### Commentary

You can do this stretch either while sitting or while standing. A greater stretch is applied when seated. Standing reduces the ability to stretch because reflexes come into play to prevent a loss of balance. During the stretch, make sure not to reduce the stretch by hunching up the shoulders. Also, keep the neck as straight as possible (no curving). Try to touch the chin to the lowest possible point on the chest.

## Neck Extensor and Rotation Stretch

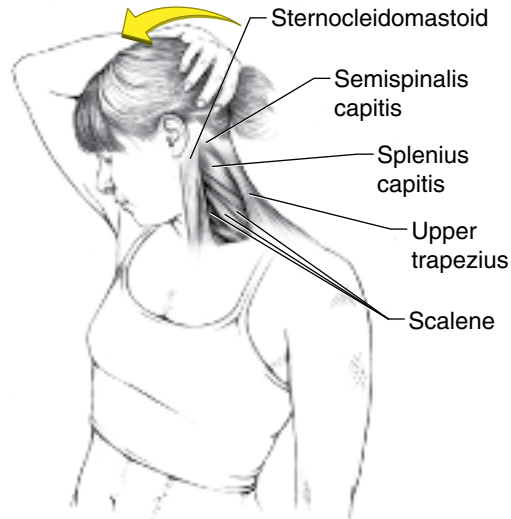
When the neck extensors become flexible, progress from stretching the right and left sides simultaneously to stretching the opposite sides individually. To do this, follow this procedure:

### Technique

Sit or stand upright.

Place the right hand on the back of the head near the crown.

Pull the head down toward the right and try to touch the chin as close as possible to the right shoulder.

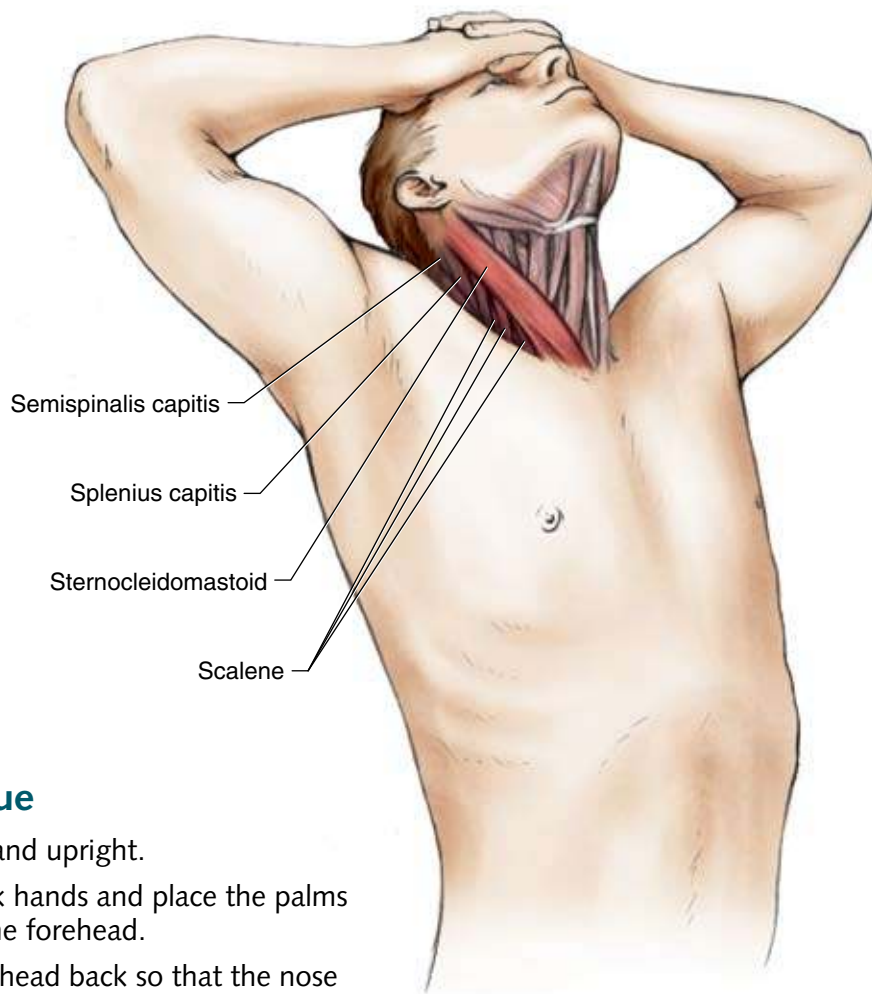


### Muscles Stretched

**Most-stretched muscles:** Left upper trapezius, left sternocleidomastoid.

**Lesser-stretched muscles:** Left longissimus capitis, left semispinalis capitis, left splenius capitis, left scalene.

## Neck Flexor Stretch



### Technique

- Sit or stand upright.
- Interlock hands and place the palms on the forehead.
- Pull the head back so that the nose points straight up to the ceiling.

### Muscles Stretched

**Most-stretched muscle:** Sternocleidomastoid.

**Lesser-stretched muscles:** Longissimus capitis, semispinalis capitis, splenius capitis, scalene.

### Commentary

You can do this stretch either while sitting or while standing. A greater stretch is applied when seated. Standing reduces the ability to stretch because reflexes come into play to prevent a loss of balance. During the stretch, make sure not to reduce the stretch by hunching up the shoulders. Also, try to point the chin as far back as possible.



## Neck Flexor and Rotation Stretch

When the neck flexors become flexible, progress from stretching the right and left sides simultaneously to stretching the opposite sides individually. To do this, follow this procedure:

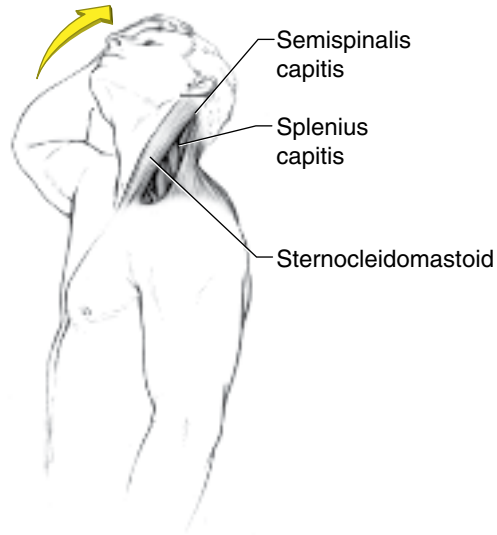
### Technique

Stand or sit upright.

Place right hand on the forehead.

Pull the head back and toward the right so that the head points toward the shoulder.

Keep the head straight; do not lay the head down to either side.



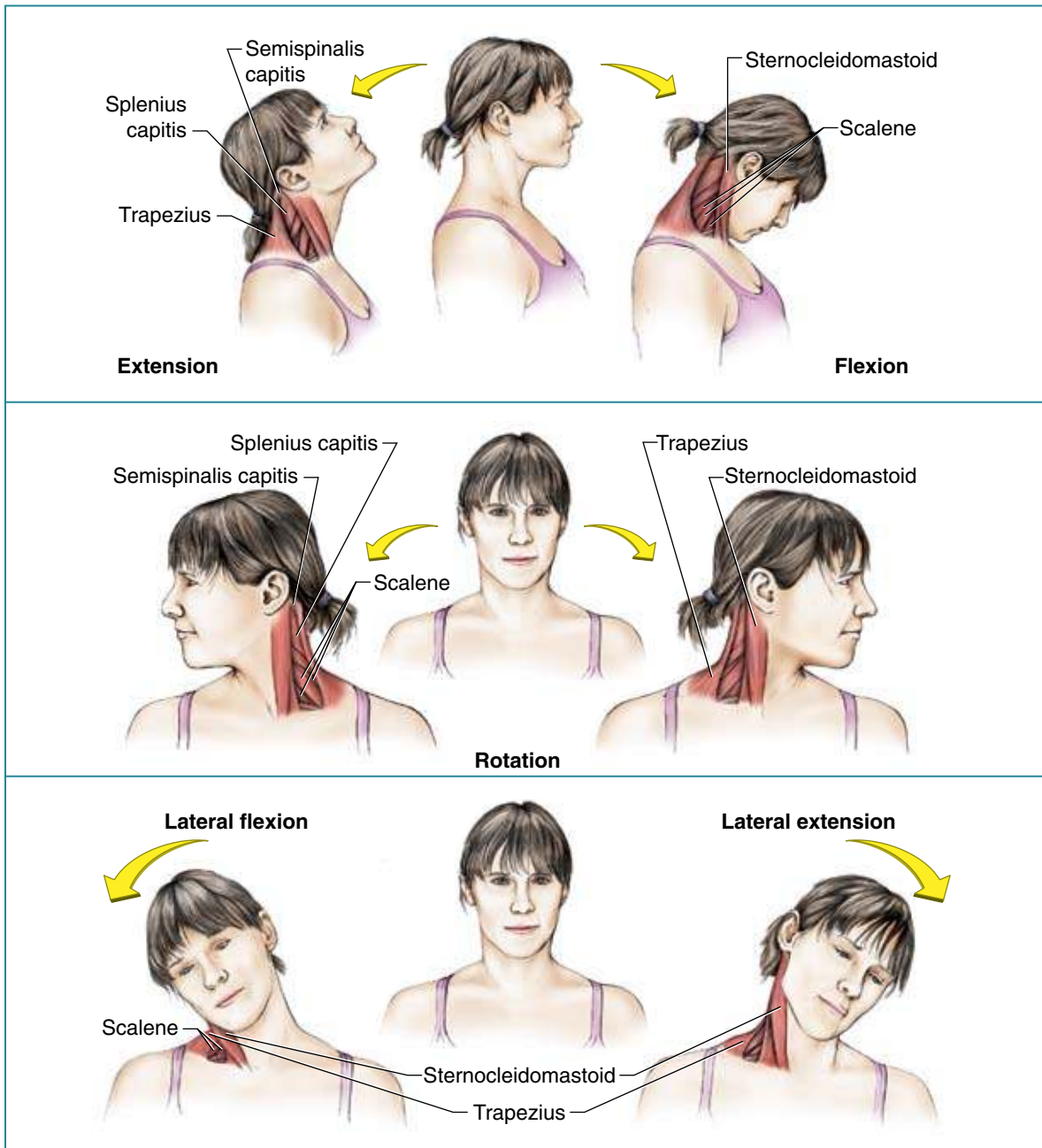
### Muscles Stretched

**Most-stretched muscle:** Left sternocleidomastoid.

**Lesser-stretched muscles:** Left longissimus capitis, left semispinalis capitis, left splenius capitis.

## Neck Muscle Movements

The stretches in this chapter are excellent overall stretches; however, not all of these stretches may be completely suited to each person's needs. The muscles involved in the various neck movements appear in the following table. To stretch specific muscles, the stretch must involve one or more movements in the opposite direction of the desired muscle's movements. For example, if you want to stretch the left scalene, you could extend the head both backward and laterally to the right. When a muscle has a high level of stiffness, you should use fewer simultaneous opposite movements (you would stretch a very tight right scalene by initially doing just left lateral extension). As a muscle becomes loose, you can incorporate more simultaneous opposite movements.



Muscle	Flexion	Extension	Rotation	Lateral flexion	Lateral extension
Longissimus capitis		✓	✓	✓	✓
Scalene	✓		✓	✓	
Semispinalis capitis		✓	✓	✓	✓
Splenius capitis		✓	✓	✓	✓
Sternocleidomastoid	✓		✓	✓	✓
Trapezius		✓	✓	✓	✓

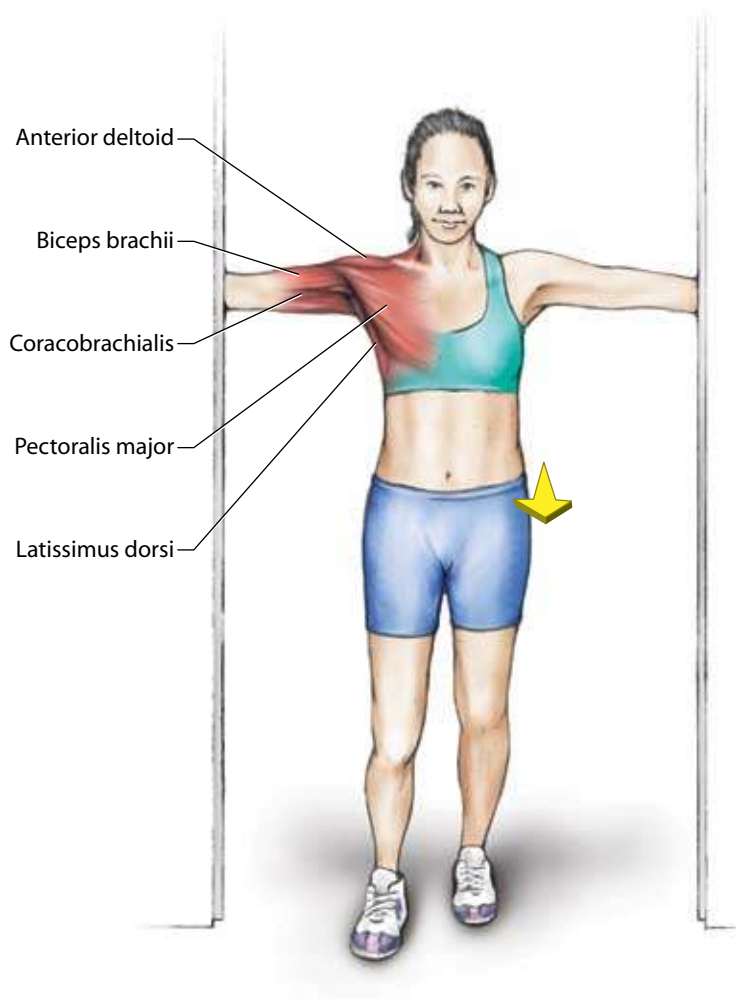


There are five major pairs of movements at the shoulder: flexion and extension, abduction and adduction, external and internal rotation, retraction and protraction, and elevation and depression. Illustrations showing these movements as well as a chart showing which muscles do specific movements are located at the end of the chapter (pages 21-23). The bones of the shoulder joint consist of the humerus (upper arm bone), scapula (shoulder blade), and clavicle (collarbone). The scapula and clavicle essentially “float” on top of the rib cage. Therefore, a major function of many upper-back and chest muscles is to attach the scapula (in the upper back) and clavicle (in the upper chest) to the rib cage and spine. This provides a stable platform for arm and shoulder movements. Of the five movement pairs mentioned here, retraction and protraction and elevation and depression are usually classified as stabilization actions. The majority of the muscles involved in moving and stabilizing the shoulder bones are located posterior. The scapula is a much larger bone than the clavicle and has room for more muscles to attach. The posterior muscles are infraspinatus, latissimus dorsi, levator scapulae, rhomboids, subclavius, subscapularis, supraspinatus, teres major, teres minor, and trapezius (attached to the upper posterior rib cage, vertebrae [spine], and scapulae), as well as the deltoid and triceps brachii (attached to the scapulae and humerus). The anterior muscles are the pectoralis major (attached to the clavicle anterior rib cage and humerus), the pectoralis minor, and serratus anterior (attached to the anterior rib cage and anterior scapulae as well as the biceps brachii, coracobrachialis, and deltoid (attached to the anterior scapulae and humerus).

Common complaints associated with the musculature of the shoulders and upper back and chest are tight muscles and muscle spasms in the neck (middle and upper trapezius), shoulder (trapezius, deltoid, supraspinatus), and upper-back muscles (rhomboids and levator scapulae). Interestingly, the tightness felt in these muscles is usually a result of initial tightness in their antagonist muscles. In other words, tight muscles in the upper chest caused the tightness felt in the upper back. Tight chest muscles (that is, the pectoralis major) cause a constant low-level stretch on the muscles of the upper back. Eventually, this low-level stretch elongates the ligaments and tendons associated with the upper-back muscles. Once these ligaments and tendons become elongated, the tone in their associated muscles falls dramatically. To reclaim the lost tone, the muscles must increase their force of contraction. Increased force in turn causes more stretch of the ligaments and tendons, and increased muscle contraction must compensate for that. Hence, a vicious cycle commences. The best way to prevent or stop this cycle is to stretch the anterior shoulder and chest muscles. As these muscles increase in flexibility, the tightness of the posterior muscles will also be reduced. Also, immediately after stretching, the strength of the muscles is diminished. It is also a good idea to stretch the opposing muscles just before and immediately after working any group of muscles. If this is done three or more times a week, the muscles will actually increase in flexibility and gain strength. Stretching will also reduce the frequency of tightness for any group of muscles.

Many of the instructions and illustrations in this chapter are given for the left or right side of the body. Similar but opposite procedures would be used for the opposite (not pictured) side of the body.

## Shoulder Flexor Stretch



### Technique

Stand upright while facing a doorway or corner.

Place feet shoulder-width apart with one foot slightly in front of the other.

With straight arms, raise your arms to shoulder level and place the palms on the walls or doorframe with the thumbs on top.

Lean the entire body forward.

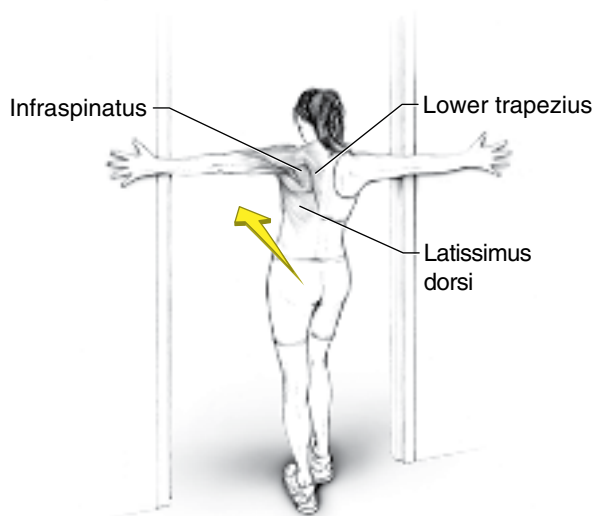
### Muscles Stretched

**Most-stretched muscles:** Pectoralis major, anterior deltoid, coracobrachialis, biceps brachii.

**Lesser-stretched muscles:** Infraspinatus, latissimus dorsi, subclavius, lower trapezius.

## Commentary

To get the maximum benefit during the stretch, keep the elbows locked and the spine straight. The greater the forward lean, the better the stretch. Forward lean is controlled by how far the lead foot is in front of the chest at the start position. Hence, place the foot forward only enough to maintain balance. It is possible to do the neck extensor stretch simultaneously with the shoulder flexor stretch. However, without having the hands pushing down on the head, the neck extensor stretch will be of a lower intensity than if it were done by itself.



## VARIATION

### Shoulder Flexor and Depressor Stretch

Elevating the arms will stretch more muscles.

#### Technique

Stand upright while facing a doorway or corner.

Place feet shoulder-width apart with one foot slightly in front of the other.

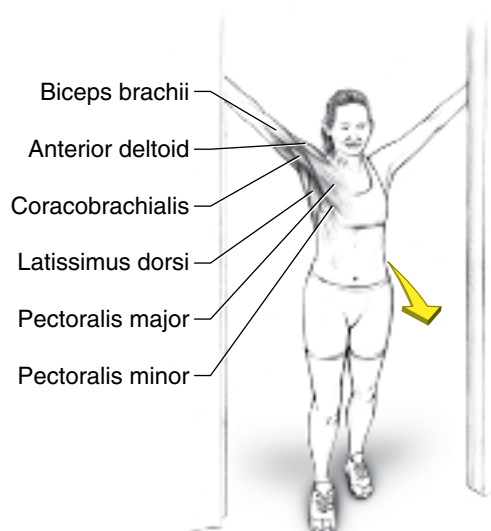
With straight arms, raise arms high above the head, and place the palms on the walls or doorframe.

Lean the entire body forward.

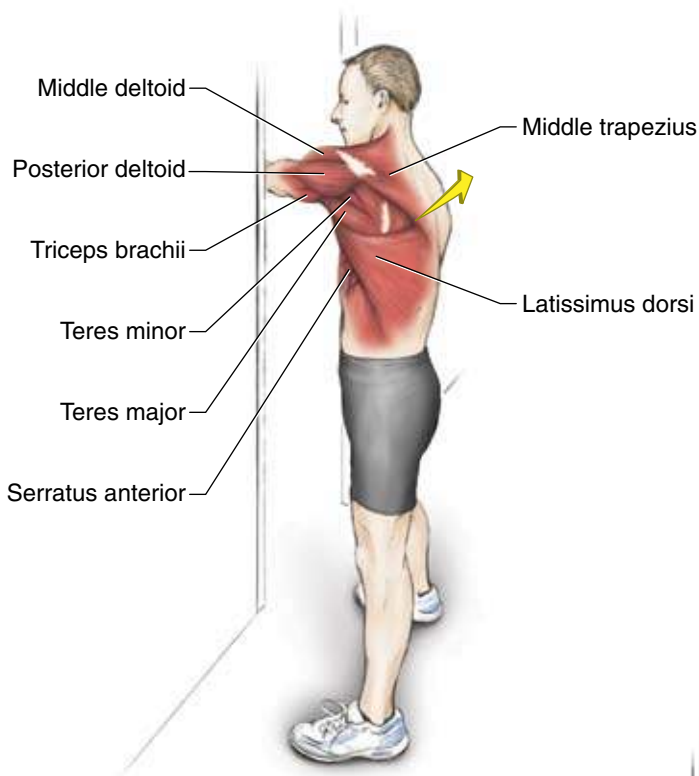
#### Muscles Stretched

**Most-stretched muscles:** Pectoralis major, anterior deltoid, coracobrachialis, biceps brachii, pectoralis minor.

**Lesser-stretched muscles:** Latissimus dorsi, lower trapezius, subclavius.



## Shoulder Extensor, Adductor, and Retractor Stretch



### Technique

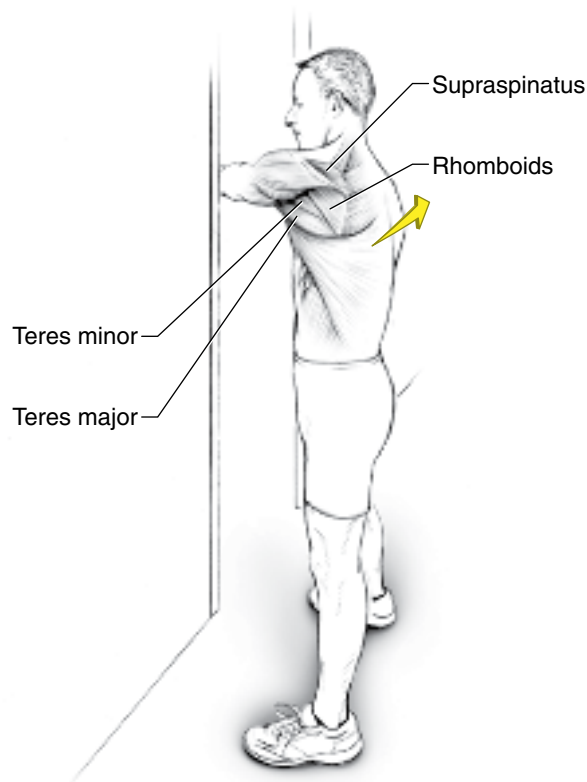
Stand upright inside a doorway while facing a doorjamb with the doorjamb in line with the right shoulder.

Place feet shoulder-width apart with the toes pointing straight forward.

Bring the left arm across the body toward the right shoulder.

Pointing the thumb down, grab hold of the doorjamb at shoulder level.

Rotate the trunk inward until you feel a stretch in the posterior left shoulder.





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