PART II Conditions in Specific Locations

CHAPTER 4

Hyperkyphosis

UNDERSTANDING HYPERKYPHOSIS

A healthy spine has four natural curves (Fig. 4-1). The two lordotic curves—cervical and lumbar—arc anteriorly. The two kyphotic curves—thoracic and pelvic—arc posteriorly. These curves are ideal in our species to maintain balance, absorb the impact of movement, and allow maximum flexibility for our particular types of activity.

Hyperkyphosis is an increased kyphotic curve. This chapter focuses on the more common thoracic hyperkyphosis: an increased thoracic curve most often accompanied by protracted scapulae, internally rotated shoulders, and a head-forward posture (Fig. 4-2). In a very short period relative to our evolution, human lifestyle has changed from one that was once considerably physical—hunting and gathering, walking, manual labor, and so on—to one that is becoming increasingly sedentary. Today, we spend a lot of time driving, sitting at a desk, working at a computer, watching television, and so on. These static postures put many of the body's joints in flexion. The hips, knees, thorax, and shoulders are often nearly immobile for hours at a time. Because of this, hyperkyphosis and hyperlordosis are two very common postural deviations that lead to chronic pain and reduced ROM in our modern lifestyle. Both of these postures may lead to other conditions, but you may find that normalizing the curves of the spine and leveling the ilia and scapulae will reduce pain and restriction and may facilitate your treatment of accompanying conditions.

Functional versus Structural Postural Imbalance

The hyperkyphosis described above is functional; its cause is primarily soft tissue dysfunction and postural deviations that result from an injury or activities of daily living. These deviations can be treated with manual therapy, self-care, and postural awareness. The therapeutic goal for functional hyperkyphosis is to lengthen the muscles that have shortened, have become hypertonic, and are pulling the bones out of alignment; to strengthen the muscles that have stretched and become weak; and to reset the neuromuscular system to recognize proper posture and diaphragmatic breathing as normal.

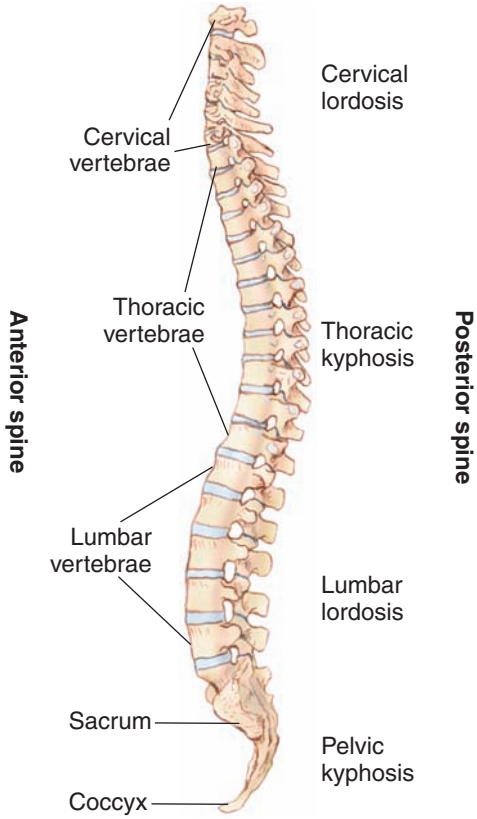


Figure 4-1 Curves of the spine. The cervical and lumbar lordotic curves arc anteriorly. The thoracic and pelvic kyphotic curves arc posteriorly.

Figure 4-2 Hyperkyphosis. Hyperkyphosis involves an increased thoracic curve most often accompanied by protracted scapulae, internally rotated shoulders, and a head-forward posture.

A structural curve, in contrast, is primarily caused by changes in bones. Bone fusions, the development of spurs or new bony prominences, fractured bones that were not well set, osteoporosis, and degenerative disc disease are a few of the possible contributing factors. Manual therapy may offer pain relief, increase ROM, and slow the progression of postural imbalance but is unlikely to reverse the dysfunction. A client's health history may help you assess whether postural deviations are structural in nature, although a diagnosis of structural hyperkyphosis requires medical testing. When a client's hyperkyphosis is structural, it is best to discuss the condition with a health care provider to fully understand the causes. You may need to modify positioning, bolstering, length of treatment, and techniques to accommodate the client's particular needs.

Muscles of the Upper Cross

Thoracic hyperkyphosis is also referred to as upper cross syndrome. Coined by Vladimir Janda, MD, DSc, upper cross syndrome refers to an imbalance and dysfunction of the agonists and antagonists that move and support the thorax. The muscles that become short and tight and the muscles that become weak and overstretched form a cross through the upper thoracic spine (Fig. 4-3). You typically find the pectorals, anterior deltoid, and posterior neck muscles short and tight, while the muscles between the scapulae and those deep in the anterior neck are stretched and weak. The weakened muscles become less able to oppose the actions of the agonists that internally rotate the shoulders, protract the scapula, flex the thoracic spine, and pull the head forward. As this happens, the imbalance can become more profound and the body less able to reverse the process without intervention (Table 4-1).

Common Signs and Symptoms

The most common signs of hyperkyphosis are postural changes such as an increased thoracic curve, protracted scapulae, internally rotated shoulders, and a head-forward posture. The most common symptom of developing thoracic hyperkyphosis is pain between the scapulae and along the posterior neck. Overstretched muscles including the rhomboids, middle trapezius, and thoracic erector spinae form taut bands that may harbor trigger points. The primary function of the rhomboids and middle trapezius in a static posture is to keep the spine erect and the scapulae retracted. When the client's common posture stretches them, these muscles (and the nerves that innervate them) are working against the tight pectorals to try to bring the scapulae closer to the spine. If the pectorals are not lengthened, the rhomboids and middle trapezius are fighting a difficult battle, a form of overuse, and can become weak and easily fatigued. In addition, trigger points in the scalenes, levator scapula, trapezius, and latissimus dorsi all refer pain between the scapulae. With adhesions, trigger points, and spasm, the cervical and thoracic spine may become hypomobile if left untreated.

Internally rotated shoulders, protracted scapulae, and the head-forward position each involve muscles that, when hypertonic, may compress nerves and vessels, resulting in thoracic outlet syndrome (see Chapter 6), which is frequently mistaken for carpal tunnel syndrome (see Chapter 7) when the site of nerve compression is not correctly identified. When thoracic outlet syndrome develops, lymphatic structures may be compressed, causing insufficient drainage and edema; vasculature may be compressed, leading to insufficient circulation and ischemia; and nerves may be compressed, leading to pain, numbness, and tingling along their distribution and weakening or atrophy of muscles supplied by the compromised nerves.

With the thorax flexed, movement of the ribcage and the muscles of respiration are restricted, which may cause shallow breathing and can lead to chronic respiratory dysfunction. A client with prior respiratory disorders who develops hyperkyphosis may experience increased signs and symptoms of respiratory dysfunction. Protraction of the scapulae turns the glenohumeral joint

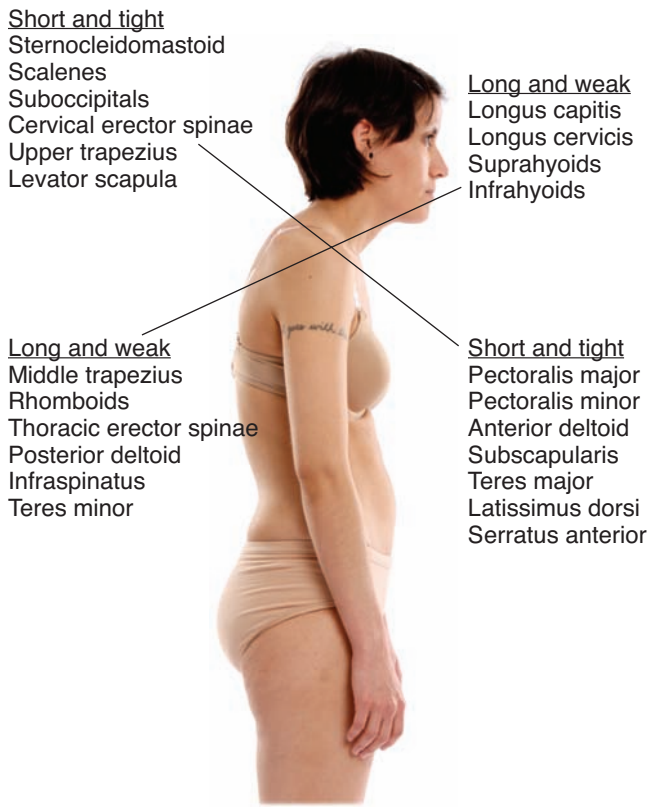


Figure 4-3 Muscles of the upper cross. Notice the relationship between the muscles that are short and tight and those that are long and weak.

Table 4-1 Muscles of the Upper Cross with Actions That Contribute to Hyperkyphosis

Muscles That are Short and Tight (with Agonist Action)	Muscles That are Stretched and Weak (with Antagonist Opposition)
Pectoralis major (internal rotation of shoulder)	Infraspinatus (internal rotation of shoulder)
Anterior deltoid (internal rotation of shoulder)	Posterior deltoid (internal rotation of shoulder)
Subscapularis (internal rotation of shoulder)	Teres minor (internal rotation of shoulder)
Teres major (internal rotation of shoulder)	
Latissimus dorsi (internal rotation of shoulder)	
Serratus anterior (protraction of scapula)	Middle trapezius (protraction of scapula)
Pectoralis minor (protraction of scapula)	Rhomboid major and minor (protraction of scapula)
SCM (head forward)	Longus capitis (head forward)
Scalenes (head forward)	Longus cervicis (head forward)
Upper trapezius (upper cervical extension)	Suprahyoids (upper cervical extension)
Levator scapulae (upper cervical extension)	Infrahyoids (upper cervical extension)
Suboccipitals (upper cervical extension)	Thoracic erector spinae (increased thoracic curve)
Cervical erector spinae (upper cervical extension)	

inferiorly, causing the rotator cuff muscles to compensate and become hypertonic. If left untreated, particularly if the client uses repetitive motions of the glenohumeral joint with resistance, frozen shoulder may develop. The head-forward posture and extension of the upper cervical vertebrae may stress the facet joints and lead to wearing of the intervertebral discs. When the head is in a forward position, the mandible is drawn posteriorly, which may contribute to dysfunction in the temporomandibular joint, often resulting in grinding of the teeth, called bruxism. Trigger points in the muscles of mastication refer pain into the teeth that can be mistaken for toothache. Trigger points in muscles including the SCM and upper trapezius may refer into the head, causing tension headaches. You may also find one or both shoulders elevated, or hyperlordosis (see Chapter 8). It is difficult to say which of these postural deviations begins the process, but as one develops, the others may follow as the body attempts to stay balanced on its center of gravity with the eyes level and looking forward.

Possible Causes and Contributing Factors

Pathologies that affect the integrity of bones are often the cause of structural hyperkyphosis. Porous bones (osteoporosis) become unable to bear weight and may cause the thoracic vertebrae to collapse upon each other, resulting in increased curvature. Nutritional deficiencies of calcium and vitamin D as well as increased consumption of calcium oxalate and carbonated beverages may play a role in the body's ability to rebuild bone. Ankylosing spondylitis—an autoimmune disease that causes arthritis or swelling in the spine—ultimately causes the vertebrae to fuse with the thorax in flexion. Tuberculosis that settles in the spine—an infection called Pott's disease—also results in deterioration of the vertebrae that can cause structural hyperkyphosis. Scheuermann's disease—an idiopathic condition that affects adolescents—occurs when the posterior aspects of the vertebrae grow faster than the anterior portion, causing the vertebrae to wedge and increase the thoracic curve. Congenital defects, such as spina bifida or muscular dystrophy, may also contribute.

Figure 4-4 **Poor seated posture.** Poor seated posture that contributes to hyperkyphosis is common among desk workers.

The primary contributing factor to functional thoracic hyperkyphosis is poor posture. In some cases, as with muscular dystrophy or radiculopathy, poor posture results from muscle degeneration and interrupted innervation. More commonly, upper cross postural deviations result from voluntary poor posture. For example, if a client regularly performs activities that require the shoulders to be in flexion and internal rotation, the head is likely to jut forward, adding much weight to the anterior frontal plane (Fig. 4-4).

Try this yourself: Sit straight with your arms hanging comfortably at your sides. Slowly raise your shoulders into flexion and internal rotation as if to type on a keyboard, paying close attention to how your neck and head follow. Certainly, you can force your head to stay straight, but these movements often naturally cause the head to move slightly forward and the neck to flex slightly. Because we need to look straight ahead, the upper vertebrae of the neck extend to level the eyes. When this is a common, daily posture, the thoracic spine begins to curve posteriorly. Moreover, when a client regularly assumes this posture, the pectoral muscles are shortened and develop increased tone, while the middle trapezius and rhomboids become overstretched, making it difficult for them to resist the pull of the pectorals. Left untreated, the kyphotic curve will continue to increase, the scapulae will continue to protract, and the cervical and lumbar lordotic curves may continue to increase to compensate.

Exercise and sports involving resisted contraction in the pectoral muscles may contribute to hyperkyphosis. Professions that involve heavy lifting, repeated flexion and internal rotation of the shoulders, or a slouched posture may place the worker at risk. Age also plays a role as the bones become weaker over time, and the person performs less frequently those activities that keep the joints mobile. Poor eyesight or hearing, which may cause the client to thrust the head forward in order to see or hear better, may become a contributing factor if left unaddressed. Respiratory conditions affecting the tone of the muscles of respiration may also play a role.

Table 4-2 lists conditions that are commonly confused with or that contribute to hyperkyphosis.

Contraindications and Special Considerations

- **Underlying pathologies.** Ankylosing spondylitis, osteoarthritis, osteoporosis, degenerative disc disease, bone spurs, or fusions may be present. If you suspect one of these (consult Table 4-2 and your pathology book for signs and symptoms), refer the client to a health care

Table 4-2 Differentiating Conditions Commonly Confused with or Contributing to Hyperkyphosis

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Osteoporosis	Bone or joint pain, tenderness, bone fractures, loss of height, slouching	Bone mineral density test CT, X-ray Urinary calcium test	Indicated in early stages and with health care provider approval in later stages. May reduce pain. Take care not to use force that may fracture a bone.
Spondylolisthesis (begins in lumbar, proceeds to thoracic spine)	Lumbar hyperlordosis Pain in low back, buttocks, and thighs Stiff back	X-ray	Massage is indicated. Use caution if bones are fragile. Stretching and strengthening encouraged.
Ankylosing spondylitis	Pain often begins in low back unilaterally and progresses bilaterally to upper back and throughout thorax Fatigue and anemia may develop	MRI Blood tests	Indicated to reduce pain, maintain mobility, and slow progress of spinal distortion Use caution if bones are fragile.
Scheuermann's disease (juvenile kyphosis)	Begins at puberty Pain, curved spine that worsens when bending, difficulty breathing, chest pain Signs and symptoms cease when child stops growing	X-ray Adam's forward bending test	Indicated to reduce pain
Pott's disease (tuberculous arthritis)	Slow onset Low-grade fever Excessive perspiration Loss of appetite Swollen, tender joints Spinal masses Numbness and tingling in extremities Reduced ROM	X-ray Tuberculin skin test (PPD) Aspiration of joint fluid Biopsy to test bacteria	Contraindicated until infection is resolved completely Work with health care provider in cases of abscesses or other contraindications. Massage may be helpful to reduce pain.
Muscular dystrophy	Many forms appear in childhood or adolescence, although a few may develop in adulthood Muscle weakness Loss of coordination Progressive, resulting in fixed contracture of muscles	Blood test for creatine level Electromyography Ultrasonography Muscle biopsy Genetic testing	Work with health care provider. Massage may reduce pain and delay contracture.
Paget's disease	Persistent bone pain Joint pain and stiffness Headache, neck pain Bowed legs Locally hot to touch Fractures Hearing loss Loss of height	X-ray Bone scan Blood test for serum alkaline phosphatase and serum calcium	Work with health care provider. Massage may help maintain flexibility. Use caution if bones are fragile.

Table 4-2 Differentiating Conditions Commonly Confused with or Contributing to Hyperkyphosis (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Nerve root compression (radiculopathy)	Muscle spasm, weakness, or atrophy Pain around scapula on affected side Neck pain Pain radiates to extremities Pain worsens with lateral flexion or rotation or when sneezing, coughing, laughing, or straining	Spurling's test Valsalva's test Neurological exam to test reflexes, sensation, and strength X-ray or MRI to assess for space occupying lesions	Indicated if cause and location are understood. Take care not to increase compression of nerve or reproduce symptoms.

provider for assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not contraindicated for massage, work with the health care provider to develop a treatment plan.

- **Endangerment sites.** Be cautious near the endangerment sites in the neck and axilla. Gently palpate for the pulse of the carotid artery before you begin working on the neck. Avoid this area; if you feel a pulse while working, back off slowly and avoid the area.
- **Treatment duration and pressure.** If the client is elderly, has degenerative bone disease, or has been diagnosed with a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better.
- **Positioning.** Use bolsters to position a client for comfort as well as to reduce postures that may contribute to hyperkyphosis. In the prone position, bolsters under the shoulders will reduce protraction of the scapulae. Adjust the face cradle to reduce extension in the neck. In the supine position, a bolster along the length of the spine and under the occiput will reduce protraction of the scapulae and extension of the neck. If hyperlordosis is present, a bolster across the anterior superior iliac spine in the prone position will reduce anterior pelvic tilt, and a bolster under the ankles may reduce tension in the low back. A bolster under the knees in the supine position may reduce tension on the low back.
- **Hydrotherapy.** Do not use moist heat on the neck or chest if the client has a cardiovascular condition that may be affected by the dilation of blood vessels. Severe hypertension and atherosclerosis are two examples of conditions where hydrotherapy is contraindicated. Consult your pathology book for recommendations.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition, such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised or if the client is taking an anti-inflammatory medication. Friction may initiate an inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours before treatment if his or her health care provider agrees.
- **Tissue length.** It is important when treating myofascial tissues to not stretch tissues that are already overstretched. Assess for myofascial restrictions first and treat only those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion because their length should not be increased. If you treat trigger points, use heat or a localized pin and stretch technique instead of full ROM stretching. For example, because the rhomboids and middle trapezius tend to be overstretched, it is not advised to perform myofascial release or a full stretch from origin to insertion across the length of these muscles.
- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Massage Therapy Research

Studies in journals covering subjects ranging from physical therapy to neuroscience report that hyperkyphosis results in structural changes or is caused by functional changes, such as the shortening or lengthening of muscles in the upper cross, and is often associated with neurological dysfunction. Although several articles describe exercise, yoga, chiropractic care, surgery, self-care, proprioceptive neuromuscular facilitation, and other methods of reducing the symptoms of hyperkyphosis, a thorough literature review reveals no research, case studies, or articles specifically showing the benefits of massage therapy for hyperkyphosis, kyphosis, or upper cross syndrome. Many of the studies addressing hyperkyphosis focus on increased thoracic curvature in the elderly as a result of osteoporosis. While much literature describes the phenomenon of increased thoracic flexion in a society prone to hunched, seated postures, research has not yet investigated massage as a specific treatment option for hyperkyphosis.

In 2008, Greig et al. conducted a study titled "Postural taping decreases thoracic kyphosis but does not influence trunk muscle electromyographic activity or balance in women with osteoporosis." As the title suggests, taping decreased the thoracic curve but had no effect on muscle tone associated with hyperkyphosis. Additional research is necessary to determine whether manual manipulation of the trunk muscles may have an effect on electromyographic activity and whether such an effect may suggest massage as a treatment option with longer-lasting effects.

Research into the benefits of massage for scoliosis, thoracic outlet syndrome, temporomandibular joint dysfunction, respiratory distress, and other syndromes commonly associated with hyperkyphosis is available. Although anecdotal evidence has suggested that manual therapy reduces pain and increases ROM when hyperkyphosis is present, additional research is needed to determine the benefits of massage therapy intended to lengthen shortened muscles, strengthen weakened muscles, and reset neuromuscular function for clients presenting with signs and symptoms of functional hyperkyphosis.

WORKING WITH THE CLIENT

Client Assessment

Hyperkyphosis is one of the most common postural deviations causing chronic pain and restricted ROM in the upper body. It involves many joints and nearly all of the muscles of the upper body. A wide variety of possible factors can contribute to the development of both structural and functional hyperkyphosis. All of these elements add up to many variations in how a client may present to you. For example, a client may hold the phone more frequently at his or her left ear with the left shoulder and present with left lateral flexion and right rotation of the neck, which suggests that the scalenes and SCM on the left side may be short and tight. Another client may frequently carry a heavy bag on the right shoulder and may present with an elevated right shoulder, which suggests that the upper trapezius and levator scapulae may be short and tight. Common presentations of hyperkyphosis are described below. However, it is essential to assess every joint to put together an accurate picture for each individual client. In addition, because treatment goals differ, it is important to know if the primary cause of hyperkyphosis is functional or structural.

Assessment begins at your very first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself.

Table 4-3 Health History

Questions for the Client	Importance for the Treatment Plan
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors.
Describe what your symptoms feel like.	Differentiate possible origins of symptoms and determine the involvement of nerves or blood vessels.
Do any movements make it worse or better?	Locate tension, weakness, or compression in structures producing such movements.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Bone density, blood, and respiratory function tests may indicate contributing factors. Medical tests may indicate that hyperkyphosis is structural in nature.
Have you been diagnosed with a conditionsuch as osteoporosis, rheumatoid arthritis or osteoarthritis, asthma, temporomandibular joint disorder, weakened vision or hearing?	Systemic and other conditions may contribute to signs and symptoms, may require adjustments to treatment, and may impact treatment outcomes.
Have you had an injury or surgery?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures that increase thoracic flexion, protracted scapulae, neck extension, or head-forward posture may contribute to the client's condition.
Are you taking any prescribed medications or herbal or other supplements?	Medications of all types may contribute to symptoms or have contraindications or cautions.
Have you had a cortisone shot in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction may initiate an inflammatory process and should not be performed if the client has recently taken anti-inflammatory medication.

Table 4-3 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to walk and enter the room ahead of you while you assess posture and movements before the client is aware that the assessment has begun. Look for imbalances or patterns of compensation for deviations common with hyperkyphosis. Have the client sit at a desk or table to fill out the assessment form, and look for a slouching posture. If he or she is slouched, ask a question to draw his or her attention to you and away from the form. Notice whether he or she extends the thoracic spine or only the upper cervical spine when looking up at you. Extending only the upper cervical spine may indicate weakness in thoracic extension. Look for slight rotation of the neck when the client is looking straight ahead. This may indicate shortening of the contralateral upper trapezius, scalenes, or SCM or shortening of the ipsilateral levator scapulae, splenius, or cervical erector spinae. If the internal rotators of the shoulder are shortened, the client's elbow and forearm may not rest on the table while writing. Watch also as the client stands up to see whether he or she extends the thoracic spine or whether the momentum comes mostly from hip and knee extension. If hyperlordosis is also present, knee extension may be the primary force, and the client may use the table for assistance in standing. Supplement these findings with a standard assessment of the client's stationary, standing posture. Figure 4-5 compares the anatomic position to posture affected by hyperkyphosis.

ROM ASSESSMENT

Test the ROM of the neck, shoulders, and thoracic spine, assessing length and strength of both agonists and antagonists that cross the joints tested. If hyperkyphosis is structural in nature, do not perform ROM tests that move the affected joints into ranges that are inhibited by altered joint structure. For example, if thoracic vertebrae are fused into flexion, do not test extension of the thoracic spine. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or re-injury. Box 4-1 presents the average active ROM results for the joints involved in hyperkyphosis.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 4-1. Pain and other symptoms may not be reproduced with active ROM assessment because the client may limit movement to a symptom-free range.

- **Active extension of the thoracic spine** may be reduced when muscle tension, adhesions, and trigger points in the extensors of the thoracic spine contribute to hyperkyphosis. The client may resist full active extension of the thoracic spine if this produces symptoms during activities of daily living.
- **Active flexion of the cervical spine** may be restricted due to weakened deep cervical flexors attempting movement against shortened upper cervical extensors.
- **Active rotation and lateral flexion** of the cervical spine may be reduced or cause pain due to hypertonicity or spasm in the rotators and lateral flexors of the cervical spine or the weakening of their antagonists.
- **Active external rotation of the shoulder** may be restricted due to adhesions, hypertonic internal rotators of the shoulder, and protraction of the scapula.

Passive ROM

Compare the client's passive ROM on one side to the other when applicable. Note and compare the end feel for each range (see Chapter 1 for an explanation of end feel).

- **Passive flexion of the cervical spine** may be restricted or cause discomfort due to shortened cervical extensors or dysfunction of the vertebrae.
- **Passive lateral flexion or rotation of the cervical spine** may be restricted unilaterally if the client's posture favors lateral flexion or rotation in the opposite direction.
- **Passive extension of the cervical spine** may be restricted by the head-forward posture due to tension in muscles such as the scalenes or SCM that also flex the cervical spine. If the head-forward posture is not present, passive extension of the cervical spine will likely occur with ease, although it may produce pain at the end point.
- **Passive external rotation of the shoulder** may be restricted if the scapula is protracted, causing the glenohumeral joint to be rotated inferiorly.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the involved joints. Compare the strength of the affected side to that of the unaffected side.

- **Resisted extension of the thoracic spine** may reveal pain and weakness in the thoracic erector spinae.
- **Resisted retraction of the scapula** may reveal pain and weakness in the rhomboids and middle trapezius.
- **Resisted rotation or lateral flexion of the neck** may produce pain or a referral if the muscles responsible for that action are tight or contain trigger points, and may reveal weakness in their antagonists.
- **Resisted external rotation of the shoulder** may reveal weakness in the external rotators of the shoulder.

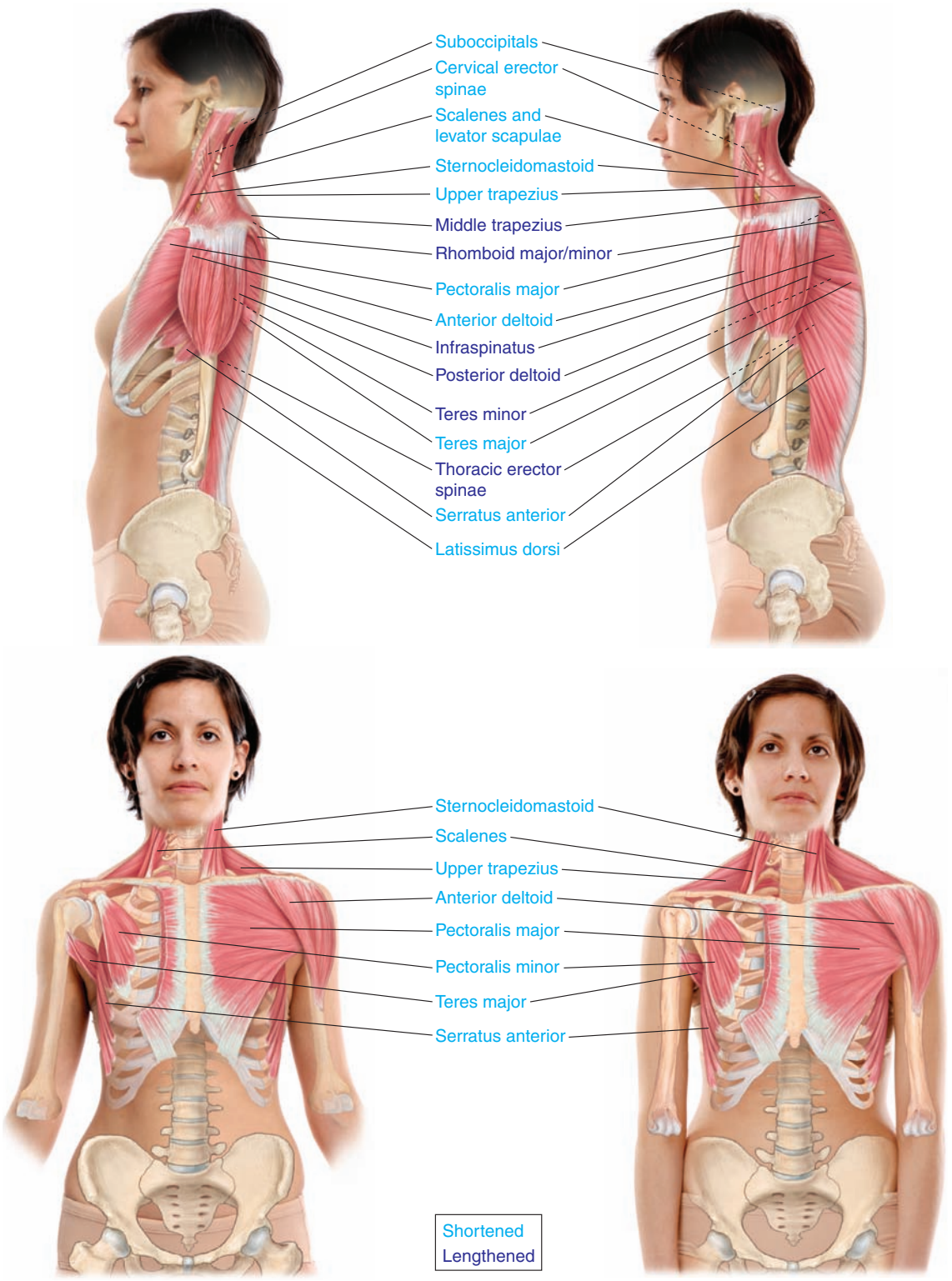


Figure 4-5 **Postural assessment comparison.** Compare the anatomical postures on the left to the hyperkyphotic postures on the right. Notice how the muscles of the upper cross react to the increased kyphotic curve and head-forward posture.

Box 4-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN HYPERKYPHOSIS

Cervical Spine

Flexion 60°
- SCM (bilateral)
- Anterior scalenes (bilateral)
- Longus capitis (bilateral)
- Longus colli (bilateral)

Extension 55°
- Upper trapezius (bilateral)
- Levator scapulae (bilateral)
- Splenius capitis (bilateral)
- Splenius cervicis (bilateral)
- Rectus capitis (bilateral)
- Oblique capitis superior (bilateral)
- Semispinalis capitis (bilateral)
- Longissimus capitis (bilateral)
- Longissimus cervicis (bilateral)
- Iliocostalis cervicis (bilateral)

Lateral Flexion 20–45°
- Upper trapezius (unilateral)
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- SCM (unilateral)
- Longus capitis (unilateral)
- Longus colli (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Ipsilateral Rotation 70–90°
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- Rectus capitis (unilateral)
- Oblique capitis (unilateral)
- Longus colli (unilateral)
- Longus capitis (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Contralateral Rotation 70–90°
- Upper trapezius (unilateral)
- SCM (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)

Shoulder

Flexion 180°
- Anterior deltoid
- Pectoralis major (upper fibers)
- Biceps brachii
- Coracobrachialis

Extension 50–60°
- Posterior deltoid
- Latissimus dorsi
- Teres major & minor
- Infraspinatus
- Pectoralis major (lower fibers)
- Triceps brachii

Internal Rotation 60–100°
- Anterior deltoid
- Latissimus dorsi
- Teres major
- Subscapularis
- Pectoralis major

External Rotation 80–90°
- Posterior deltoid
- Infraspinatus
- Teres minor

Abduction 180°
- Deltoids
- Supraspinatus

Adduction 50–75°
- Latissimus dorsi
- Teres major
- Infraspinatus
- Teres minor
- Pectoralis major
- Triceps brachii (long head)
- Coracobrachialis

Horizontal Abduction 45°
- Posterior deltoid
- Infraspinatus
- Teres minor

Horizontal Adduction 130°
- Anterior deltoid
- Pectoralis major (upper fibers)

Thoracic Spine

Flexion 30–40°
- Rectus abdominis
- External obliques
- Internal obliques

Extension 20–30°
- Spinalis
- Longissimus
- Iliocostalis
- Multifidi
- Rotatores
- Semispinalis capitis
- Latissimus dorsi
- Quadratus lumborum

Lateral Flexion 20–25°
- Spinalis (unilateral)
- Longissimus (unilateral)
- Iliocostalis (unilateral)
- Quadratus lumborum (unilateral)
- External oblique (unilateral)
- Internal oblique (unilateral)
- Latissimus dorsi (unilateral)

Ipsilateral Rotation 35°
- Internal oblique (unilateral)

Contralateral Rotation 35°
- Rotatores (unilateral)
- Multifidi (unilateral)
- External oblique (unilateral)

Mandible

Elevation (contact of teeth)
- Masseter
- Temporalis
- Medial pterygoid

Depression 35–50 mm
- Hyoids
- Digastric
- Platysma

Protraction 3–7 mm
- Lateral pterygoid
- Medial pterygoid

Retraction
- Temporalis
- Digastric

Contralateral Lateral Deviation 5–12 mm
- Lateral pterygoid
- Medial pterygoid

Respiration

Inhalation
- Diaphragm
- Scalenes
- SCM
- External intercostals
- Serratus anterior
- Serratus posterior superior

Exhalation
- Internal intercostals
- Serratus posterior inferior
- Internal obliques
- External obliques
- Transversus abdominis

SPECIAL TESTS

The following special tests will help you determine when a client should be evaluated by his or her health care provider using X-ray or other tools, which may reveal conditions that are contraindicated or require special consideration when planning massage treatment.

The **vertebral artery test** may reveal insufficiency in the vertebral artery and is performed if the client experiences vertigo, blurred vision, or light-headedness during activities of daily living (Fig. 4-6).

1. Position the client seated in a chair facing you with the eyes open.
2. Instruct the client to fully rotate and extend the neck to one side for 30 seconds.
3. If, during this time, the client complains of nausea or dizziness or if you notice involuntary motion of the eyes, the test is positive for insufficient circulation through the vertebral artery, and the client should be referred to his or her health care provider.
4. If the test is negative on one side, test the other. Do not test the other side if the first side tests positive.

Spurling's test may reveal compression of a nerve or irritation to the facet joint in the cervical spine and is performed when the client has had an injury, complains of pain that radiates, or experiences numbness and tingling in the arm (Fig. 4-7). Although massage may not be contraindicated for a client with these conditions, refer the client to his or her health care provider for more detailed information or to a massage therapist with advanced training if you have not studied the client's condition in detail. If the client tests positive for vertebral artery insufficiency, do not perform Spurling's test.

1. If the client has recurring symptoms on one side only, begin with that side.
2. Stand behind the seated client and instruct him or her to extend, laterally flex, and rotate the head to the affected side.

Figure 4-6 Vertebral artery test. Watch the client's eyes for any involuntary movement during this test.

Figure 4-7 Spurling's test. Use gentle traction following this test to release pressure.

3. Gently and slowly press down on the client's head. If the client cannot extend, laterally flex, or rotate the neck, perform a simple compression test without these actions.
4. If the client experiences radiating pain, numbness, or tingling in the arm, the test is positive for nerve root compression.
5. Ask the client to describe the location of symptoms, because this may suggest which nerve is compressed.
6. If the client feels pain that does not move past the neck, the test is positive for irritation of the facet joint.
7. Applying gentle traction to the neck after the test may relieve symptoms. If traction does relieve symptoms, this is considered reinforcement that Spurling's test is positive for compression of a nerve or facet joint irritation.

The **Valsalva maneuver** may reveal a herniated disc, tumor, or other factor that increases pressure on the spinal nerves; it is used when the client complains of pain in a localized area along the spine, particularly when coughing or sneezing. A herniated disc does not contraindicate massage, but this test is not specific for the cause of increased pressure. For this reason, it is best to refer the client to his or her health care provider for further testing before performing a massage.

1. To avoid even a temporary reduction in circulation, do not perform this test if the client has tested positive for vertebral artery insufficiency or has cardiovascular disorders.
2. With the client seated and facing you, ask him or her to take a deep breath and then attempt to exhale against the closed throat (such as when moving the bowels).
3. The test is positive if the client feels pain in a localized spot along the spine.

PALPATION ASSESSMENT

Palpate the muscles of the upper cross to assess for hyper- and hypotonicity and myofascial restrictions. You are likely to find hypertonicity and myofascial restrictions in the pectorals, especially near the glenohumeral joint. The serratus anterior, subclavius, and anterior intercostals may also be adhered and hypertonic, particularly if the client slouches or has developed a pattern of shallow breathing. The SCM, upper trapezius, suboccipitals, cervical erector spinae, levator scapulae, and scalenes may be hypertonic, particularly if the client has developed the head-forward posture, elevated shoulders, or extension of the upper cervical spine. When internal rotation of the shoulder is present, you may also find adhesions and hypertonicity in the anterior deltoid, latissimus dorsi, subscapularis, and teres major.

Overstretched muscles may include the deep anterior neck muscles, rhomboids, middle trapezius, and thoracic erector spinae with the head-forward posture, protracted scapulae, and increased thoracic curve. With internally rotated shoulders, the posterior deltoid, infraspinatus, and teres minor may be lengthened.

Condition-Specific Massage

Because hyperkyphosis may be structural, it is essential to understand the client's health history. If a systemic condition or a degenerative bone or disc disease is present, discuss treatment with the client's health care provider and adjust the treatment accordingly. Treatment goals for structural hyperkyphosis may be limited to pain reduction. If thoracic outlet syndrome, chronic tension headaches, or hyperlordosis is present, refer to those chapters in this text for special testing and consideration of the neuromuscular characteristics. Temporomandibular joint dysfunction may also develop with hyperkyphosis. This disorder is not covered in this text, but you may treat the muscle of mastication generally to offer some relief; if you have not studied this condition in detail, refer the client to a massage therapist with training in this area.

It is essential for the treatment to be relaxing. You are not likely to eliminate the pain associated with hyperkyphosis or any of the associated conditions in one treatment. Do not try to do

so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure keeps him or her from relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised.

Ask the client to let you know if any part of your treatment reproduces symptoms. If deep palpation of a trigger point reproduces symptoms, explain this phenomenon to your client and ask him or her to breathe deeply during the application of the technique. As the trigger point is deactivated, the referral pain will also diminish. Common trigger points and their referral points are shown in Figure 4-8.

If any other symptoms are reproduced, adjust the client to a more neutral position, reduce your pressure, or move slightly off the area, and take note of this because it may help you understand more clearly exactly what is contributing to the client's symptoms. Instruct your client to use deep but relaxing breathing to assist in relaxation.

The following suggestions are for treatment that considers several factors involved in hyperkyphosis. Because several joints and many muscles are involved in this condition, your treatment will likely fill the entire session.

- Begin with the client in the supine position with a rolled towel along the length of the spine (Fig. 4-9). This bolster will retract the scapulae and lengthen the pectoral muscles. If the client's neck is in extension, fold a pillow case or hand towel into a bolster that is small enough to be placed under the occiput without obstructing your access to the posterior neck muscles.
- If the client has symptoms that suggest thoracic outlet syndrome, begin on the affected side. If both arms are affected, begin with the dominant side. See Chapter 6 on thoracic outlet syndrome for considerations concerning edema and reproduction of symptoms.


- Place moist heat on one pectoral if the client does not have a cardiovascular condition. After heating one pectoral, move the heat to the other side and begin treating the heated side. After heating the second pectoral, you can move the heat to the posterior neck if this is comfortable for the client.

- Before applying emollient, assess the tissues of the anterior upper cross for myofascial restrictions and release them if found. Adhesions are often found around the glenohumeral joint, along the anterior deltoid, along the lateral and posterior neck, and at the occiput.


- Reduce tension, then apply lengthening strokes to the full length of the pectoralis major to soften tissues to allow you to treat deeper structures (Fig. 4-10). Apply these strokes from sternum or clavicle toward the humerus to reduce internal rotation of the shoulder.

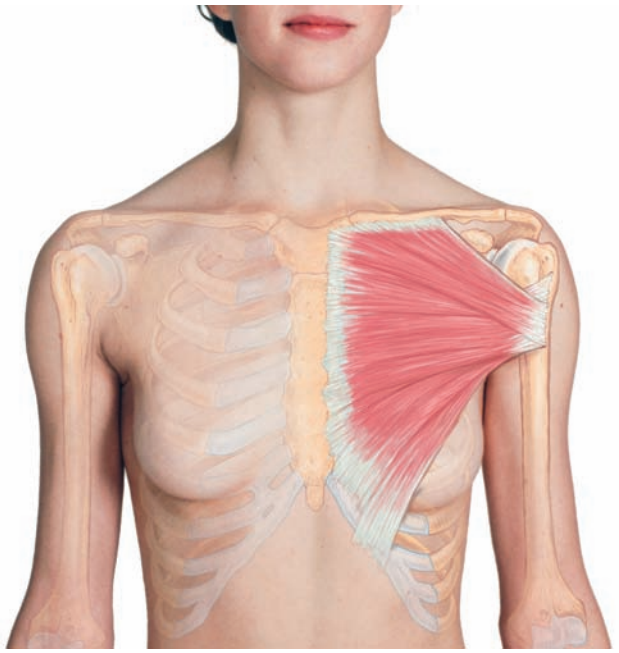
- Assess the pectoralis major for trigger points, and treat them if found. Common trigger points in the pectoralis major are found along the mid sternum, at the clavicular attachments, and along the inferior fibers, particularly near the axilla.


- Assess and treat the subclavius for hypertonicity and trigger points. The subclavius is a slight, thin muscle deep to the pectoralis major and may not be easily palpated (Fig. 4-11). Trust your knowledge of anatomy as you palpate along the inferior edge of the middle third of the clavicle toward the costal cartilage of the first rib. If you find and treat trigger points in the subclavius, use a pin and stretch technique to lengthen the muscle fibers.


- You can treat the pectoralis minor through the pectoralis major, but it is difficult to distinguish the two muscles when palpating both. You can access pectoralis minor more directly by pushing the lateral fibers of the pectoralis major medially as you palpate ribs 3, 4, and 5 (Fig. 4-12). This may be easiest by kneeling next to the client and placing his or her hand on

Figure 4-8 **Common trigger points associated with hyperkyphosis and their referral patterns.**

Figure 4-9 **Bolster in supine position.** Position the bolster along the spine before the client lays supine. Either use a bolster that is long enough to cradle the head, or use a small, folded towel or pillow case under the occiput so that the neck is not hyperextended.



PECTORALIS MAJOR

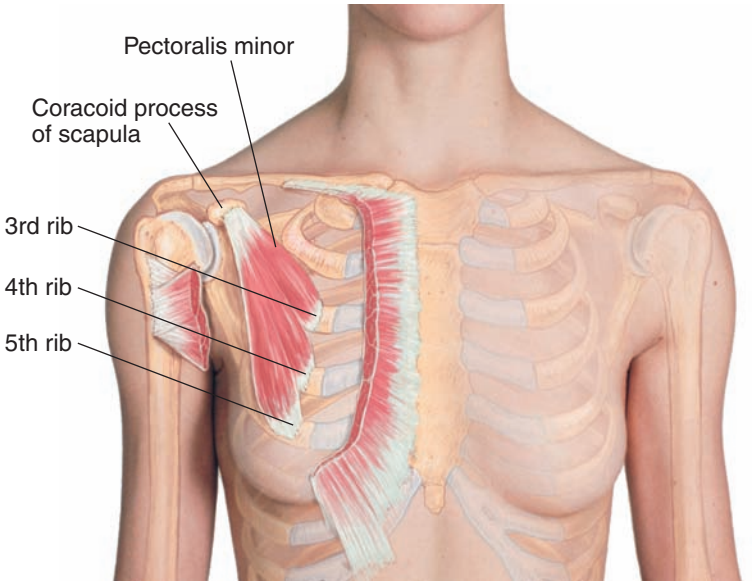
Origin	*Medial half of clavicle, sternum, and cartilage of ribs 1 to 6.*
Insertion	*Crest of greater tubercle of humerus.*
Action	***All fibers*** *adduct shoulder, internally rotate shoulder, assist in elevating thorax in forced inspiration;* ***upper fibers*** *flex shoulder, horizontally adduct shoulder;* ***lower fibers*** *extend shoulder.*
Nerve	*Medial and lateral pectoral.*

Figure 4-10 **Pectoralis major.** Short, tight pectorals contribute to the internal rotation of the shoulders. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

SUBCLAVIUS

Origin	*First rib and costal cartilage.*
Insertion	*Inferior, lateral aspect of clavicle.*
Action	*Draws rib inferiorly and anteriorly, elevates first rib in inhalation.*
Nerve	*Subclavian.*

Figure 4-11 **Subclavius.** The subclavius may be adhered and hypertonic when the thorax is flexed. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



PECTORALIS MINOR

Origin	*Third, fourth, and fifth ribs.*
Insertion	*Coracoid process.*
Action	*Depress scapula, protract scapula, tilt scapula anterior, assist in inhalation.*
Nerve	*Medial pectoral.*

Figure 4-12 Pectoralis minor. The pectoralis minor may be shortened if the scapulae are protracted. Figs. 4-12, 4-13, and 4-14 adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

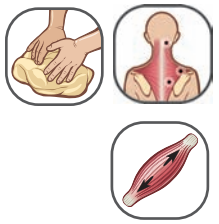
your shoulder, which will gently lift the pectoralis major out of the way. This is also preferable to externally rotating the shoulder, which would put tension on a shortened pectoralis major. Once you have found the pectoralis minor, ask the client to depress his or her shoulder and feel for a contraction. If you are palpating through the pectoralis major, you may also feel it contract.

- If you treat myofascial restrictions, hypertonicity, and trigger points in the pectoral area, perform a full stretch to the pectorals, and close with clearing strokes. If you found the area to be only minimally affected, close with clearing strokes.

- Assess the anterior deltoid for hypertonicity (Fig. 4-13). Warm the tissues and lengthen them from the clavicle toward the deltoid tuberosity to reduce the internal rotation of the shoulder.

- Treat any trigger points found, and stretch the anterior deltoid using external rotation or by extending the shoulder off the edge of the table.

- With the head turned slightly away from the side you are treating, warm and lengthen the superficial neck muscles, particularly the upper trapezius, from the occiput to the acromion process (Fig. 4-14). Be very careful not to work in the endangerment areas. Avoid direct compression to nerves and blood vessels, and back away gently if you feel a pulse.



- Soften then lengthen the levator scapulae, splenius capitis, splenius cervicis, the suboccipitals, and the cervical erector spinae (Fig. 4-15). Treat any trigger points as necessary. Hooking your fingers under the occiput and gently rocking the head into minimal flexion and extension is an effective way of releasing the suboccipitals.

ANTERIOR DELTOID

Origin	*Lateral third of clavicle, acromion process, spine of scapula.*
Insertion	*Deltoid tuberosity.*
Action	***All fibers** abduct shoulder; **anterior fibers** flex shoulder, internally rotate shoulder, horizontally adduct shoulder; **posterior fibers** extend shoulder, externally rotate shoulder, horizontally adduct shoulder.*
Nerve	*Axillary nerve.*

Figure 4-13 **Anterior deltoid.** The anterior deltoid may be short and tight if the shoulder is internally rotated.

UPPER TRAPEZIUS

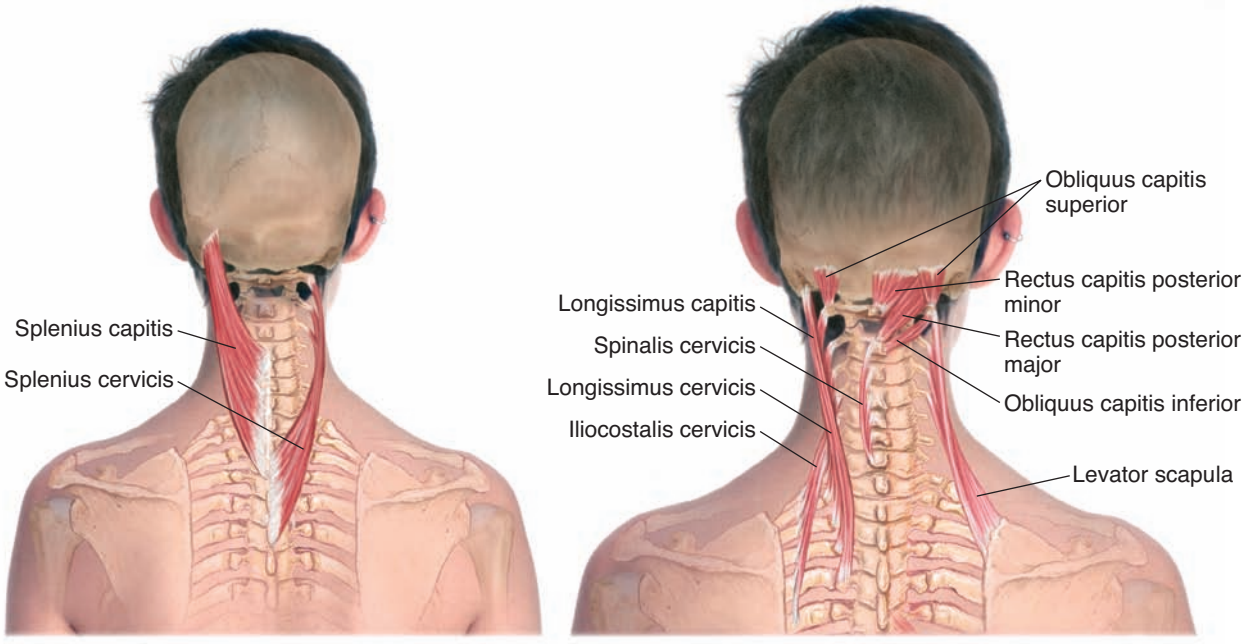
Origin	*External occipital protuberance, medial superior nuchal line of occiput, ligamentum nuchae.*
Insertion	*Lateral third of clavicle, acromion process.*
Action	***Bilaterally**: extend neck and head; **unilaterally**: ipsilateral lateral flexion of neck and head, contralateral rotation of neck and head, elevate scapula, upwardly rotate scapula.*
Nerve	*Spinal accessory and cervical plexus.*

Figure 4-14 **Upper trapezius.** Treat the superficial upper trapezius before accessing the deeper neck muscles.

- If you treat hypertonicity and trigger points in the posterior neck muscles, perform a full stretch, and close with clearing strokes.

- Release the SCM; using pincer grip petrissage along its length is often effective. Treat trigger points if found. Trigger points in the SCM may cause vertigo, nausea, or ringing in the ears. Ask your client to let you know if any unusual sensations are felt, and reduce your pressure if necessary.

- Once you have softened the SCM and trapezius, you will have greater access to the scalenes (Fig. 4-16). To access the anterior scalene, gently push the SCM medially with one or two fingertips as you feel for the deeper scalenes. As you move the SCM medially, your fingers should be gently resting on the soft tissue covering the transverse processes of the cervical vertebrae. Use this as your guide for treating the anterior scalene. Once you have found it, ask the client to take a quick, forced breath into his or her chest, and feel for a contraction.



SPLENIUS CAPITIS

Origin	*Ligamentum nuchae, SP of C7–T3.*
Insertion	*Mastoid process and lateral superior nuchal line of occiput.*
Action	***Bilaterally:*** *extend neck and head;* ***unilaterally:*** *ipsilateral rotation and lateral flexion of head and neck.*
Nerve	*Branch of dorsal division of cervical nerves.*

SPLENIUS CERVICIS

Origin	*SP of T3–6.*
Insertion	*TVP of upper cervical vertibrae.*
Action	***Bilaterally:*** *extend neck and head;* ***unilaterally:*** *ipsilateral rotation and lateral flexion of head and neck.*
Nerve	*Branch of dorsal division of cervical nerves.*

LEVATOR SCAPULA

Origin	*TVP of C1–4.*
Insertion	*Upper, medial border and superior angle of scapula.*
Action	***Bilaterally:*** *extend neck and head;* ***unilaterally:*** *elevate scapula, downward rotation of scapula, lateral flexion of neck and head, ipsilateral rotation of neck and head.*
Nerve	*Dorsal scapular and cervical nerves.*

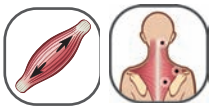
SUBOCCIPITALS

Origin	*SPs and TVPs of C1–2.*
Insertion	*Nuchal lines of occiput and TVP of C1.*
Action	***Bilaterally:*** *tilt the head into extension,* ***unilaterally:*** *ipsilateral rotation of head.*
Nerve	*Suboccipital.*

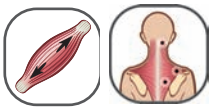
CERVICAL ERECTOR SPINAE: SPINALIS; LONGISSIMUS, ILIOCOSTALIS

Origins	*Ligamentum nuchae, SP C7; TVPs T1–5; posterior ribs 1–12.*
Insertion	*SPs of C2–7; TVP C1–7, mastoid process; TVPs of lower cervicals.*
Action	***Bilaterally:*** *extend vertebral column;* ***unilaterally:*** *ipsilateral lateral flexion.*
Nerve	*Dorsal primary divisions of spinal nerves.*

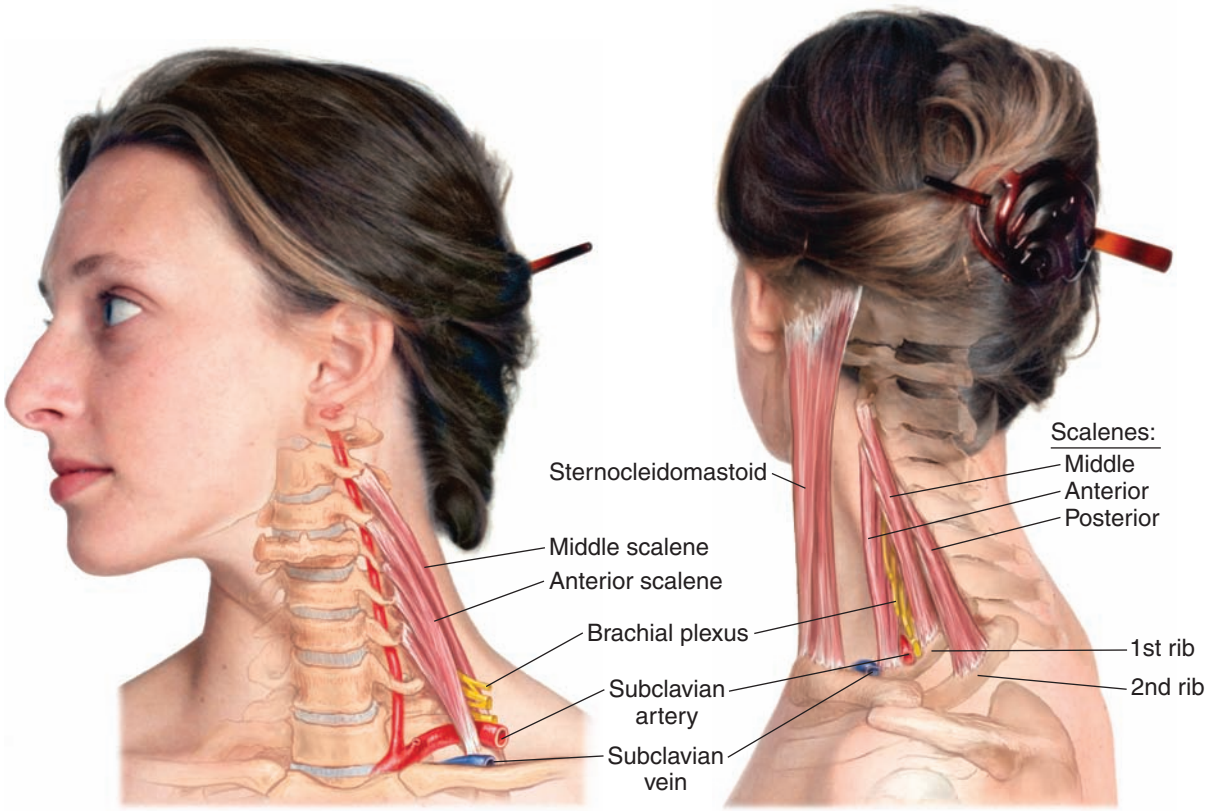
Figure 4-15 Posterior neck muscles. Posterior neck muscles may be short and tight with an extension of the neck. Figs. 4-15 and 4-16, adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



- Lengthen the anterior scalene from the transverse processes to the first rib. Treat any trigger points found with muscle stripping and compression. It is often helpful once you have found a trigger point in the scalenes to compress it gently while slowly rotating the head ipsilaterally. Trigger points in the anterior scalene are often quite sensitive, and the client may feel cautious when you work deeply in the neck. Begin gently so as not to frighten the client or cause him or her to jerk the head. Remember that you are working in an area that is filled with nerves and vasculature. Trigger points in the scalenes may radiate across the top of the shoulder and into the arm, hand, and fingers. If the client also has thoracic outlet syndrome, symptoms may appear. Reduce your pressure, and realign the neck if necessary.



- Find the middle and posterior scalenes by gently palpating the transverse processes and then moving slightly posterior. The middle scalene crosses the transverse processes as it heads toward the first rib. The posterior scalene is posterior to the middle scalene, and runs inferiorly toward the second rib. Once you have found them, ask the client to take a quick, forced breath into his or her chest, and feel for a contraction. Take the same cautions with the



SCALENES

Origin	*Anterior-TVP 3–6, middle-TVP 2–7, posterior-TVP 5–6.*
Insertion	***Anterior**, 1st rib; **middle**, 1st rib; **posterior**, 2nd rib.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, elevate ribs in inhalation and flex head and neck.*
Nerve	*Cervical.*

STERNOCLEIDOMASTOID

Origin	*Top of manubrium and medial third of clavicle.*
Insertion	*Mastoid process and superior nuchal line.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, flexion of the neck, assist in inhalation.*
Nerve	*Spinal accessory XI.*

Figure 4-16 **SCM and scalenes.** The SCM and scalenes may be short and tight with the head-forward posture.

middle and posterior scalenes as you did with the anterior scalene. Lengthen the muscles, and treat trigger points if found.

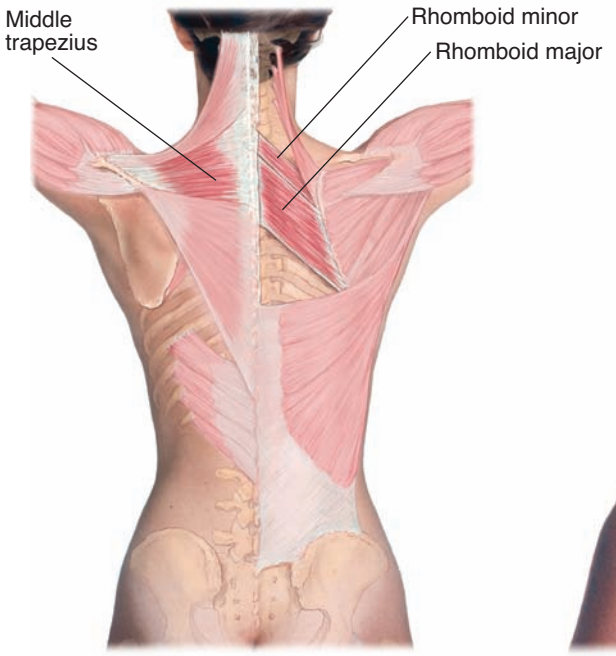
- If you treat trigger points, stretch the scalenes by increasing the distance between their origins and insertions. Options for stretching include contralateral lateral flexion and ipsilateral rotation. If you found no trigger points, use clearing strokes, and turn the client into the prone position.

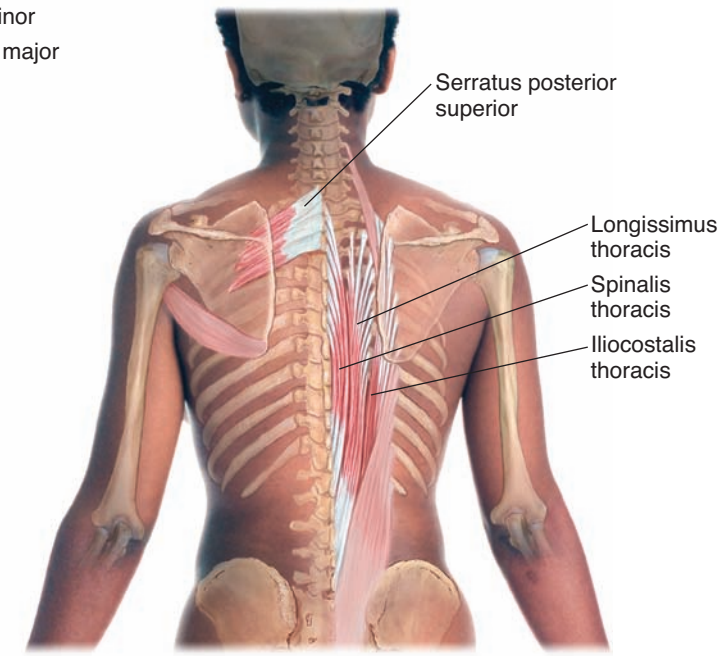
- Turn the client to the prone position, and use rolled towels to bolster the shoulders. This will keep the pectorals lengthened, retract the scapulae, and reduce any stretch on the rhomboids and middle trapezius. The bolster should be placed under the shoulder and a few inches of the humerus to avoid adding tension to the joints.

- Adjust the face cradle to reduce flexion in the cervical spine. If you see a crease in the skin on the back of the neck, lower the head rest slightly as long as this is comfortable for the client.

- Reduce adhesions between the scapulae. These are commonly found around the superior angle of the scapula, at the vertebrae, and at the intersection of the lower trapezius and latissimus dorsi (Fig. 4-17).

- When treating the middle trapezius and rhomboids, apply strokes from the scapula toward the spine. Remember that these muscles are often overstretched in hyperkyphosis. Stripping in the opposite direction may lengthen the already overstretched muscles.





MIDDLE TRAPEZIUS

Origin	*SP of C6–T3.*
Insertion	*Acromion process and spine of scapula.*
Action	*Adduct and stabilize scapula.*
Nerve	*Spinal accessory and cervical plexus.*

RHOMBOIDS

Origin	***Major**, SP T2–5; **minor**, SP C7–T1.*
Insertion	***Major**, medial border of scapula between spine and inferior angle; **minor**, upper, medial border of scapula.*
Action	*Adduct, elevate, and downwardly rotate scapula.*
Nerve	*Dorsal scapular from brachial plexus.*

SERRATUS POSTERIOR SUPERIOR

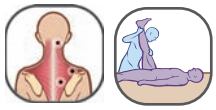
Origin	*SP C7–T3.*
Insertion	*Posterior surface of ribs 2–5.*
Action	*Elevate ribs during inhalation.*
Nerve	*Spinal nerves I–IV.*

THORACIC ERECTOR SPINAE

Origin	***Spinalis**, SP C7–L1; **longissimus**, common tendon; **iliocostalis,** ribs 1–12.*
Insertion	***Spinalis**, SP thoracic vertebrae; **longissimus**, lower 9 ribs and TVP thoracic vertebrae; **iliocostalis**, ribs 1–6.*
Action	***Unilateral**, ipsilateral lateral flexion of thorax; **bilateral**, extend thorax.*
Nerve	*Dorsal divisions of spinal nerves.*

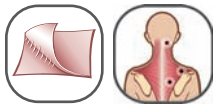
Figure 4-17 Middle trapezius, rhomboids, serratus posterior superior, and thoracic erector spinae. The middle trapezius, rhomboids, serratus posterior superior, and thoracic erector spinae may be overstretched and weak with protraction of the scapulae and thoracic flexion. Figs. 4-17, 4-18, and 4-19 adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- When treating the deeper thoracic erector spinae, cross fiber strokes may help separate adhered tissues. Apply strokes from superior to inferior to encourage thoracic extension.



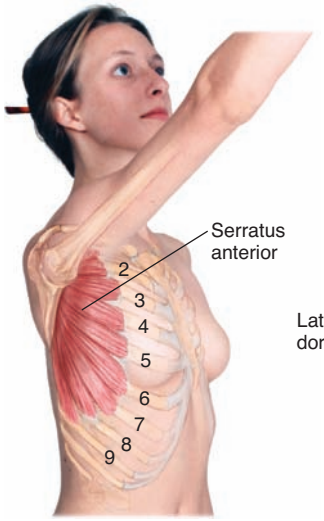
- Assess the rhomboids, middle trapezius, and thoracic erector spinae for trigger points. It may be difficult to use compression on the erectors because of their rope-like texture. Try to isolate the trigger point and stabilize the tissue with one hand while you compress with the other to keep it from continually rolling away from your pressure. If you treat trigger points in these muscles, use a pin and stretch technique to lengthen only the affected area to avoid stretching the full muscle.

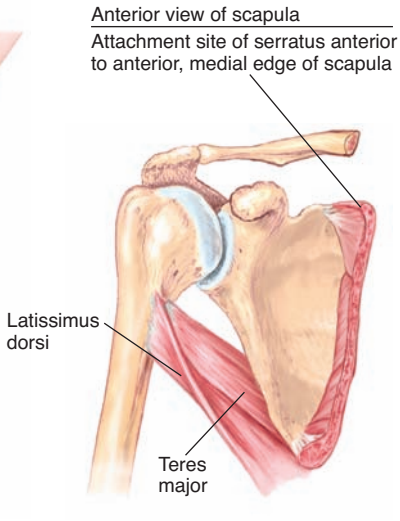
- Assess the teres major, serratus anterior, and latissimus dorsi for hypertonicity and trigger points and treat if necessary (Fig. 4-18).

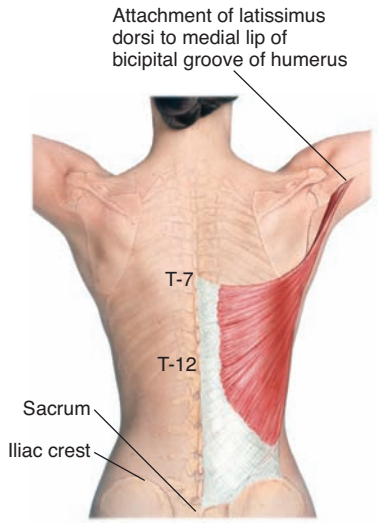


- Assess the infraspinatus and teres minor for adhesions and trigger points and treat if necessary (Fig. 4-19).

- If you have time, consider the other possible conditions that may develop with hyperkyphosis, and treat these areas. Tension headaches suggest additional treatment to the head, tem-







SERRATUS ANTERIOR

Origin	*Lateral surface of upper 8 or 9 ribs.*
Insertion	*Anterior surface of medial border of scapula.*
Action	*Abduct and depress scapula, stabilize scapula against rib cage, forced inhalation.*
Nerve	*Long thoracic.*

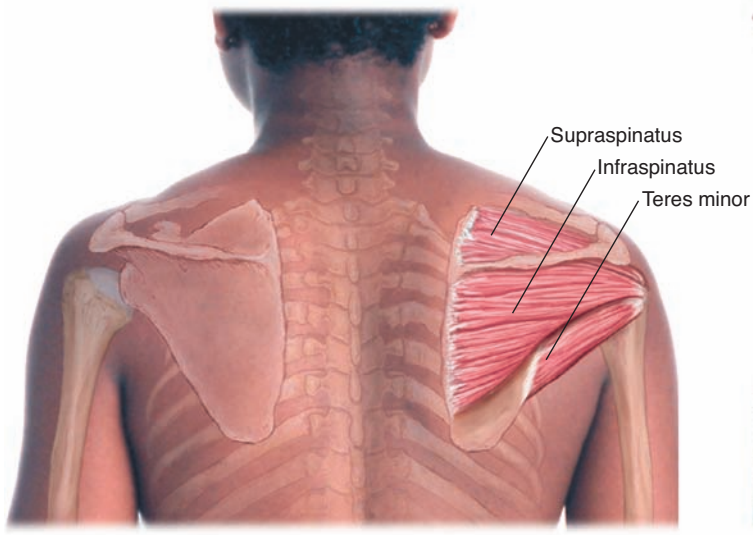
LATISSIMUS DORSI

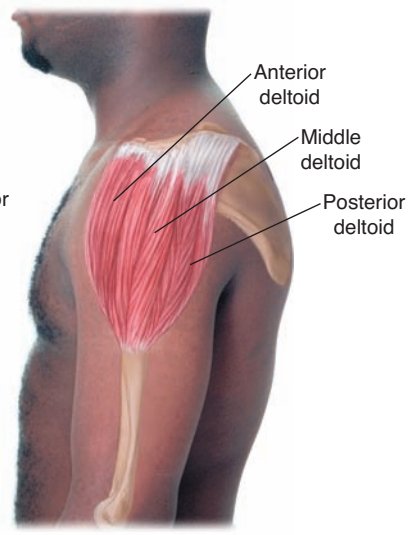
Origin	*SP of T7–12, ribs 8–12, thoracolumbar aponeurosis, and posterior iliac crest.*
Insertion	*Crest of lesser tubercle of humerus.*
Action	*Extend, adduct, and medially rotate shoulder.*
Nerve	*Thoracodorsal.*

TERES MAJOR

Origin	*Lateral, inferior angle and lateral border of scapula.*
Insertion	*Crest of lesser tubercle of humerus.*
Action	*Extend, adduct, and medially rotate shoulder.*
Nerve	*Lower subscapular.*

Figure 4-18 **Teres major, latissimus dorsi, and serratus anterior.** The teres major, latissimus dorsi, and serratus anterior may become hypertonic with hyperkyphosis.





INFRASPINATUS

Origin	*Infraspinous fossa of scapula.*
Insertion	*Greater tubercle of humerus.*
Action	*Laterally rotate, adduct, extend and horizontally abduct shoulder, stabilize head of humerus in glenoid cavity.*
Nerve	*Suprascapular.*

TERES MINOR

Origin	*Superior, lateral border of scapula.*
Insertion	*Greater tubercle of humerus.*
Action	*Laterally rotate, adduct, extend and horizontally abduct shoulder, stabilize head of humerus in glenoid cavity.*
Nerve	*Axillary.*

POSTERIOR DELTOID

Origin	*Spine of scapula.*
Insertion	*Deltoid tuberosity.*
Action	*Abduct, extend, laterally rotate and horizontally abduct shoulder.*
Nerve	*Axillary nerve from brachial plexus.*

Figure 4-19 **Infraspinatus, teres minor, and posterior deltoid.** The infraspinatus, teres minor, and posterior deltoid may become overstretched with internal rotation of the shoulder.

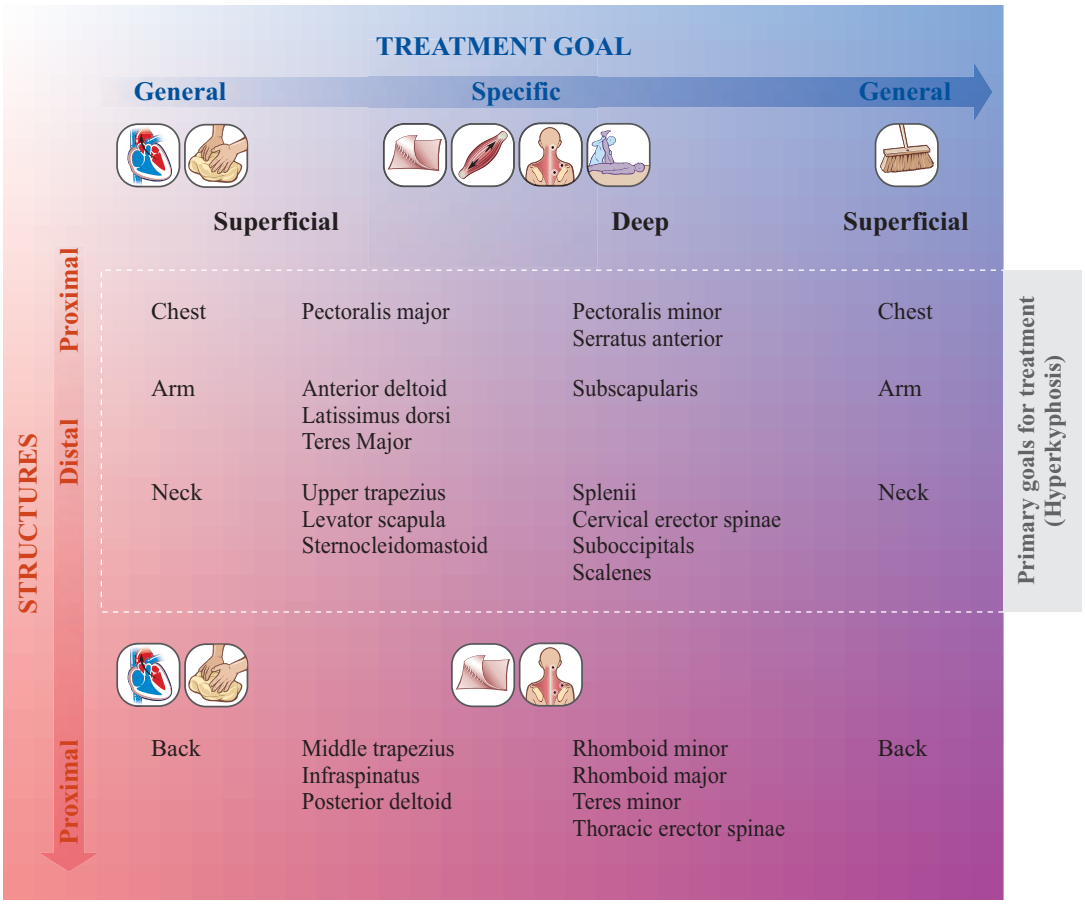


Figure 4-20 **Hyperkyphosis treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating hyperkyphosis.

poromandibular joint dysfunction to the jaw, thoracic outlet syndrome to the affected limb, and hyperlordosis to the hip flexors and lumbar erectors. You may not have time to treat all of these fully, but you can give some attention to them in each session as time permits. As the signs and symptoms of hyperkyphosis decrease, you can increase the amount of time you spend on other pain patterns or restrictions in ROM.

- End with clearing strokes to the full back.

The Treatment Overview diagram summarizes the flow of treatment (Fig. 4-20).

CLIENT SELF-CARE

Avoiding further injury is a primary concern when recommending self-care. Self-care for a client with structural hyperkyphosis should be planned with the client's health care provider. Reducing or eliminating habitual offending activities and other perpetuating factors is crucial for long-term relief of pain related to functional hyperkyphosis. The client with functional hyperkyphosis must learn to recognize when he or she is holding the affected muscle in a shortened position and which of his or her activities of daily living is putting undue stress on the joints and the muscles that cross them. You can help clients learn how to modify such activities to avoid

overstressing the affected structures. The following are intended as general recommendations for stretching and strengthening the muscles involved in hyperkyphosis. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines:

- Instruct the client to perform self-care activities throughout the day, such as while taking a phone call, reading e-mail, watching television, or during other activities of daily living instead of setting aside extra time.
- Encourage the client to take regular breaks from repetitive actions. Demonstrate gentle self-massage to keep adhesions and hypertonicity at bay between treatments.
- Instruct the client on proper posture in the seated position to keep pressure off the weakened joints.
- Instruct an athlete who is strengthening the pectorals more regularly than he or she is strengthening the rhomboid and middle trapezius to reduce pectoral resistance exercises and increase scapular retraction and thoracic extension to balance strength in the thoracic area.
- Instruct a client who regularly performs heavy lifting to lift with the legs instead of the back.
- Demonstrate all strengthening exercises and stretches to your client and have him or her perform these in your presence before leaving to ensure that he or she is performing them properly and will not harm himself or herself when practicing alone. Stretches should be held for 15–30 seconds and performed frequently throughout the day within the client's limits. The client should not force the stretch. It should be slow and gentle, trying to keep other muscles as relaxed as possible.

Stretching

Instruct the client to stretch the pectoralis major and minor by standing in a doorway with the hands on the frame while stepping forward to bring the arms slightly posterior (Fig. 4-21). It is essential that he or she step rather than lean forward, because leaning will affect the muscles of the neck, back, and hips. The stretch is best performed with the spine straight. The client can raise the hands above the head on the doorway to stretch the lower fibers, at the level of the shoulder to stretch the middle fibers, and below the hips to stretch the upper fibers.

As an alternative stretch that the client can perform during work hours, while reading an e-mail or during a conference call, instruct the client to clasp the fingers behind the head (moderate stretch) or rest the fingers behind the ears (deeper stretch) while drawing the elbows posteriorly within his or her range of comfort (Fig. 4-22). This will also retract the scapulae and reduce the stretch on the rhomboids and middle trapezius.

To stretch the posterior neck muscles, instruct your client to let the head hang so that the chin approaches the chest, without flexing the thoracic spine (Fig. 4-23). The client should not actively force the chin to touch the chest. If he or she wants to increase the stretch, he or she can rest the hands on the back of the head and allow the weight of the arms to gently pull the chin toward the chest. It may help to gently rotate the flexed neck from side to side so that the chin is parallel to the shoulder on either side. Although, for some, it may feel good to include cervical extension into the stretch, this is not advised if the client is at risk for nerve compression or disc herniation. Even in the absence of disc disease or nerve compression, one rotation in extension may be performed after several side-to-side rotations in flexion, but do not instruct the client to do a full, repeated circumduction of the head.

Figure 4-21 Doorway pectoral stretch. Instruct the client to step forward rather than lean forward.

Figure 4-22 Seated pectoral stretch. Instruct the client to clasp the fingers together behind the head and gently draw the elbows back.

Strengthening

The client should also strengthen the middle trapezius, rhomboids, and thoracic erector spinae in order to efficiently antagonize protraction of the scapula and flexion of the thorax.

Instruct the client to sit or stand while squeezing the scapulae together (Fig. 4-24). When this is done properly, only the scapulae should retract, and the shoulders should be relaxed. Hold each contraction for 5–10 seconds with 3–5 seconds of rest between contractions. Perform 10 repetitions or as many as are comfortable before feeling fatigue or weakness.

Instruct the client to strengthen the thoracic erector spinae by resting his or her hands behind the head in either a seated or prone position while extending the thoracic spine within his or her limits.

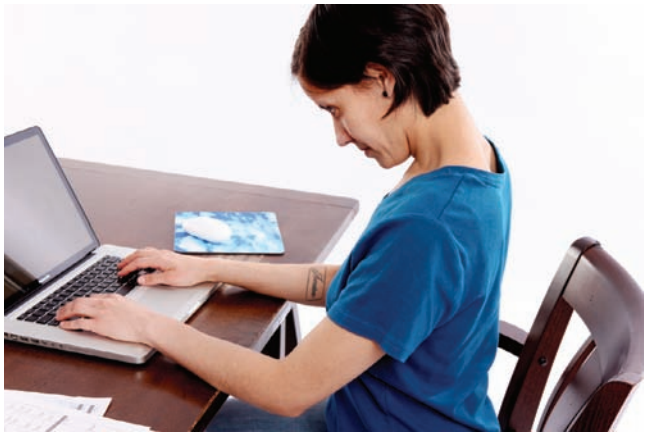


Figure 4-23 Cervical extensor stretch. Instruct the client to let the head hang without any force.

Figure 4-24 Middle trapezius and rhomboid strengthening. Instruct the client to squeeze the scapulae together without using any muscles other than middle trapezius and rhomboids.

Figure 4-25 Strengthening the deep neck flexors. Instruct the client to draw the chin inward.

The client can work toward reducing the head-forward posture by tucking the chin inward (Fig. 4-25). The act of retracting the neck and head may also reduce thoracic flexion. Hold the posture for about 5–10 seconds with 3–5 seconds of rest between contractions. Perform 10 repetitions or as many as are comfortable before feeling fatigue or weakness in the neck.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client developing hyperkyphosis will have treatments once a week until symptoms are absent for at least 7 days. A client with more severe signs and symptoms is best treated twice per week until signs of improvement occur, such as improvement in ROM and reduction in hypertonicity and pain. Reduce frequency to once per week until symptoms are absent for at least 7 days. When the client reports that he or she has been pain-free for up to 7 days, treatment can be reduced to twice per month. If the client is pain-free for 2 or more weeks at a time, he or she can then schedule an appointment once per month or as necessary. With functional hyperkyphosis, there should be some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.

- The client is not adjusting his or her activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest. Explain the importance of the client's participation in the healing process, and encourage the client to follow your recommendations, but be careful not to judge or reprimand a client who does not.
- The condition is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced training. Continuing to treat a client whose case is beyond your scope could hinder healing and turn the client away from massage therapy altogether.
- The hyperkyphosis is structural or there is an undiagnosed, underlying condition. Discontinue treatment until the client sees a health care provider for a medical assessment. Discuss the medical assessment with the client's health care provider to determine cautions or contraindications for future treatments.

If you are not treating the client in a clinical setting or private practice, you may not be able to take this client through the full program of healing. Still, if you can bring some relief, it may encourage the client to discuss this change with his or her health care provider and seek manual therapy rather than more aggressive treatment options. If the client agrees to return for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on a specific area. Likewise, once you have treated the structures specific to hyperkyphosis, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Seth is a 26-year-old recording engineer. He works an average of 50 hours per week, usually beginning in the late afternoon and finishing well after midnight. Seth rides his bicycle 6 miles to work and 6 miles home for daily exercise. He eats a reasonably healthy diet and drinks water throughout the day, but beer is often the drink of choice during a recording session. He has been feeling pain between his scapulae, especially on the left side.

Subjective

The client complained of pain between his shoulder blades, particularly on the left side, with an area of sharp, intermittent pain along his spine about midway between his upper and lower back. He rides a classic 10-speed bicycle on which he must lean forward to hold the handle bars, causing him to bend his neck back in order to look forward. While at work, he spends the first hour or so arranging microphones and equipment but spends the rest of the session in a chair at the recording console. He rarely gets up, except to go to the bathroom. He reports that the symptoms are most aggravating when he gets tired or feels weaker toward the end of a recording session, and he has noticed that he feels less stiff the day after working with a band that does not drink alcohol. When it hurts most, it hurts to turn his head to the right, and he feels like he cannot turn all the way when he tries to turn it to the left. He has no insurance and has not seen a health care provider but has had no history of illness and feels no pain or weakness in any other part of his body. When asked if he has experienced nausea, vertigo, or blurred vision, Seth responded "No." When asked if he had radiating pain or numbness or tingling in the arm, Seth responded "No." He could not recall if he felt pain near the spine when he coughs or sneezes. The symptoms do not keep him from his normal activities. Seth asked for a session focused on his neck and back pain.

Objective

As Seth was explaining his symptoms, he stood with most of his weight on the left leg, the right hip externally rotated, and the thorax slightly laterally flexed to the left. Postural assessment revealed a slight increase in

thoracic kyphosis, slight internal rotation of the shoulders bilaterally, and significant head-forward posture with extension of the upper cervical spine, particularly near the occiput. The left shoulder is slightly elevated. The head is slightly rotated to the right and laterally flexed to the left. The left hip is slightly elevated; the right hip is slightly externally rotated.

Valsalva test was negative for herniation or other factors increasing pressure on the spinal cord.

Active rotation of the cervical spine was reduced to the left and caused pain at the end point to the right. Flexion of the cervical spine was reduced but caused no pain. Extension of the thoracic spine was normal and produced no pain.

Palpation revealed hypertonicity in upper trapezius, SCM, scalenes, and pectoralis major bilaterally, and levator scapula, latissimus dorsi, and lower trapezius on the left. The rhomboids minor, serratus posterior superior, middle trapezius, and thoracic erector spinae are taut and tender bilaterally.

Action

I began in the supine position with a rolled towel along the length of the spine and a pillow under the occiput. I performed myofascial release on the tissue around the humeral attachments of the pectoralis major and latissimus dorsi and along the sternum. I used effleurage to warm the pectorals and anterior deltoid and used muscle stripping to lengthen both bilaterally. No trigger points were found.

I performed myofascial release on the posterior neck, particularly near the occiput. I used effleurage to warm the superficial tissues followed by muscle stripping to the upper trapezius and levator scapulae. No trigger points were found. I used pincer grip kneading on the SCM bilaterally. No trigger points were found. I used muscle stripping on the scalenes, splenius muscles, and occipitals bilaterally. Hypertonicity was greater in the left scalenes. A trigger point was found in the left anterior scalene, halfway between the origin and the insertion, that referred toward the left scapula. Referred pain decreased from level 7 to 3 after two rounds of compression followed by muscle stripping. No trigger points were found on the right side. I performed a full cervical rotation to the left and lateral flexion to the right followed by postisometric relaxation to lengthen the left scalenes.

I removed the bolster from the occiput to apply deep petrissage to the occipital muscles. No trigger points were found. I applied a passive stretch to the cervical extensors by bringing the chin toward the chest.

In a prone position, I began with firm effleurage and superficial cross-fiber friction on the latissimus dorsi, particularly on the left side. A tender spot was found slightly medial to the scapula in upper fibers of the left latissimus dorsi. No referral was produced.

I performed superficial, bilateral cross-fiber friction to reduce adhesions around the superior angle of the scapula and at the junction of the lower trapezius and latissimus dorsi. Muscle stripping on the lower trapezius revealed a trigger point slightly medial to the lateral border of the left scapula, which referred around the left scapula and toward the acromion process. Compression of the trigger point produced a local twitch response. Pain reduced from level 6 to 2. I used pin and stretch along the fibers containing the trigger point.

I used deep effleurage from the medial border of the scapula toward the spine along the rhomboids and middle trapezius. Compression slightly inferior to the superior angle of the scapula produced a local twitch response in the rhomboid major but no referred pain. Local pain reduced from level 5 to 2.

I followed deep cross-fiber friction with muscle stripping from superior to inferior along the thoracic erector spinae. No trigger points were found. The client reported feeling no pain, but rather, comfortable relief here.

Following treatment, active left rotation of the cervical spine increased by approximately 10° compared to pre-treatment, and right rotation caused no pain. Flexion of the cervical spine improved by approximately 25° compared to pre-treatment.

Plan

I demonstrated stretches for the pectoral muscles and posterior neck, and strengthening exercises for the rhomboids and middle trapezius that can be performed during work hours. Seth rescheduled for 1 week from today. If improvement is significant enough to allow time for treatment to other areas, I will assess and treat the muscles of the lower back and hips that may be contributing to the elevation and external rotation of the hip and lateral flexion of the trunk. Based on my assessment of the tissues and posture, which are only minimally affected, general maintenance may be sufficient following a second treatment if the client is pain-free and maintains normal ROM for at least 1 week. I encouraged the client to drink plenty of water following treatments to flush out metabolites and keep the muscles hydrated. I recommended avoiding alcohol during flare-ups if it intensifies symptoms. I recommended that Seth consider switching to a bicycle, like an upright cruiser, which allows him to sit erect without extending his neck.

CRITICAL THINKING EXERCISES

1. Develop a 10-minute stretching and strengthening routine for a client, which covers all of the muscles involved in hyperkyphosis. Use Table 4-1, Box 4-1, and Figure 4-8 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened, while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles. Describe each step of the routine in enough detail that the client can perform it without your assistance.
2. A client calls to schedule a massage for pain between the shoulder blades and in the neck. She explains that she had open heart surgery 5 years ago that left a scar along the length of her sternum. Although her physician considers her healthy and she has normal activities of daily living, she is regularly monitored for signs of cardiovascular disease. Discuss the impact her surgery may have had in the development of her chronic pain, the essential questions to ask the client and her health care provider before initiating treatment, and the cautions and considerations necessary when planning treatment.
3. Discuss the necessary adjustments to treatment for a client who has a natural or surgical fusion of cervical or thoracic vertebrae.
4. Conduct a short literature review to explain how the following conditions may put a client at greater risk for developing hyperkyphosis:
   - Nerve root compression
   - Obesity
   - Respiratory disorders
   - Rheumatoid arthritis
   - Vitamin D deficiency
   - Hormone imbalance
   - Spondylolisthesis
   - Pott's disease
   - Paget's disease

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CHAPTER 5

Tension Headaches

UNDERSTANDING TENSION HEADACHES

Headaches can indicate a wide variety of changes in a person's health. They may result from an injury, occur as a symptom of a systemic condition, or may be a condition in themselves. The International Headache Society classifies headaches as primary headaches, secondary headaches, and cranial neuralgias or other headaches. Tension headaches, migraines, and cluster headaches are commonly categorized as primary headaches; this means that the headache is the pathology itself (Fig. 5-1). Headaches that are caused by underlying pathologies (e.g., sinus headaches) are considered secondary headaches. It is essential to understand the client's health history and to refer the client to a health care provider for diagnosis if you suspect an underlying condition or other contraindications before treating chronic headaches as if the cause is muscle tension. While massage therapy may help relieve symptoms and reduce the occurrence of some secondary headaches, it is not a cure for an underlying condition, and caution should be taken when treating these clients**.** However, if no other conditions are present, reducing hypertonicity, trigger points, and blood pressure with regularly scheduled massage therapy can decrease the severity and frequency of chronic tension headaches.

Tension headaches are the most common type of headache. Evidence suggests that they may be caused by muscle tension and trigger points, primarily in the shoulders, neck, and head. They respond well to treatments such as over-the-counter pain relievers and manual therapies such as massage. Tension headaches often disrupt the client's activities of daily living, but they are rarely dangerous. Tension headaches are different from migraines, which are believed to have origins that vary but are commonly associated with vascular constriction or a condition of the central nervous system. However, muscle tension often accompanies migraines, and studies have shown that massage can reduce the intensity and frequency of episodes.

Common Signs and Symptoms

Tension headaches are often bilateral but may be unilateral and specific to the referral pattern of one or more trigger points. The pain is dull and aching and is often described as feeling like the pressure of a band or vice around the head or a heavy cape over the head and shoulders. Unlike people with migraines, sufferers of tension headaches do not commonly experience aura, nausea, or vomiting, and physical activity does not usually intensify a tension headache.

In addition to aching in the head, clients sometimes feel pain in the neck or shoulders or between the scapulae. These symptoms may even precede headaches. If the client has hyperkyphosis or hyperlordosis, the common pain patterns that accompany these conditions may also be present. Hypertonicity and trigger points are frequently found in the cervical extensors, particularly the upper trapezius, splenius cervicis, splenius capitis, and the suboccipitals; in cervical

Figure 5-1 **Primary headaches.** The client's pattern of pain may help you understand what type of headache he or she is experiencing. Left to right: sinus headache, cluster headache, tension headache, migraine headache. Used with permission of A.D.A.M.

flexors including the scalenes and SCM; and in the muscles of mastication. Satellite trigger points may be found in the referral patterns of primary trigger points. The muscles of respiration may also be involved, particularly with hyperkyphosis or chronic respiratory conditions. Clients who suffer from tension headaches may also experience tenderness in the scalp, loss of appetite, fatigue, insomnia, mood changes, and problems with concentration.

Chronic tension headaches are likely to arise in adolescence or young adulthood. This may occur because young adults must become more self-sufficient, which can be stressful, and because activities of daily living often become more sedentary, which affects postural changes that may contribute to muscle tension. Tension headaches often last from 30 minutes to several weeks and can come and go or persist without relief. The headache is considered chronic when it occurs two or three times per week over the course of several months. Without treatment, the client may suffer from chronic tension headaches for years. Tension headaches often manifest in the afternoon, when stress and fatigue accumulate and trigger points become active. The client may have difficulty sleeping—a symptom that, if left untreated, may contribute to the cause of tension headaches.

Possible Causes and Contributing Factors

To date, there is no consensus about the precise cause(s) of tension headaches or whether the tension said to contribute is actually due to a contraction of the muscles. Tension in the muscles has been noted in sufferers of both tension and migraine headaches. Fluctuations in levels of chemicals including serotonin have also been found in both. While the cause(s) of these fluctuations remain(s) unclear, researchers now believe that the imbalance activates pain pathways to the brain and impedes natural pain suppression. Nevertheless, headaches are often felt in the referral area of a trigger point, and studies have shown that relaxing tense muscles reduces the frequency of both tension and migraine headaches. However, massage is not likely to improve a migraine that is already in progress, and caution should be used when treating a tension headache in progress to avoid pressure and techniques that could intensify symptoms.

Any postural deviation that affects the cervical or thoracic spine can contribute to muscle tension and resulting headaches. The head-forward posture commonly found in hyperkyphosis is often observed. Temporomandibular joint dysfunction, also often found in clients with hyperkyphosis, is likewise a common contributing factor. Torticollis, disc herniations, whiplash, or other unresolved trauma may be involved. Clients whose activities of daily living include main-

taining an inactive posture, such as sitting at a desk or sleeping with the neck in extension, may set the muscles at a high resting tone, contributing to the formation or activation of trigger points. Lack of physical activity—the muscle's enemy—can lead to adhesions, to an accumulation of metabolites, and ultimately to active trigger points. Overuse, fatigue, and stress on the muscles can be culprits of hypertonicity and trigger points. Dehydration, which may cause fatigue and confusion, is one of the most common causes of headaches.

Chemical and hormonal changes, side effects of medications, fluctuations in blood pressure, and hunger or low blood sugar can all contribute to headaches. In these cases, the symptoms are often relieved by addressing the cause. The overuse of pain medication can result in a rebound effect, a phenomenon in which the medication (or suddenly stopping the medication) triggers symptoms it used to relieve. This too can be resolved by decreasing, ceasing, or changing the use of medication under the supervision of a health care provider. Depression and anxiety, which are often related to chemical imbalances and can also cause a client to contract the muscles of the neck and jaw, may play a role in tension headaches.

Insufficient sleep or changes in sleep patterns can affect circadian rhythms and the biological functions they regulate**.** Sleeping in a cold room or sitting for long periods near a source of cold, such as an air conditioning vent, may activate trigger points that may contribute to headaches. Lifestyle choices including the use of or withdrawal from drugs, alcohol, or caffeine; excessive smoking; and overexertion may contribute to the development of chronic headaches. Cold and flu, eyestrain, nasal congestion, and sinus infections may also be contributing factors.

Chronic tension headaches rarely develop after the age of 50. If so, they may be a red flag for a more serious condition, and the client should be referred to his or her primary health care provider for assessment. In addition, the client should seek medical attention if headaches are severe (thunderclap), get worse, change patterns, or are no longer relieved by pain medication. Similarly, the client should seek emergency medical attention if difficulty speaking, fever, rash, seizures, numbness, or weakness accompanies headache. These signs and symptoms may indicate a stroke, aneurysm, or other serious conditions. Headaches that occur after coughing, straining, or sudden movement may be a symptom of intracranial pressure or pressure on the spinal cord or nerves and should be assessed by a medical professional. If headaches develop following an injury, the client should see a health care provider for medical assessment before receiving a massage.

Table 5-1 lists conditions commonly confused with or contributing to tension headaches.

Contraindications and Special Considerations

- **Headache on the day of treatment.** If the client presents with a headache on the day of treatment, do not work aggressively. Although massage is not contraindicated during a tension headache, you should take care not to aggravate the client's symptoms. Myofascial release, lymphatic drainage, and gentle, superficial strokes are most appropriate. The client may not tolerate the face cradle and may be disturbed by light, scents, or sound. You may also consider a shorter treatment or rescheduling the client. If the client's headache frequently occurs in the late afternoon, consider scheduling on a weekend morning when trigger points may not be activated.
- **Underlying pathologies.** Headaches can be a symptom of a wide variety of underlying conditions. If you suspect any condition (consult Table 5-1 and your pathology book for signs and symptoms), refer the client to his or her health care provider for diagnosis before initiating treatment. If the client is diagnosed with an underlying pathology that is not contraindicated for massage, work with the health care provider to develop a treatment plan. A client who has newly developed chronic headaches after age 50 should be referred to his or her health care provider.
- **Endangerment sites.** Be cautious near the endangerment sites in the neck. Gently palpate for the pulse of the carotid artery before you begin working. Avoid this area, and if you feel a pulse while working, back off slowly.

Table 5-1 Differentiating Conditions Commonly Confused with or Contributing to Tension Headaches

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Migraine	Episodic or chronic Moderate or severe Often unilateral Pulsating or throbbing Aggravated by physical activity Aura, nausea, vomiting, sensitivity to light and sound	Diagnosed by signs and symptoms, familial history, and response to treatment MRI or CT to rule out other causes EEG to exclude seizures	Massage may not be appropriate during a migraine, but may reduce frequency when performed regularly between headaches.
Cluster headaches	Usually unilateral Swelling under or around eye, red eye Excessive tears Sudden headache with sharp, steady pain, often during sleep	Diagnosed by signs and symptoms MRI to rule out other pathologies	Massage may not be appropriate during a cluster headache, but may reduce frequency and severity when performed regularly between headaches.
Sinus headache	Pain or pressure at cheeks and brow Tender sinuses Worse when bending forward or lying down Postnasal drip, sore throat, nasal discharge Possible fever, cough, or fatigue Allergic or infectious sinusitis	Diagnosed by signs and symptoms Mucus sample to test for infection CT scan or MRI	Massage is contraindicated if infection or serious underlying pathology is present. Massage is otherwise appropriate within the client's comfort. The face cradle may be uncomfortable.
Brain tumor	Headaches, seizures, decreased sensation or weakness in one part of the body Changes in mental function and personality Clumsiness, tremor Changes in vision, memory, alertness, speech, hearing, or smell Vomiting, fever, or general ill feeling	CT scan MRI EEG Tissue biopsy Cerebrospinal fluid test	Massage is contraindicated until the client is cleared by a health care provider.
Brain aneurysm	Double vision Loss of vision Headaches Eye pain Neck pain When ruptured: Sudden, severe headache Nausea, vomiting Numbness, weakness, or decreased sensation in a body part Vision or speech changes, drooping eyelid(s) Confusion, lethargy, or seizures	CT scan MRI Cerebrospinal fluid test Cerebral angiography EEG	Massage is contraindicated until the client is cleared by a health care provider. Take caution with circulatory techniques.

Table 5-1 Differentiating Conditions Commonly Confused with or Contributing to Tension Headaches (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Stroke or transient ischemic attack	Symptoms are often unilateral, occur suddenly, last a short time, and may occur again Numbness, tingling, weakness, heavy extremities, speech difficulty, vision changes, vertigo, loss of balance or coordination, staggering or falling Facial paralysis Eye pain Confusion	Medical history CBC CT scan MRI Cerebral arteriogram	Massage is contraindicated when symptoms are present. For a client surviving a stroke or transient ischemic attack, massage is indicated if the client is cleared by the attending medical professional. Avoid rigorous circulatory techniques. Massage around the neck is postponed until the client has returned to pre-stroke activities of daily living.
Trigeminal neuralgia	Usually unilateral, around the eye, cheek, and lower face Pain triggered by touch or sound Sharp, electric spasms lasting a few seconds or minutes Pain while brushing teeth, chewing, drinking, eating, or shaving	MRI Blood tests Rule out other conditions	Because of sensitivity to touch, massage is contraindicated without permission and guidance from the client regarding what feels good. The face cradle may be too painful. Massage elsewhere is indicated.
Hemicrania continua	Pain on one side of the head, consistent and daily Generally moderate with occasional severe pain Tearing or redness of eye on affected side Nasal congestion Swelling or drooping of eyelid(s)	Idiopathic No definitive test Diagnosed by signs and symptoms and by ruling out other causes of headache	Refer to health care provider for assessment. Clients with symptoms of hemicrania continua are unlikely to tolerate massage until the symptoms are under control.
Meningitis	Fever and chills Nausea and vomiting Severe headache Stiff neck Sensitivity to light Confusion or decreased consciousness Rapid breathing Loss of appetite Agitation	Chest X-ray CT scan Cerebrospinal fluid test	Massage is contraindicated until the condition is resolved. Refer client to a health care provider.

(*continued*)

Table 5-1 Differentiating Conditions Commonly Confused with or Contributing to Tension Headaches (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Encephalitis	Fever Headache Stiff neck, muscle weakness, or paralysis Vomiting Light sensitivity Confusion, drowsiness, or clumsiness Irritability Seizure, loss of consciousness, stupor, or coma	Cerebrospinal fluid test EEG MRI CT scan	Massage therapy is contraindicated until the condition is resolved. Refer client to a health care provider.
Temporal arteritis	Usually occurs in patients over age 50 Unilateral throbbing Tenderness in scalp Fever, loss of appetite, sweating, weight loss Muscle aches, weakness, and fatigue Reduced, blurred, or double vision Jaw pain	Palpation of scalp for tenderness Weak or no pulse in affected artery Blood tests Liver function tests Biopsy of temporal artery	Refer a client over age 50 with newly developed chronic headaches to a health care provider.
Paget's disease	Persistent bone pain Joint pain and stiffness Headache, neck pain Bowed legs Locally hot to touch Fractures Hearing loss Loss of height	X-ray Bone scan Blood test for serum alkaline phosphatase and serum calcium	Work with health care provider. Massage may help maintain flexibility. Use caution if bones are fragile.
Nerve root compression (radiculopathy)	Muscle spasm, weakness, or atrophy Pain around the scapula on the affected side Neck pain Pain radiates to the extremities Pain worsens with lateral flexion or rotation or when sneezing, coughing, laughing, or straining	Spurling's test Valsalva's test Neurological exam to test reflexes, sensation, and strength	Massage is indicated if cause and location are understood. Take care not to increase compression or reproduce symptoms.

- **Treatment duration and pressure.** If the client is elderly, has degenerative bone disease, or has a condition that diminishes his or her activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better.
- **Positioning.** Use bolsters to position a client for comfort as well as to correct postures that may contribute to headaches. If the head-forward posture or extension of the neck is evident, using a small bolster under the occiput in the supine position and adjusting the face cradle to reduce the extension of the neck in the prone position may help. If hyperkyphosis is present, bolsters under the shoulders in the prone position will reduce protraction of the scapulae. In the supine position, a bolster along the length of the spine including the occiput reduces protraction of the scapulae and extension of the neck.
- **Hydrotherapy.** Do not use moist heat on the neck or chest if the client has a cardiovascular condition that may be affected by the dilation of blood vessels. Severe hypertension and atherosclerosis are two examples of conditions that are contraindicated for massage. Consult your pathology book for recommendations.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised, or if the client is taking anti-inflammatory medication. Friction creates the inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours before treatment if his or her health care provider agrees.
- **Tissue length.** It is important when treating myofascial tissues to not stretch already overstretched tissues. Assess for myofascial restrictions first and only treat those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. If you treat trigger points, use heat or a localized pin and stretch technique to lengthen that area.
- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Massage Therapy Research

In 2002, Quinn et al. published a study titled "Massage Therapy and Frequency of Chronic Tension Headaches." The study involved four nonsmoking adults between the ages of 18 and 55 who had experienced headaches two to three times per week in the prior 6 months; these were diagnosed as chronic or episodic tension headaches according to the International Headache Society guidelines. Baseline headache measures were recorded for 4 weeks, followed by 30-minute massages twice per week for 4 weeks. The treatment plan was very specific and was followed precisely for each participant. Participants were asked to keep a headache diary noting frequency, intensity, and duration of each headache. Compared with baseline headache measures, the frequency of headaches was reduced as early as the first week of treatment, and the frequency reduction was maintained for the duration of the study. Pain was also reduced, although it is not sufficiently clear if the massage techniques, stretching, or relaxation techniques included in the treatment had a more or less direct effect on pain reduction. The duration of headaches became shorter for all four participants, and intensity diminished in three participants. On four occasions, participants arrived for treatment with a headache that was relieved during the 30-minute treatment. In addition, the authors noted that in most sessions, the participants felt headache symptoms when identified trigger points were palpated deeply even when they had not felt the pain prior to palpation; this suggests that the activation of common trigger points may have a strong connection to tension headaches. Although the results are encouraging, a more substantial study with a control group is needed.

In 1990, Puustjärvi et al. published a study titled "The Effects of Massage in Patients with Chronic Tension Headache." The study involved 21 female patients from 21 to 44 years of age who had experienced chronic neck and head pain. Cervical ROM, surface electromyography (EMG) of the upper trapezius and frontalis muscles, pain quality and intensity, and incidence

of pain were recorded for 2 weeks before and 2 weeks after treatment, and again at 3 and 6 months during the follow-up period. Each participant received 10 1-hour massage treatments to the upper body over a period of 2.5 weeks and had no other form of therapy during the study. Compared to the initial recordings, the ROM increased in flexion, lateral flexion, and rotation. EMG improvements were noted in the frontalis muscle alone. Pain decreased significantly, and the number of pain-free days doubled. The participants' psychological state was improved immediately following the 2.5 week treatment period, and the improvement continued at the 3- and 6-month follow-ups. Although the evidence is encouraging, this study is not fully reliable because it did not include a control group, and the treatments were not standardized.

In addition, the 1998 study by Hernández-Reif et al. titled "Migraine Headaches Are Reduced by Massage Therapy" and the 2007 case study by Eisensmith titled "Massage Therapy Decreases Frequency and Intensity of Symptoms Related to Temporomandibular Joint Syndrome in One Case Study" suggest that massage therapy may be effective for both migraine headaches and temporomandibular joint syndrome.

WORKING WITH THE CLIENT

Client Assessment

Assessment begins at your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself. Headaches are a common symptom of a wide variety of conditions. It is essential for your assessment to be thorough. If you suspect an underlying condition that requires medical attention, refer the client to his or her health care provider for assessment. If the client is diagnosed with an underlying condition, research the contraindications or special considerations for the condition. During your assessment, ask questions that will help you differentiate the possible causes of headaches.

Table 5-2 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to enter the room ahead of you while you observe his or her posture and movements. Look for imbalances or patterns of compensation due to pain or weakness. In the absence of a clear cause of tension headaches, such as whiplash or other injury, hyperkyphosis is often a contributing factor. Look for a head-forward posture, neck extension or rotation, elevated shoulders, and slouching. Notice if the client is able to turn the head without involving the shoulders or thoracic spine. This may indicate reduced ROM in the cervical spine. You may also notice hyperlordosis, scoliosis, rotation, or elevation in the hips or pes planus. Figure 5-2 compares the anatomic position to posture affected by hyperkyphosis with the head forward, a common contributing factor to tension headaches.

ROM ASSESSMENT

Test the ROM of the neck, shoulders, and thoracic spine, assessing the length and strength of both agonists and antagonists that cross the joints tested. See Chapter 4 if hyperkyphosis is present. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or

Table 5-2 Health History

Questions for the Client	Importance for the Treatment Plan
Do you have a headache now?	Treatment may need to be adjusted to avoid aggravating symptoms. The client may wish to reschedule.
When did you begin experiencing headaches? Have you experienced any other new symptoms coincident with the onset of headaches?	Newly developed chronic headaches, especially when accompanied by other symptoms, may be a sign of an underlying pathology.
How frequently do you get headaches? Do they occur at or near the same time of day or following similar activities?	Differentiate between episodic or chronic tension headaches. Trigger points are often activated in the late afternoon.
Have you seen a health care provider about your headaches? What was the diagnosis? What tests were performed?	A wide variety of conditions cause headache as a symptom. Infection, acute injury, or an underlying pathology may contraindicate massage. Refer the client to his or her primary health care provider if you suspect an underlying condition.
Was there any change in your activities of daily living before you developed headaches?	This helps determine potential contributing factors.
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors. Tension headaches often follow the referral area of one or more trigger points.
Describe the character of your symptoms.	This helps to differentiate the possible origins of symptoms. Tension headaches often feel like a band or vise around the head or neck. The character of pain is less likely to be throbbing, pulsating, or sharp.
Do any movements make it worse or better?	Locate tension, weakness, or compression in structures involved in such movements. Tension headaches are not commonly made worse with general activity, although the specific movement of a joint crossed by a muscle containing a trigger point may produce or increase symptoms.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures that increase neck extension, head-forward posture, or pressure on the mandible may contribute to headaches.
Are you taking any prescribed medication or herbal or other supplements?	Side effects of medications of all types may contribute to symptoms, have contraindications, or require special considerations in treatment.
Have you had a cortisone shot in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction may cause inflammation and should not be performed if the client has recently taken anti-inflammatory medication.

re-injury. Box 5-1 presents the average active ROM results for the joints involved in tension headache.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 5-1. Pain and other symptoms may not be reproduced with active ROM assessment because the client may limit his or her movement to the symptom-free range.

- **Active extension of the thoracic spine** may be reduced when muscle tension, adhesions, and trigger points are the cause of tension headaches. The client may be resistant to full active extension of the thoracic spine if this produces symptoms during activities of daily living.
- **Active flexion of the cervical spine** in the full range may be restricted due to weakened cervical flexors attempting movement against shortened upper cervical extensors.

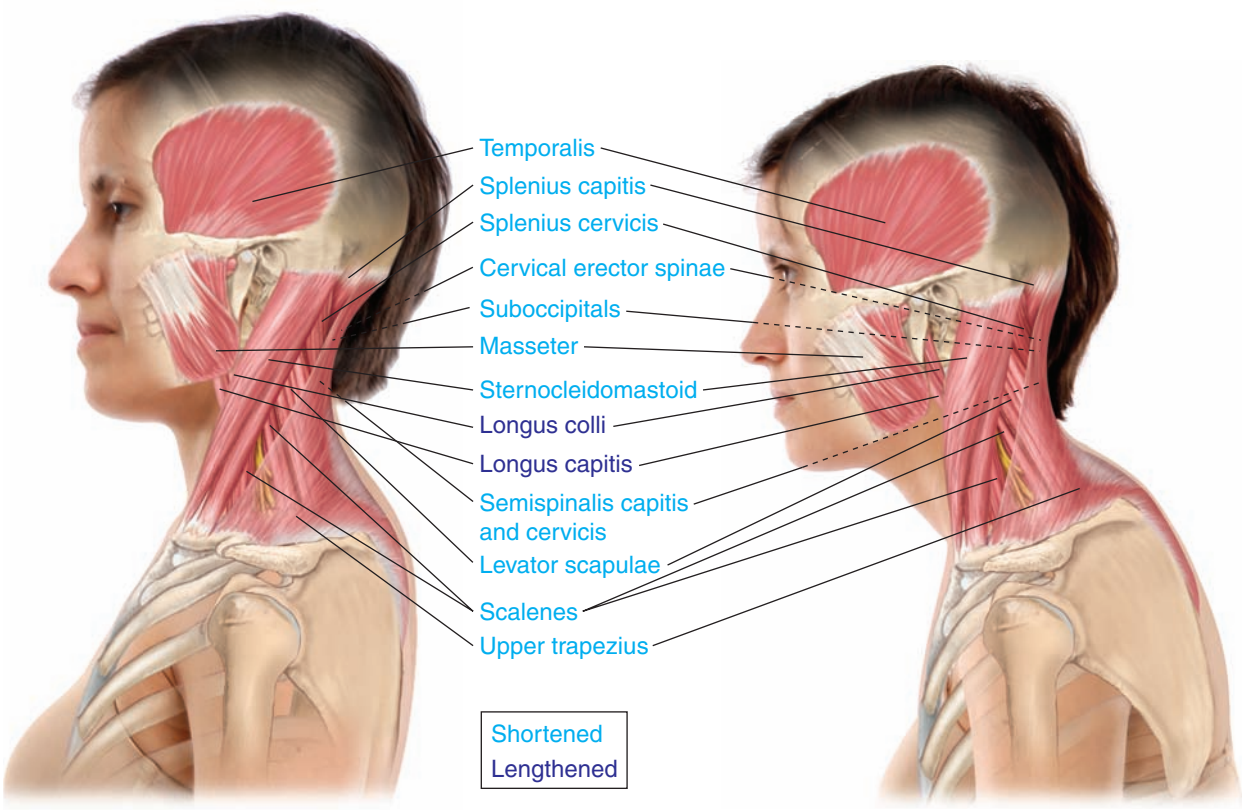


Figure 5-2 Postural assessment comparison. Compare the anatomical posture on the left to the deviated posture on the right. Notice how the muscles of the upper cross react to the increased kyphotic curve and head-forward posture, which may contribute to chronic tension headaches.

- **Active rotation and lateral flexion** of the cervical spine may be reduced or cause pain due to hypertonicity or spasm in the muscles responsible for rotation or lateral flexion, or weak antagonists.
- **Active mobility of the mandible** may be reduced in any direction when the muscles of mastication are hypertonic or contain trigger points.

PASSIVE ROM

Compare the client's P ROM on one side to the other when applicable. Notice and compare the end feel for each range (refer to Chapter 1 for an explanation of end feel).

- **Passive flexion of the cervical spine** may be restricted due to shortened cervical extensors.
- **Passive lateral flexion or rotation of the cervical spine** may be restricted unilaterally if the client's posture favors lateral flexion or rotation to the opposite side.
- **Passive extension of the cervical spine** will likely occur with ease but may produce pain at the end point.

RESISTED ROM

Use resisted tests to assess the strength of the muscles that cross the joints involved. Compare the strength of the affected side to the unaffected side.

- **Resisted flexion of the neck** may reveal weakness in the anterior neck muscles.
- **Resisted rotation or lateral flexion of the neck** may produce or refer pain if the muscles responsible for that action are tight or contain trigger points, and may reveal weakness in their antagonists.

Box 5-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN TENSION HEADACHES

Cervical Spine

Flexion 60°
- SCM (bilateral)
- Anterior scalene (bilateral)
- Longus capitis (bilateral)
- Longus colli (bilateral)

Extension 55°
- Upper trapezius (bilateral)
- Levator scapulae (bilateral)
- Splenius capitis (bilateral)
- Splenius cervicis (bilateral)
- Rectus capitis (bilateral)
- Obliquus capitis superior (bilateral)
- Semispinalis capitis (bilateral)
- Longissimus capitis (bilateral)
- Longissimus cervicis (bilateral)
- Iliocostalis cervicis (bilateral)

Lateral Flexion 20–45°
- Upper trapezius (unilateral)
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- SCM (unilateral)
- Longus capitis (unilateral)
- Longus colli (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Ipsilateral Rotation 70–90°
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- Rectus capitis (unilateral)
- Obliquus capitis (unilateral)
- Longus colli (unilateral)
- Longus capitis (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Contralateral Rotation 70–90°
- Upper trapezius (unilateral)
- SCM (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)

Thoracic Spine

Extension 20–30°
- Spinalis
- Longissimus
- Iliocostalis
- Multifidi
- Rotatores
- Semispinalis capitis
- Latissimus dorsi
- Quadratus lumborum

Mandible

Elevation (contact of teeth)
- Masseter
- Temporalis
- Medial pterygoid

Depression 35–50 mm
- Suprahyoid
- Infrahyoid
- Digastric
- Platysma

Protraction 3–7 mm
- Lateral pterygoid
- Medial pterygoid

Retraction
- Temporalis
- Digastric

Contralateral Lateral Deviation 5–12 mm
- Lateral pterygoid
- Medial pterygoid

SPECIAL TESTS

The following special tests will help you determine when a client should be evaluated by a health care provider using X-ray or other tools, which may reveal conditions that are contraindicated or require special considerations when planning treatment with massage.

The **vertebral artery test** may reveal insufficiency in the vertebral artery and is performed if the client states that he or she experiences vertigo, blurred vision, or light-headedness during activities of daily living (Fig. 5-3).

1. Position the client seated in a chair facing you with the eyes open.
2. Instruct the client to fully rotate and extend the neck to one side for 30 seconds.
3. If, during this time, the client complains of nausea or dizziness or if you notice involuntary motion of the eyes, the test is positive for insufficient circulation through the vertebral artery, and the client should be referred to his or her health care provider.
4. If the test is negative on one side, test the other. Do not test the other side if the first side tests positive.

Spurling's test may reveal compression of a nerve or irritation to the facet joint in the cervical spine and is performed when the client has had an injury, complains of pain that radiates, or experiences numbness and tingling in the arm. Although massage may not be contraindicated for a client with these conditions, refer the client to a health care provider for more detailed information or a massage therapist with advanced training in treating difficult cases. If the client tested positive for vertebral artery insufficiency, do not perform Spurling's test.

1. If the client has recurring symptoms on one side only, begin with that side.
2. Stand behind the seated client and instruct him or her to extend, laterally flex, and rotate the head to the affected side.

Figure 5-3 Vertebral artery test. Watch for involuntary movement of the client's eyes during this test.

Figure 5-4 Spurling's test. With the client's head extended, laterally flexed, and rotated to the affected side, gently and slowly press down on the client's head. Use gentle traction following this test to release pressure.

3. Gently and slowly press down on the client's head (Fig. 5-4). If the client cannot extend, laterally flex, or rotate the neck, perform a simple compression test without these actions.
4. If the client experiences radiating pain, numbness, or tingling in the arm, the test is positive for nerve root compression.
5. Ask the client to describe the location of symptoms because this may suggest which nerve is compressed.
6. If the client feels pain that does not move past the neck, the test is positive for irritation of the facet joint.
7. Applying gentle traction to the neck after the test may relieve symptoms. If traction does relieve symptoms, this is considered reinforcement that Spurling's test was positive for compression of a nerve or facet joint irritation.

PALPATION ASSESSMENT

Muscles that commonly contribute to tension headaches attach at the occiput, mastoid process, ligamentum nuchae, the cervical vertebrae, the upper thoracic vertebrae, and the scapulae. Palpate these areas for tenderness. Carefully palpating the many muscles attached to those bones will give you the most complete picture. The muscles most commonly involved in tension headaches include the trapezius, scalenes, SCM, splenius capitis and cervicis, semispinalis capitis and cervicis, the cervical erector spinae, levator scapulae, and suboccipitals. Palpate these for hyper- or hypotonicity and trigger points.

The muscles of mastication and respiration may also be hypertonic and tender, especially if hyperkyphosis, the head-forward posture, temporomandibular joint dysfunction, or a respiratory disorder is present. Palpate the temporalis, masseter, and pterygoids to assess their involvement. The intercostals and diaphragm may be tender or hypertonic. The occipitofrontalis, which includes the occipitalis, frontalis, and galea aponeurotica between them, may be tender.

Condition-Specific Massage

Because headaches may be a secondary condition or may have a structural cause, it is important to know the health history of the client. If a systemic condition or degenerative bone or disc disease is present, it is advisable to first discuss treatment with the client's health care provider and to adjust accordingly. If hyperkyphosis is present, refer to Chapter 4 for special testing and treatment considerations. Temporomandibular joint dysfunction is another condition that may contribute to tension headaches. Temporomandibular joint dysfunction is not covered in this text, but you may treat the muscles of mastication generally to offer some relief, study this condition in greater detail elsewhere, or refer the client to a massage therapist with training in this area.

It is essential for treatment to be relaxing. You are not likely to eradicate the pain associated with chronic tension headaches, or any of the conditions associated with it, in one treatment. Do not try to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure keeps him or her from relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised.

Ask the client to let you know if any part of your treatment reproduces symptoms. If deep palpation of a trigger point reproduces symptoms, explain this to your client and ask him or her to breathe deeply during the technique. As the trigger point is deactivated, the referral pain will also diminish. Muscles with trigger points that refer pain into the head include the trapezius, SCM, masseter, temporalis, medial and lateral pterygoid, suboccipitals, semispinalis capitis and cervicis, and splenius capitis and cervicis. Common trigger points that refer pain into the head are shown in Figure 5-5.

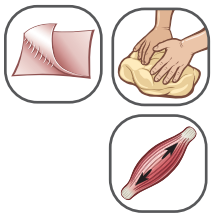
If any other reproduction of symptoms occurs, adjust the client to a more neutral position, reduce your pressure, or move slightly off the area, and make a note about it, as it may help you understand more clearly exactly which neuromuscular conditions are contributing to the client's symptoms. Instruct your client to use deep but relaxing breathing to encourage calming.

The following suggestions are for the treatment of tension headaches. You may not need a full hour to treat the muscles commonly involved in tension headaches, and overtreating may reproduce symptoms. Treating too many trigger points in one session may increase pain. If time remains, address any other postural deviations or contributing factors you may find in your assessment.

- If light affects the client's condition, cover his or her eyes with an eye pillow or pillowcase. Ask the client if scents or sounds are disturbing, and adjust accordingly. If hyperkyphosis is present, use a rolled towel or other bolster along the length of the spine in the supine position. If the client's neck is in extension, fold a pillowcase or hand towel into a small bolster, and place it under the occiput without obstructing your access to the posterior neck muscles.

- If it is comfortable for the client, place moist heat on the neck and shoulder muscles.
- If shortened pectorals or hyperkyphosis is a factor, treat this area fully (see Chapter 4). If the pectorals are not involved, treat the area superficially to relax the client, and open the channels of circulation in the thorax.

- Assess the tissues of the lateral neck for myofascial restrictions. These may be found near the mastoid process and along the lateral neck toward the acromion process and lateral clavicle. Reduce adhesions if indicated.



- Assess and treat tissues from the cervical vertebrae to the acromion process to reduce adhesions in the upper trapezius and to begin assessing for taut bands in the cervical muscles. Treat tissues from the cervical vertebrae toward the superior angle of the scapulae to assess and treat the levator scapulae. (Fig. 5-6).

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

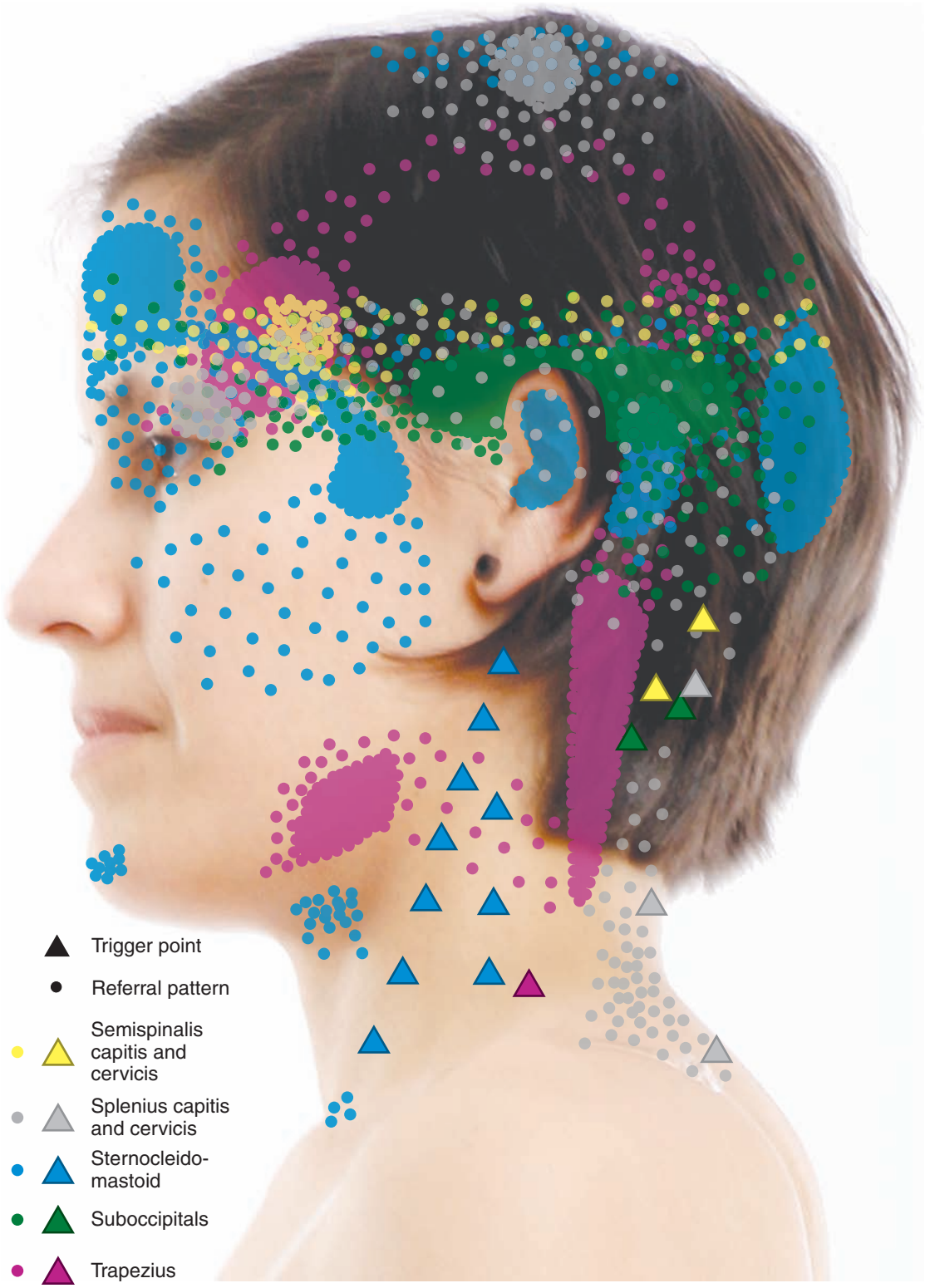


Figure 5-5 Common trigger points and referral. Common trigger points and referral patterns associated with tension headaches. (*continued*)

Figure 5-5 (*Continued*)

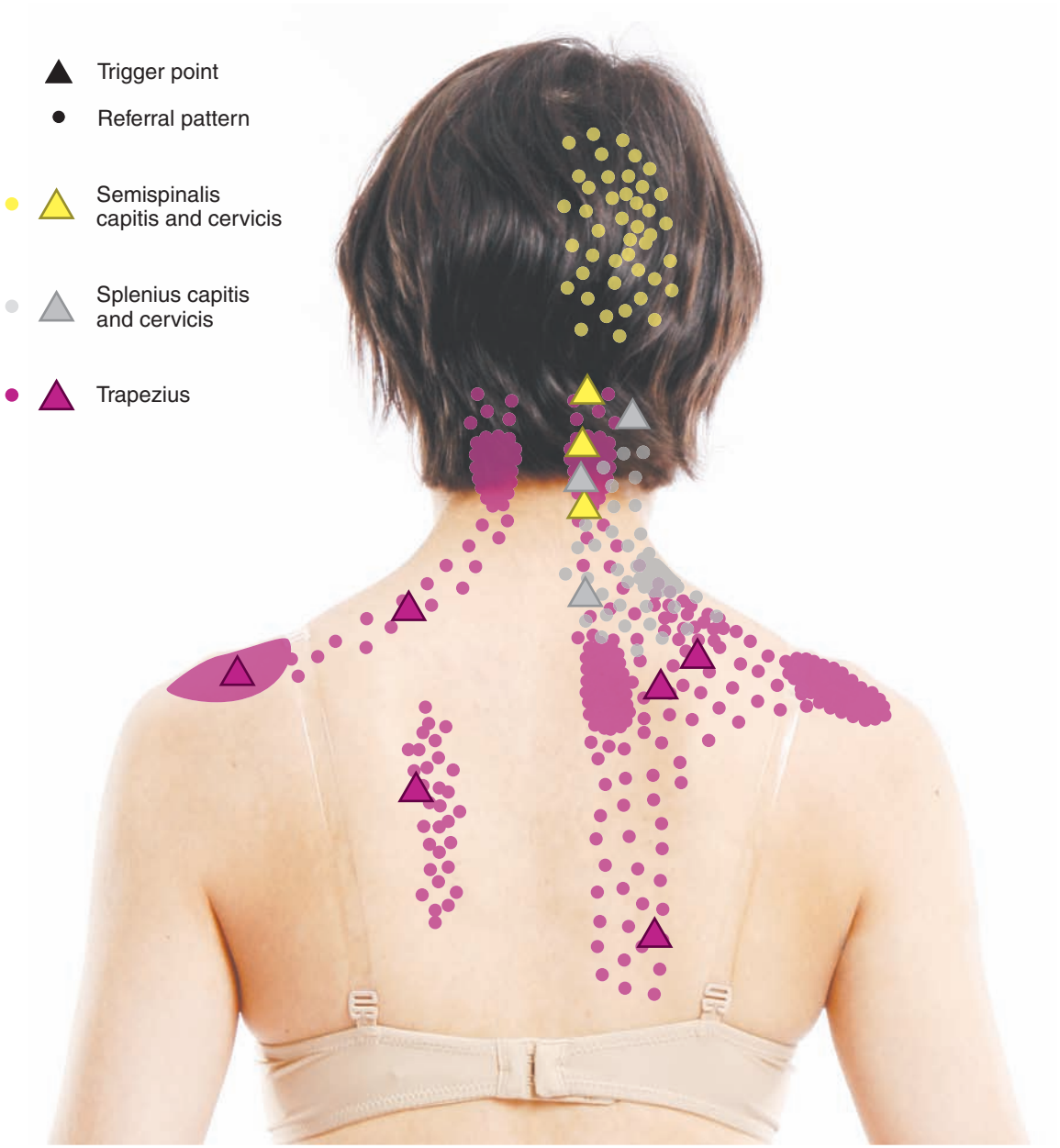
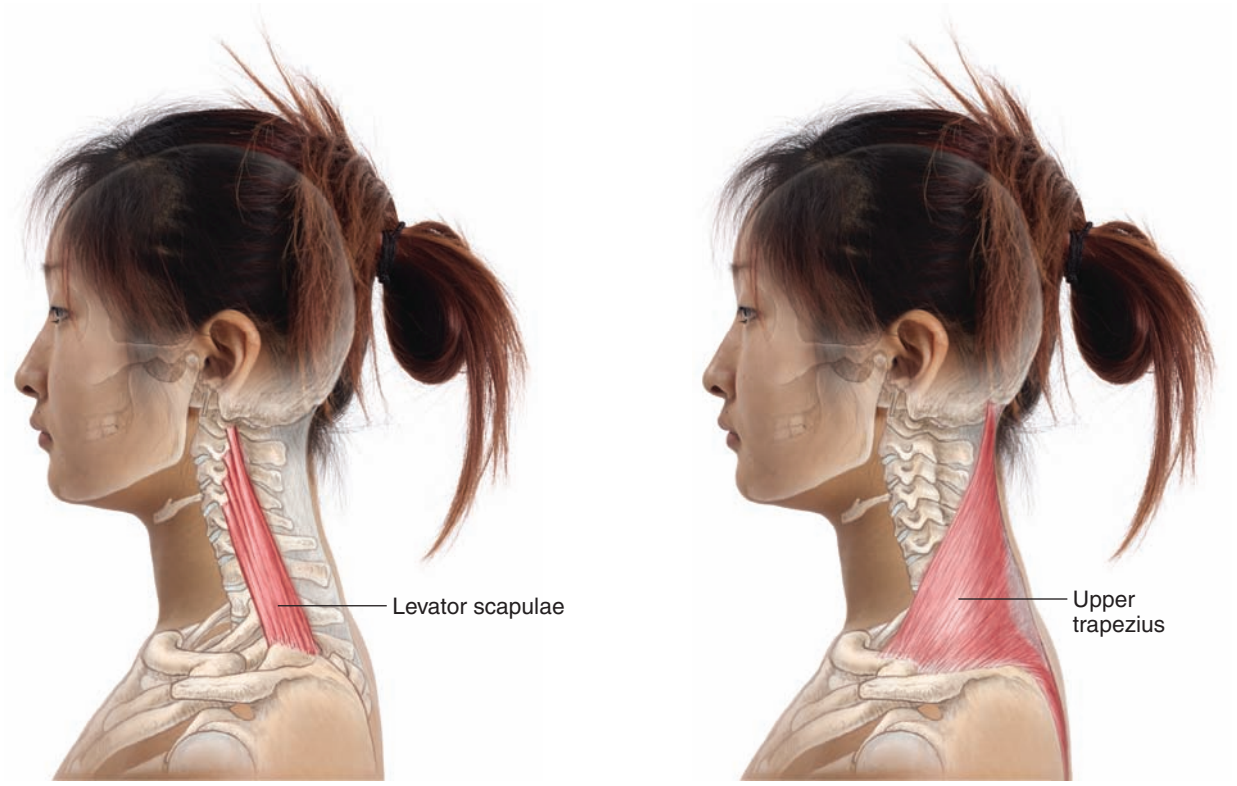


Figure 5-5 (*Continued*)

- Assess and reduce tension at the attachment sites of all posterior cervical muscles including the acromion process, clavicle, and spine of the scapulae. Follow with the same technique along the transverse and spinous processes of the upper thoracic, all cervical vertebrae, and the occiput.

- Assess the SCM, suboccipitals, semispinalis capitis and cervicis, and splenius capitis and cervicis for taut bands and trigger points (Fig. 5-7), and treat those you find.

- Arrange your four fingers of both hands along the occiput and apply pressure to perform Golgi tendon release along the occiput.



LEVATOR SCAPULA

Origin	*Transverse process of C1-4.*
Insertion	*Upper medial border and superior angle of scapula.*
Action	***Bilaterally**: extend neck and head; **unilaterally**: elevate scapula, downward rotation of scapula, lateral flexion of neck and head, ipsilateral rotation of neck and head.*
Nerve	*Dorsal scapular and cervical nerves.*

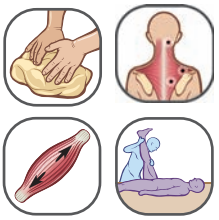
UPPER TRAPEZIUS

Origin	*External occipital protuberance, medial superior nuchal line of occiput, ligamentum nuchae.*
Insertion	*Lateral third of clavicle, acromion process.*
Action	***Bilaterally**: extend neck and head; **unilaterally**: ipsilateral lateral flexion of neck and head, contralateral rotation of neck and head, elevate scapula, upwardly rotate scapula.*
Nerve	*Spinal accessory and cervical plexus.*

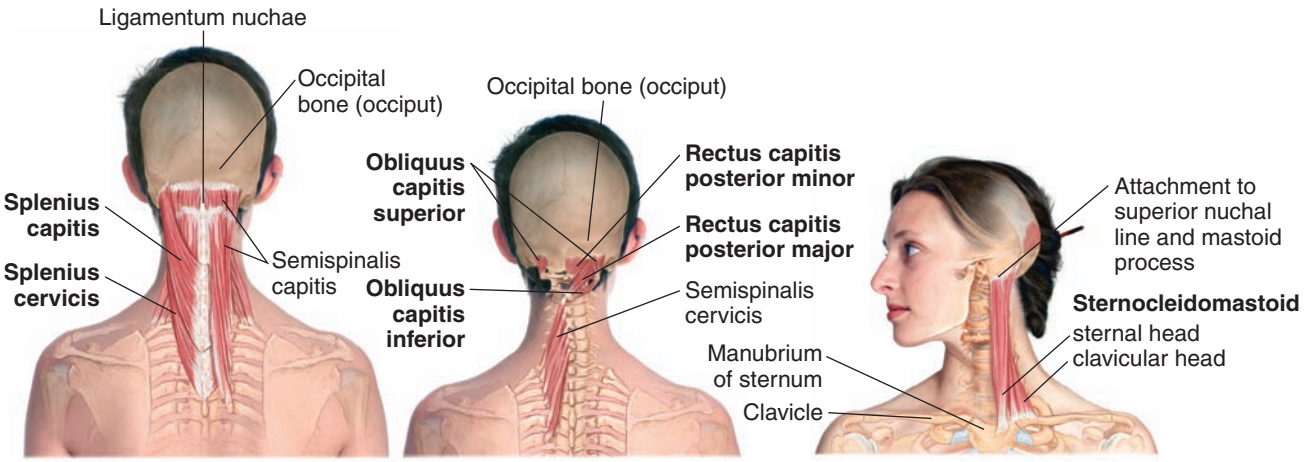
Figure 5-6 Upper trapezius and levator scapulae. Reduce adhesions and assess for taut bands in the upper trapezius and levator scapulae. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Thoroughly stretch all muscles that extend and laterally flex the neck.

- Assess and treat the tissues of the anterior neck, in particular the SCM and scalenes (Fig. 5-8). Gently nudge the SCM medially to assess and treat the anterior scalenes. Warm the tissues thoroughly, treat any trigger points found, and follow with a full stretch to the SCM and scalenes.



- Treat the muscles of mastication, including the temporalis, masseter, and pterygoids to reduce tension (Fig. 5-9). Assess for taut bands and treat any trigger points found. Wearing non-powdered or washed gloves, stretch these muscles by gently opening the mouth passively and holding for at least 15 seconds. You can also perform postisometric relaxation techniques by asking the client to close the mouth against your resistance, taking care to instruct the client not to bite down completely, and then releasing the contraction for a full stretch. Intra-oral treatment may be prohibited according to your state regulations.



SPLENIUS CAPITIS

Origin	*Ligamentum nuchae, SP of C7–T3*
Insertion	*Mastoid process and lateral superior nuchal line of occiput.*
Action	***Bilaterally**: extend neck and head; **unilaterally**: ipsilateral rotation and lateral flexion of head and neck.*
Nerve	*Branches of dorsal division of cervical nerves.*

SPLENIUS CERVICIS

Origin	*SP of T3–6.*
Insertion	*TVP of upper cervical vertebrae.*
Action	***Bilaterally**: extend neck and head; **unilaterally**: ipsilateral rotation and lateral flexion of head and neck.*
Nerve	*Branches of dorsal division of cervical nerves.*

SEMISPINALIS CAPITIS

Origin	*TVPs of thoracic vertebrae and articular processes of lower cervical vertebrae.*
Insertion	*SPs of C2–7 and upper thoracic vertebrae, superior nuchal line of occiput.*
Action	*Extend the vertebral column and head.*
Nerve	*Dorsal primary divisions of spinal nerves.*

SEMISPINALIS CERVICIS

Origin	*TVPs of T1–6, articular processes of C4–7*
Insertion	*SPs of C2–5*
Action	***Unilaterally**: lateral flexion of the neck and head; **bilaterally**: extension of the cervical spine.*
Nerve	*Posterior rami of the cervical nerves.*

SUBOCCIPITALS

Origin	*SPs and TVPs of C1–2.*
Insertion	*Nuchal lines of occiput and TVP of C1.*
Action	*Tilt the head into extension, ipsilateral rotation of head.*
Nerve	*Suboccipital.*

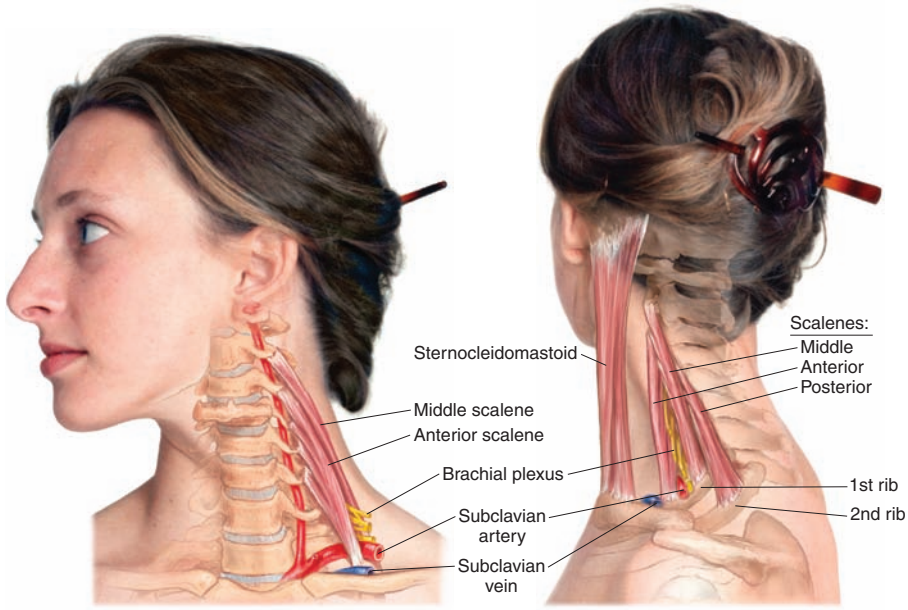
STERNOCLEIDOMASTOID

Origin	*Top of manubrium and medial third of clavicle.*
Insertion	*Mastoid process and superior nuchal line.*
Action	***Unilateral**: ipsilateral lateral flexion and rotation of the head and neck; **bilateral**: flexion of the neck, assist in inhalation.*
Nerve	*Spinal accessory XI.*

Figure 5-7 Muscles attached to the occiput. Reduce adhesions and assess for taut bands and trigger points in the SCM, suboccipitals, semispinalis capitis and cervicis, and splenius capitis and cervicis. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Gently treat the rest of the face, particularly around the sinuses. If you suspect sinus pressure to be a contributing factor, spend a bit more time warming and softening the contents of the sinuses by placing your finger at the sinus and using gentle pressure. You may actually feel movement of fluid during this technique. Follow with gentle tapping at the sinuses, asking the client to hum deeply, explaining that the vibration may help to break up congestion. Follow with superficial gliding strokes moving inferiorly to drain the sinuses.

- Treat the full scalp to increase circulation and release tension in the occipitofrontalis. If the client tolerates it, pulling the hair very gently may be useful in increasing circulation and reducing tension in the scalp.
- Apply clearing strokes to the face and head.
- If time permits and the client can tolerate the face cradle in the prone position, treat the posterior thoracic muscles as needed. If hyperkyphosis is involved, you may find overstretched



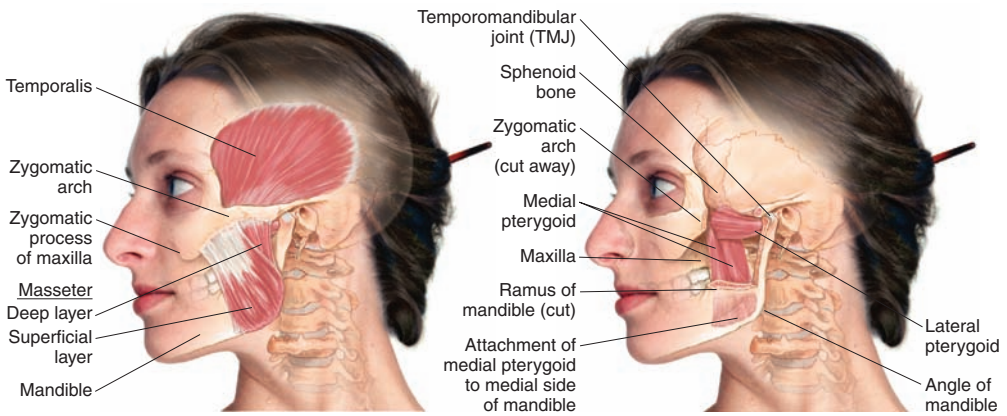
SCALENES

Origin	*Anterior-TVP 3–6, middle-TVP 2–7, posterior-TVP 5–6.*
Insertion	***Anterior**, 1st rib; **middle**, 1st rib; **posterior**, 2nd rib.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, elevate ribs in inhalation and flex head and neck.*
Nerve	*Cervical.*

STERNOCLEIDOMASTOID

Origin	*Top of manubrium and medial third of clavicle.*
Insertion	*Mastoid process and superior nuchal line.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, flexion of the neck, assist in inhalation.*
Nerve	*Spinal accessory XI.*

Figure 5-8 Scalenes. The SCM and scalenes may be short and tight with the head-forward posture. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



TEMPORALIS

Origin	*Temporal fossa and fascia.*
Insertion	*Coronoid process of mandible.*
Action	*Elevate and retract the mandible.*
Nerve	*Deep temporal branch of mandibular nerve.*

MASSETER

Origin	*Zygomatic arch.*
Insertion	*Angle and ramus of mandible.*
Action	*Elevate mandible.*
Nerve	*Mandibular nerve via masseteric nerve.*

LATERAL PYERYGOID

Origin	***Superior head**: infratemporal surface and crest of greater wing of sphenoid bone; **inferior head**: lateral surface of lateral pterygoid plate of sphenoid bone.*
Insertion	*Articular disc and capsule of temporomandibular joint, neck of mandible.*
Action	***Unilateral**: contralateral lateral deviation of mandible; **bilateral**: protract mandible.*
Nerve	*Mandibular.*

MEDIAL PTERYGOID

Origin	*Medial surface of lateral pterygoid plate of sphenoid bone and tuberosity of maxilla.*
Insertion	*Medial surface of ramus of mandible.*
Action	***Unilateral**: contralateral lateral deviation of mandible; **bilateral**: elevate and protract mandible.*
Nerve	*Mandibular.*

Figure 5-9 Muscles of mastication. Reduce adhesions and assess for taut bands in the temporalis, masseter, and pterygoids. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

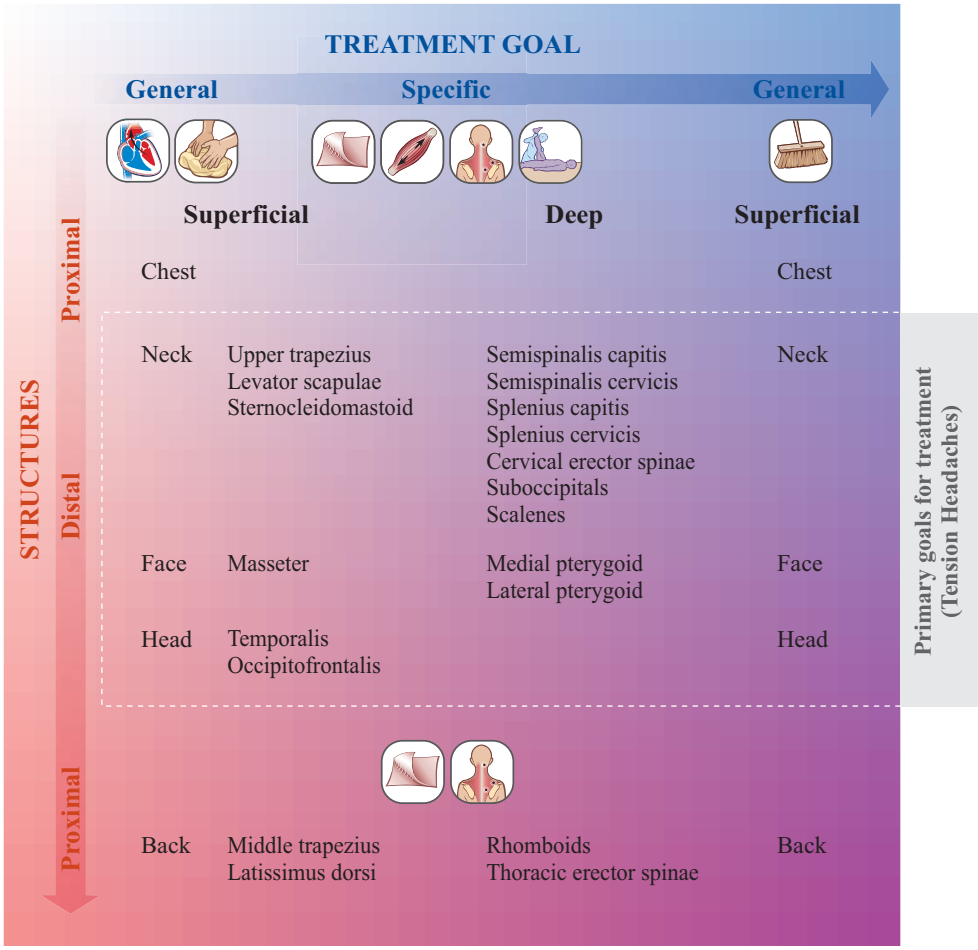


Figure 5-10 **Tension headache treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating tension headaches.

rhomboids, middle trapezius, and thoracic erector spinae and hypertonic cervical erector spinae, lower trapezius, and latissimus dorsi. If a respiratory condition is a factor, be sure to assess and treat the serratus muscles.

The treatment overview diagram summarizes the flow of treatment (Fig. 5-10).

CLIENT SELF-CARE

The following are intended as general recommendations for stretching and strengthening muscles involved in tension headaches. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines:

- Instruct the client to perform self-care activities throughout the day, such as while taking a phone call, reading e-mail, watching television, or performing other activities of daily living instead of setting aside extra time.

- Encourage the client to take regular breaks from repetitive actions.
- Demonstrate gentle self-massage to keep adhesions and hypertonicity at bay between treatments.
- Encourage the client to perform relaxed, deep breathing exercises when pain arises.
- Encourage the client to keep a headache journal, which may help identify patterns and aggravating factors.
- Instruct the client on proper posture to keep pressure off weakened joints. For the client who spends long hours at a desk or on the telephone, it is essential to demonstrate the proper seated posture and to instruct the client not to hold the phone between the ear and shoulder. Recommend a sleeping position that does not stress the client's affected structures.
- Demonstrate all strengthening exercises and stretches to your client and have him or her perform these in your presence before leaving to ensure that he or she is performing them properly and will not harm himself or herself when practicing alone. Stretches should be held for 15–30 seconds and performed frequently throughout the day within the client's limits. The client should not force the stretch. It should be slow and gentle, trying to keep every other muscle as relaxed as possible.

Stretching

To stretch the posterior neck muscles, instruct the client to let the head hang so that the chin approaches the chest (Fig. 5-11). He or she should not force the chin to touch the chest with an active contraction. To increase the stretch, the client can rest the hands on the back of the head and allow the weight of the arms to gently pull the chin toward the chest. It may help to gently rotate the flexed neck to one side to more specifically target muscles that need lengthening.

To stretch the cervical rotators and restore mobility, instruct the client to slowly and gently rotate the neck to one side, hold for 5–10 seconds, then rotate to the other side and hold; repeat this 5–10 times or as often as is comfortable before the client feels fatigue or weakness. For some, it may feel good to rotate the head in extension as well, but this is not advised if the client is at risk for nerve compression or herniation. Even in the absence of disc disease or nerve compression, one rotation in extension may be performed after several side-to-side rotations in flexion, but do not instruct the client to do a full repeated circumduction of the head.

If temporomandibular joint dysfunction is a contributing factor, and the joint does not dislocate during movement, instruct the client to open the mouth as widely as is comfortable and to hold for 15 seconds, relax for 5 seconds, and repeat this stretch 5–10 times. If possible, have the client alternate between opening the mouth straight and then opening the mouth with the lower jaw to the right, then to the left, always coming back to the middle between stretches. You may also instruct the client to perform gentle massage to the muscles of mastication.

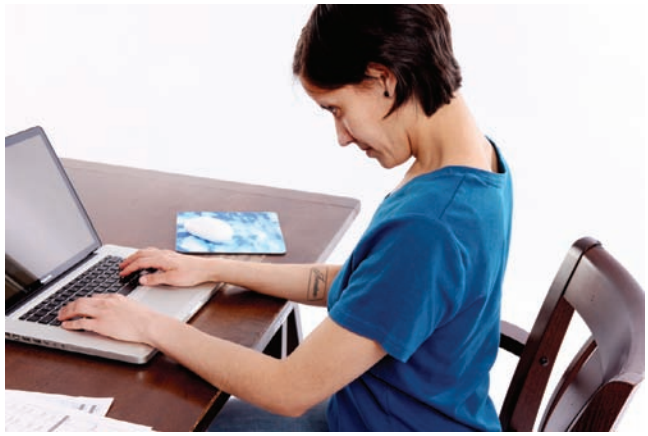


Figure 5-11 Cervical extensor stretch. Instruct the client to let the head hang without any force.

Figure 5-12 Cervical flexor strengthening. Instruct the client to flex the neck against the resistance of his or her hand.

Strengthening

The client can strengthen the deep anterior neck muscles with resisted flexion of the neck. Instruct the client to rest the forehead in the palm of his or her hand, and with the spine erect and thorax in proper alignment, flex the neck against the resistance of the hand (Fig. 5-12). These can be held for approximately 5–10 seconds with 3–5 seconds of rest between each resistance. The client can perform 10 or more repetitions for as long as it is comfortable before feeling fatigue or weakness in the neck.

If hyperkyphosis is a contributing factor, the client must also strengthen the middle trapezius and rhomboids in order to oppose the pull of the shortened pectoral muscles. Instruct the client to stand with the arms comfortably hanging at the sides while squeezing the scapulae together. When this is done properly, only the middle trapezius and rhomboids should contract while the shoulders are relaxed. See Chapter 4 for more detailed instruction and images.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, the client with chronic tension headaches will have treatments once or twice a week until symptoms are absent for at least 7 days. As treatment continues, the period of symptom-free days should increase until headaches become occasional or are relieved completely. After this, the client can schedule as necessary. If the headaches are caused by muscle tension, there should be some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting his or her activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest.

- The condition is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical or medical massage training. Continuing to treat a client whose case is beyond your scope of practice could turn the client away from massage therapy altogether and hinder his or her healing.
- The headaches have an undiagnosed, underlying cause. Discontinue treatment until the client sees a health care provider for medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be the therapist who takes this client through the full program of healing. Still, if you can bring some relief, it may encourage the client to discuss this change with a health care provider and to consider massage therapy rather than more aggressive treatment options. If the client agrees to return for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on a specific area. Likewise, once you have treated the structures specific to tension headaches, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Grace is a 20-year-old college student. She was an athlete in high school and has tried to continue in sports, but her current responsibilities make it difficult for her to stay active. Grace does her best to choose healthy options when she finds the time to eat a proper meal. She rarely has time for exercise, but walks to and from classes, which are approximately a mile away from her home. She has been getting headaches in the late afternoon a few days a week.

Subjective

Grace stated having headaches that begin in the late afternoon. The headaches get better while she is walking home but sometimes kick up again after dinner when she does her homework and persist until she goes to sleep or takes an aspirin. She does not wake up with the headache. She has had occasional headaches at school for a few months, but recently they have become as frequent as 3 or 4 times per week. She feels the pain on the side of her head as if it wraps around her ear. The pain is often on the left side, but occasionally it feels like it fills her whole head. She also stated that recently she noticed that she feels pain on the left side of her upper back when she gets a headache. She stated that her desk at work is set up with the phone and keyboard to the left of her screen, so she often holds the phone with her left shoulder and has to turn her head to the right to look at the screen when typing. When asked to describe the character and intensity of pain, she stated that it felt as if she were wearing a helmet that is too tight, and that the pain was distracting and slowed her down but did not cause her to stop working. On a scale of 1–10, Grace stated that she felt pain at a level 6 most of the time, occasionally at 7 or 8. When asked, Grace was unsure whether she has the tendency to grind her teeth. When asked, she stated that she has had no numbness, tingling, extremes of temperature, or other unusual sensations in the extremities, has felt no dizziness, vertigo, nausea or changes in vision or speech, and has never experienced an aura or sensitivity to light with her headaches. Grace drinks water regularly throughout the day.

Objective

When I stood to Grace's right, she was able to look toward me by rotating only her head. When I stood to her left, she rotated her whole thorax to look in my direction. Postural assessment revealed a head-forward posture and an elevated left shoulder. Her head is laterally flexed left and rotated to the right. Her thorax is slightly flexed to the left. Her hips are slightly rotated to the right. Palpation assessment revealed that her

superficial neck extensors are adhered and dense. It was difficult to distinguish individual muscles or to feel muscle fibers initially.

Action

I began treatment in the supine position with a bolster under the occiput and an eye pillow over the eyes. I performed myofascial release on the superficial adhesions along the occiput toward the mastoid process and down the lateral neck. I spent a significant amount of time warming the lateral and posterior neck with effleurage and cross-fiber friction. I applied muscle stripping to the upper trapezius bilaterally. I found a trigger point approximately 2 inches medial to the left acromion process that referred pain into the head around the ear at a pain level of 8. Compression followed by focused muscle stripping reduced the intensity of the referred pain to level 5. I applied pincer grip petrissage to the SCMs. No trigger points were found. I used cross-fiber friction on the scalenes followed by muscle stripping. I found a trigger point in the left anterior scalene approximately 1 inch superior to the clavicle that referred pain across the left shoulder at level 6. Compression followed by muscle stripping reduced the referred pain to level 2. I applied a deep stretch to the upper trapezius, SCMs, and scalenes bilaterally. I also applied cross-fiber friction to the neck extensors and circular petrissage along the spine of the scapulae, superior angles of the scapulae, and the thoracic and cervical vertebrae. Taut bands were found in the left splenius capitis and levator scapulae. No trigger points were found. I used deep friction on the neck extensors to reduce adhesions and release taut bands. With the remaining time, I paid minor attention to the full length of the erector spinae, latissimus dorsi, internal and external obliques, and quadratus lumborum to assess and begin reducing thoracic flexion and rotation in hips.

Grace stated that she felt less stiff than when she arrived.

Plan

I demonstrated stretches to the neck extensors and rotators. I recommended that she practice these frequently throughout the day, particularly when she is working or studying. I also recommended that she reorganize her desk so that she can look straight ahead instead of rotating her head toward the screen. I recommended that she use, when possible, a speakerphone or headset or to hold the telephone with her hand instead of using her shoulder. I recommended biweekly treatments for 2 weeks followed by reassessment. This will help to keep adhesions at bay so that we can target more specific tissues in subsequent sessions. Grace scheduled a 1-hour session 4 days from today.

CRITICAL THINKING EXERCISES

1. Develop a 10-minute stretching and strengthening routine for a client that covers all of the muscles commonly involved in tension headaches. Use Box 5-1 and Figure 5-5 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened, while strengthening is performed by actively bringing the origin and insertion closer together and is important if the antagonists of shortened muscles have weakened. Describe each step of the routine in enough detail that the client can perform it without your assistance.
2. A potential client explains that about 6 months ago she started feeling stiffness and pain in her neck and shoulders. She associates this pain with being pulled and spun abruptly during a tango class. She saw her doctor when the pain persisted for a week but was released with no injuries found. No X-rays or special tests were performed. The doctor recommended chiropractic treatment, and the client complied. No X-rays were taken, but orthopedic tests were negative for a herniated disc. The chiropractor adjusted the cervical and thoracic vertebrae, which brought relief for only a day or two. Three subsequent visits also resulted in only temporary relief. In the past few weeks, the client has been experiencing chronic headaches. Assuming that the abrupt movement while dancing was the primary contributing factor, what injury may have occurred that would result in chronic pain and headaches? What are some things to consider in your assessment of an injury that was only temporarily

relieved by chiropractic adjustment to the vertebrae? Which structures will you assess and what abnormalities might you expect to find?

3. Discuss special considerations and adjustments to treatment for a client who has chronic tension headaches as well as a condition such as hypertension or atherosclerosis that is currently under control and being monitored by a health care provider.

4. Conduct a short literature review to explain how the following conditions may put a client at risk for chronic headaches:
   - Nerve root compression
   - Diabetes
   - Chronic bronchitis
   - Dental overbite
   - Whiplash
   - Menopause
   - Depression or anxiety
   - Withdrawal from drugs, alcohol, caffeine, or cigarettes

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Thoracic Outlet Syndrome

CHAPTER 6

UNDERSTANDING THORACIC OUTLET SYNDROME

The thoracic outlet is the space between the base of the anterior lateral neck and the axilla (Fig. 6-1). A neurovascular bundle that includes the brachial plexus, the subclavian artery, and the subclavian vein passes through the thoracic outlet. Thoracic outlet syndrome refers to a collection of symptoms that occur when any of these structures become compressed. The symptoms are often vague, and there is no true consensus about the cause or diagnosis. The condition is called neurogenic thoracic outlet syndrome when the nerves are compressed, and vascular thoracic outlet syndrome when the blood vessels are compressed. Neurogenic thoracic outlet syndrome is most common, although occasionally, both occur simultaneously.

The nerve roots of the brachial plexus exit the spine between C5 and T1. These roots merge to form the superior, middle, and anterior trunks. Each trunk splits into anterior and posterior divisions, which then regroup to form the posterior, lateral, and medial cords; these later split into the branches that innervate the arm. Compression of the nerves slows the transmission of impulses; this can result in pain, burning, numbness, and tingling in the shoulder, axilla, lateral thorax, and down the arm to the hand. The subclavian artery, subclavian vein, and cervical lymph trunk also pass through the thoracic outlet. Compression of these structures can result in decreased blood supply to the arm, insufficient venous return, and lymphatic congestion, causing swelling in the arm, pale or cool skin, and a weakened pulse.

When thoracic outlet syndrome has muscular contributing factors, postures and activities that shorten myofascial tissues and decrease the space through which the nerves and vessels pass may cause symptoms. There are three primary areas where muscular compression of the contents of the thoracic outlet occurs: between the anterior and middle scalenes (anterior scalene syndrome), beneath the clavicle and subclavius (costoclavicular syndrome), and beneath the pectoralis minor (pectoralis minor syndrome). Because common postures like working at a computer for extended periods often result in a head-forward posture, flexion and internal rotation of the shoulder, pronation of the forearm, and extension of the wrist, compression may occur at more than one of these sites, as well as beneath the pronator teres or in the carpal tunnel. Compression occurring at more than one site along the path of a peripheral nerve is called a double crush.

Common Signs and Symptoms

The symptoms of thoracic outlet syndrome usually begin gradually. Symptoms are commonly unilateral but may be bilateral. The signs and symptoms of neurogenic thoracic outlet syndrome include aching, pain, burning, numbness, or tingling in the shoulder, neck, arm, or hand of the

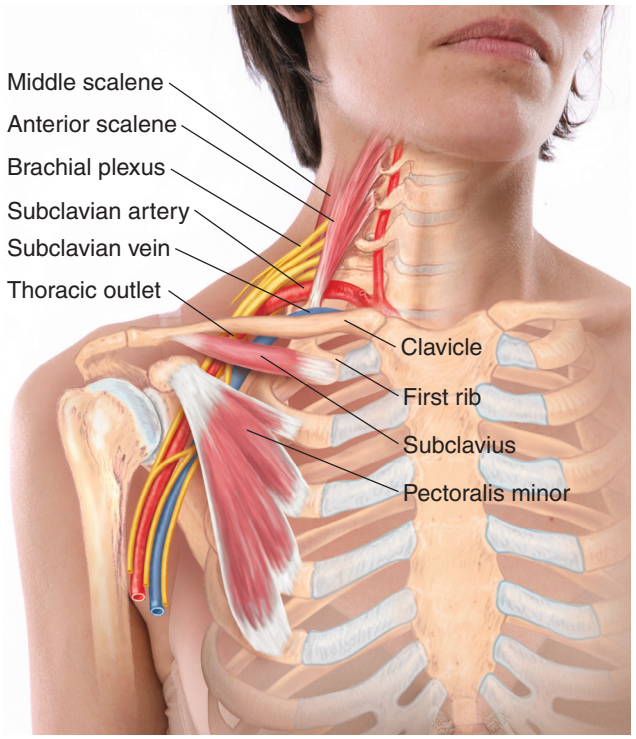


Figure 6-1 The thoracic outlet. The brachial plexus, subclavian vein, and subclavian artery pass through the thoracic outlet.

Figure 6-2 Sleeping on one side. With the arm raised above the head during sleep, the brachial plexus and blood vessels can become compressed, producing symptoms and waking the client.

affected side. Untreated, reduced innervation may lead to loss of tone, initially in the thenar muscles and eventually in the muscles of the arm and hand, causing reduced strength and fine motor skills. Atrophy may occur in advanced cases.

With vascular thoracic outlet syndrome, the client may experience the symptoms described above in addition to swelling, ischemia, and pain in the arm and hand or sensitivity to temperatures in the hand and fingers. The skin of the hand may be pale or bluish. Symptoms may mimic those of Raynaud's syndrome, namely cold fingers and pallor. The client may have a weak or absent pulse in the affected arm. Black spots on the hand and fingers may be present when decreased circulation affects the health of those tissues. In the worst-case scenario, vascular compression can be caused by blood clots, or can result in blood clots if left untreated. A client with these symptoms should be assessed by a medical professional prior to massage.

Because postural imbalance is often a contributing factor, the client may also have neck pain, chest pain, jaw pain, or frequent tension headaches. Note, however, that chest pain that refers to the jaw, throat, and arm may also be symptoms of a cardiac problem, which requires medical assessment prior to performing massage therapy. See Table 6-1 for conditions commonly confused with or contributing to thoracic outlet syndrome. Raising the arm above the head often intensifies the symptoms, particularly when lifting heavy objects. Lying down or gently moving the head and shoulder into a neutral position may reduce symptoms, particularly in the early stages of the syndrome.

Many people suffering from thoracic outlet syndrome are awakened from sleep by pain or tingling, often because they sleep with the head resting on the raised arm (Fig. 6-2). Disturbed sleep can contribute to a cycle in which fatigue exacerbates symptoms and produces anxiety and depression, which may in turn disturb sleep.

Possible Causes and Contributing Factors

Thoracic outlet syndrome is not a clearly defined condition but a collection of signs and symptoms associated with various contributing factors. Anatomically, a small percentage of people have a cervical rib—a bony prominence that emerges from the C7 transverse process and meets

Table 6-1 Differentiating Conditions Commonly Confused with or Contributing to Thoracic Outlet Syndrome

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Herniated disc C4-5	Symptoms may increase when coughing, laughing, and straining Weak deltoid Shoulder pain Usually no radiating pain or paresthesia	Kemp's test Spurling's test CT scan Myelography MRI	Massage is indicated with caution and proper training. Acute inflammation and acute injury are contraindications. Work with the health care team.
C5-6	Weak biceps and wrist extensors Pain and paresthesia in radial distribution		
C6-7	Weak triceps and finger extensors Pain and paresthesia down posterior arm into third digit		
C7-T1	Weak hand grip Pain and paresthesia in ulnar distribution		
Cervical spondylosis (cervical arthritis)	Neck pain that may radiate to the shoulder or arms Loss of or abnormal sensation in the shoulder or arms Weak arms Stiff neck that gradually worsens Loss of balance Headache Loss of bladder or bowel control	X-ray CT scan MRI Myelogram EMG	Massage is indicated with caution. In cases of nerve impingement or spurs that irritate nerves, work with a health care provider. Position client to reduce symptoms, and do not remove protective muscle splinting.
Nerve root compression (radiculopathy)	Muscle spasm, weakness, or atrophy Pain around the scapula on the affected side Neck pain Pain radiates to extremities Pain worsens with lateral flexion or rotation or when sneezing, coughing, laughing, or straining	Spurling's test Valsalva's test Neurological exam to test reflexes, sensation, and strength	Massage is indicated if cause and location are understood. Take care not to increase compression or reproduce symptoms.
Tendinitis (biceps, forearm, or rotator cuff)	Local inflammation and point tenderness No muscle wasting	Pain on full passive stretch of the joint that the tendon crosses; pain with resisted activity	See chapter 13
Pronator teres syndrome	Pain in forearm, worsened by elbow flexion/extension Absence of pain during the night	Resisted pronation of the forearm (excluding resistance to the wrist) Tinel's sign at the median nerve as it passes under the pronator teres	Massage is indicated

(*continued*)

Table 6-1 Differentiating Conditions Commonly Confused with or Contributing to Thoracic Outlet Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Hypothyroid condition	Weakness, fatigue, intolerance to cold, constipation, unintentional weight gain, brittle hair and nails, dry skin, puffy skin, hoarse voice, sleep disturbance, and mood swings	Physical exam T3, T4, and Serum TSH laboratory tests	Massage is indicated when no other contraindicated condition, such as a circulatory complication, is present.
Rheumatoid arthritis	Fatigue, loss of appetite, low-grade fever, bilateral nonspecific muscle pain, rheumatic nodules, periods of flares and remission	Physical exam Blood tests X-ray	Massage is indicated in nonacute stages. Work with health care team.
Angina pectoris	Chest pain Pain in arms, neck, jaw, shoulder, or back in addition to chest pain Nausea Fatigue Shortness of breath Anxiety Sweating	Physical exam Risk factors Blood test Electrocardiogram Stress test Chest X-ray Echocardiogram CT scan	Trigger points in pectoralis major may mimic some symptoms of angina pectoris. If the client presents with risk factors or the symptoms listed here, refer him or her to a health care provider prior to treatment. When risk factors are present, massage is indicated only if cleared by a primary health care provider, and if client is able to perform normal activities of daily living.
Diabetes	Frequent urination, frequent thirst, increased appetite, fatigue, nausea	Physical exam Fasting blood sugar test	Massage is indicated when tissues and circulation are not compromised.
Cervical stenosis	Pain, weakness, and numbness in the shoulders, arms, and legs Clumsy fine motor skills Balance disturbance	Physical exam X-ray MRI CT scan Myelogram Bone scan	Massage is indicated with caution. Work with a health care provider. Client may receive corticosteroid injections or may be using anti-inflammatory medication.
Tumors (axillary, first rib, pancoast, nerve sheath, and spinal cord)	Signs and symptoms vary depending on type and location of tumor. General characteristics for tumors affecting the thoracic outlet include the following: Pain, often severe and constant, in shoulder and scapula that radiates to the arm and hand Weakening, atrophy, and numbness or tingling in the arm and hand Paraplegia	CT scan MRI Pet scan CBC Biopsy Chest X-ray	Refer client to health care provider if you suspect a tumor. Work with the health care provider if a tumor has been diagnosed. Recommendations for massage depend on the type and location of the tumor.

Table 6-1 Differentiating Conditions Commonly Confused with or Contributing to Thoracic Outlet Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Shoulder injuries (impingement, rotator cuff tears, and adhesive capsulitis)	Often gradual onset with spontaneous resolution Minor pain at rest; acute pain with activity, which may radiate down the arm Pain often worse at night, disrupting sleep Weakness, reduced ROM in shoulder Tenderness and swelling in shoulder Gradual loss of ROM	Physical exam X-ray MRI	Massage is indicated. Work with the health care team.
Carpal tunnel syndrome	Pain, numbness, and tingling in thumb, index, and middle fingers, and lateral half of ring finger Gradual atrophy and reduced fine motor skills	Phalen's test Tinel's sign EMG nerve conduction test	See chapter 7
Temporomandibular joint disorder	Difficulty biting or chewing Clicking sound when moving jaw Aching in the jaw and face Earache Headache Reduced ROM in mandible	Dental exam MRI X-ray Palpation of muscles of mastication	Massage is indicated
Raynaud's disease	Cold hands and feet White or blue skin Dulled sensation Numbness or pain as extremities warm	Signs and symptoms Rule out conditions causing similar symptoms such as nerve damage Tests for underlying causes Cold simulation test Nail bed or nailfold capillaroscopy Antinuclear antibodies test Erythrocyte sedimentation rate	Raynaud's that is not linked to an underlying condition is indicated for massage. If Raynaud's disease is associated with another condition, follow the guidelines for that condition.
Reflex sympathetic dystrophy syndrome (complex regional pain syndrome)	Often preceded by injury Severe, burning pain that is more intense than the severity of injury and gets worse over time Changes in skin temperature, color, texture, and sensitivity Changes in nail and hair growth Sweating Swelling Joint stiffness Reduced ROM	Signs and symptoms Ruling out other conditions Bone scans	Sufferers of RSDS may not tolerate touch in the affected area. If the client is willing, massage is indicated on or around the affected area.

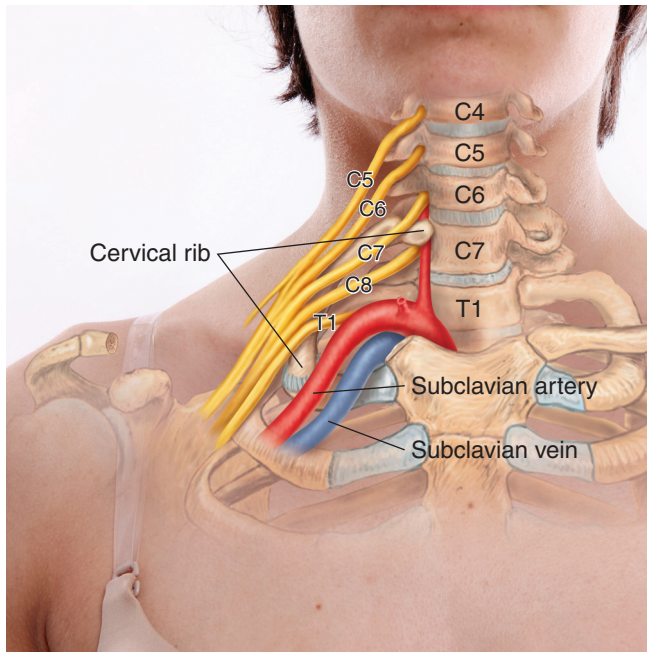


Figure 6-3 Cervical rib. An extra rib can develop from the transverse process of C7, connecting to the lateral aspect of the first true rib.

the lateral aspect of the first rib (Fig. 6-3). Cervical ribs are often unilateral but can be bilateral. The presence of a cervical rib, which can be palpated or seen on an X-ray, alters the path of the nerves and vessels as well as the shape of the surrounding soft tissues. In some cases, the C7 transverse process is unusually large, and while it does not form a complete cervical rib, its increased size can displace the tissues around it. Other bony prominences that may develop in the cervical or axillary region as a result of orthopedic disorders can also elicit symptoms. Hyperkyphosis, scoliosis, a subluxed cervical vertebra, or a herniated cervical disc can alter the anatomy of the thoracic outlet and may contribute to symptoms. For example, scoliosis in the thoracic spine will affect the balance of the cervical vertebrae to which the scalenes are attached, potentially shortening the scalenes, which may lead to trigger points and compression of the nerves and vessels passing through the thoracic outlet.

Symptoms of thoracic outlet syndrome may also develop with the use of crutches or any other device or posture that puts pressure on the structures in the axillary region. Weak shoulder muscles may cause a drooping of the shoulder, which causes the clavicle to fall upon the first rib, resulting in compression. Previous traumas including whiplash, rotator cuff injuries, or a fractured clavicle or humerus that were not successfully treated may result in adhesions, scar tissue, compensating patterns, and trigger points that contribute to thoracic outlet symptoms.

The most common postural imbalances that contribute to the symptoms of thoracic outlet syndrome are identical to those of hyperkyphosis. The main difference is that with thoracic outlet syndrome, these postural imbalances have led to the compression of nerves and vessels, causing numbness, tingling, and swelling whereas the symptoms of hyperkyphosis are primarily pain and reduced ROM. Holding postures that include extension and rotation of the neck; head-forward posture; and abduction, flexion, and internal rotation of the shoulder also contribute to the symptoms of this syndrome. People who work at a computer for long periods, teachers who write frequently on a blackboard, cashiers, house painters, and those in any profession in which the neck and shoulders are held in a static position or in which repetitive actions involve flexion and rotation of the shoulder, particularly above the head, are at risk. Athletes whose activities involve forced movement of the shoulder, such as tennis, golf, and volleyball players, are also at risk.

Hypertonicity and trigger points in the anterior and middle scalenes, subclavius, and pectoralis minor are the most common contributing factors and are the focus of the treatment described in this chapter. Any increase in the tone of these muscles can decrease the amount of space through which the brachial plexus and accompanying vessels travel. However, because of

the frequent involvement of postural and respiratory abnormalities, nearly all of the muscles attached to the cervical vertebrae, scapulae, or ribs or those that cross the glenohumeral joint may be hypertonic or may develop trigger points. Referral patterns for trigger points in the latissimus dorsi, serratus anterior, and serratus posterior superior can be confused with the symptoms of thoracic outlet syndrome and may be the result of postural deviations that contribute to thoracic outlet syndrome. Other muscles that are not directly involved but may be peripherally involved include the coracobrachialis, anterior deltoid, biceps, upper and middle trapezius, levator scapulae, and SCM because of their attachment sites and their roles in postural imbalances.

Neurogenic thoracic outlet syndrome is a peripheral neuropathy. Systemic disorders including diabetes, hyperthyroid, and rheumatoid arthritis may contribute to the development of peripheral neuropathies. Smoking cigarettes—although not a cause of thoracic outlet syndrome—exacerbates the inflammatory process and can intensify symptoms. In addition, because thoracic outlet syndrome may involve the muscles of respiration, the repeated deep inhalation and exhalation associated with smoking, along with chronic respiratory disorders and coughing, can contribute to hypertonicity in these muscles. Thoracic outlet syndrome may also develop during pregnancy because of increased fluid and postural changes, but this usually resolves itself following delivery. Alcoholism, poor nutrition, vitamin B deficiency, and general stress may also contribute to or exacerbate symptoms.

Because so many factors may potentially contribute to thoracic outlet syndrome, it is important to understand the client's health history before proceeding with treatment. Many of the conditions listed above have contraindications for massage therapy or require adjustments to treatment. Refer the client to his or her health care provider for medical assessment if you suspect any systemic condition. If the client has been diagnosed with a condition that requires special consideration when planning massage, discuss treatment with the client's health care provider and adjust accordingly.

Table 6-1 lists conditions commonly confused with or that contribute to thoracic outlet syndrome.

Contraindications and Special Considerations

- **Underlying pathologies.** The signs and symptoms of thoracic outlet syndrome may result from a wide variety of underlying conditions. If you suspect one of these (consult Table 6-1 and your pathology book for signs and symptoms) or if the client shows signs of vascular compression, refer the client to his or her health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not a contraindication for massage, work with the health care provider when necessary to develop an appropriate treatment plan.
- **Edema.** If edema is present, do not work directly on the site. Work proximally, moving the fluid toward the nearest proximal lymph nodes. If vascular compression is a consideration but massage is not contraindicated for the client, do not allow the arm to fall below the heart because gravity may draw fluid into the arm and hand. Bolster the arm if necessary to keep fluid from accumulating.
- **Treatment duration and pressure.** If the client is elderly, has degenerative bone disease, or has been diagnosed with a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better.
- **Positioning.** Use bolsters to position a client for comfort as well as to correct postures that may reproduce symptoms. If the head-forward posture or extension of the neck is evident, placing a small bolster under the occiput in the supine position and adjusting the face cradle to reduce the extension of the neck in the prone position may help. A bolster along the length of the spine in the supine position reduces the protraction of the scapulae and the extension of the neck. Bolsters under the shoulders in the prone position reduce the protraction of the scapulae and lengthen the pectoral muscles.

- **Reproducing symptoms.** Symptoms may occur during treatment if you manually compress the neurovascular bundle or if the client's posture causes structures to compress this area. If treatment produces symptoms, first adjust the client to a more neutral posture to relieve compression. If this does not relieve the symptoms, reduce your pressure or move away from the area. You may be able to treat around the site that reproduced the symptoms, but proceed with caution.
- **Hydrotherapy**. Do not use moist heat on the neck or chest if the client has a cardiovascular condition that may be affected by the dilation of blood vessels. Severe hypertension and atherosclerosis are two examples of conditions that are contraindicated for hydrotherapy. Consult your pathology book for recommendations. Do not use heat in areas of edema or inflammation, because heat dilates vessels and may increase the accumulation of fluid.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition, such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised or if the client is taking anti-inflammatory medication. Friction initiates an inflammatory process, which may interfere with the intended action of the anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours prior to treatment if his or her health care provider is in agreement.
- **Tissue length.** It is important when treating soft tissues that you do not further stretch those that are already overstretched. Assess for myofascial restrictions first and treat only those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. If you treat trigger points in a muscle that is overstretched, use heat or a localized pin and stretch technique to lengthen that area.
- **Mobilizations.** Be cautious with mobilizations if the client has degenerative disc disease, rheumatoid arthritis, a cervical rib, hypermobile joints, or if ligaments are unstable from pregnancy or a systemic condition.

Massage Therapy Research

Although articles about the benefits of conservative treatment have been published and abundant anecdotal evidence suggests recovery from symptoms is possible following massage, there are currently no extensive experimental investigations into the specific outcomes following massage for the treatment of thoracic outlet syndrome. Much of the research on treatment for thoracic outlet syndrome focuses on pharmaceutical muscle blocks and surgery. Much of the theory behind the use of massage in the treatment of thoracic outlet syndrome has been adapted from other disciplines. Studies conducted by trained therapists into specific outcomes using only massage are needed.

In 1996, Barnes published an article titled "Myofascial Release in Treatment of Thoracic Outlet Syndrome" describing a single treatment program. The client had a 2-year history of chronic pain in her neck, upper extremities, and whole back initiated by an injury to the posterior mid thorax. The client saw many physicians in a variety of specialties and several physical therapists and took dozens of medications in various combinations with no lasting results. Her level of function was reduced; she needed help dressing and grew tired after even minimal writing. Her medical diagnosis at the time she was referred to Barnes' clinic was thoracic outlet syndrome. The client received 30-minute treatments two or three times a day for 2 weeks by a team of physical therapists trained in myofascial release. The client was able to sleep comfortably without using bolsters after the fourth treatment. The client's mobility increased, and she was walking and climbing stairs by the end of the 2-week program. She continued to have difficulty with fine motor skills. Although the positive outcome suggests the benefits of manual therapy for clients with thoracic outlet syndrome, this case study involves a single, severe case complicated by multiple diagnoses that was treated intensively. Further study is needed.

In 1999, Peng published a study titled "16 Cases of Scalenus Syndrome Treated by Massage and Acupoint-Injection." The 16 participants in this study were all female, between 20 and 40 years of age, who had symptoms from 3 months to 4 years prior to treatment. Each had had a previous injury to the shoulder. One of the participants had a cervical rib. All had a positive Adson's test. Of the 16 participants, 12 had vascular symptoms including a cold affected limb, 9 presented with impaired fine

motor skills, and 4 showed thenar atrophy. In the seated position with the neck as relaxed as possible, manual manipulations were applied to the shoulder and medial arm followed by kneading and compression of acupoints, which are known in the system of Chinese medicine, while the limb was mobilized. The arm was then shaken and rubbed until the skin warmed. This treatment was performed every day. The study does not state the precise treatment program, only that the relief of symptoms required one or two courses of treatment for 20–40 days. In addition to manual therapy, these clients received an acupoint-injection containing procaine hydrochloride and vitamin B12 once every 5 days followed by infrared radiation. According to the author, all but one client was cured. Only the client with the cervical rib continued to have pain and numbness in the arm, but even this client had a negative Adson's test after treatment. Again, this study did not isolate the effects of massage from another form of treatment, in this case acupoint-injection. In addition, few details are provided regarding relief of neurogenic or vascular symptoms or changes in ROM; it is stated only that the client was cured. Although the results are encouraging, further study is necessary.

In 2006, Michael Hamm published a case study titled "Impact of Massage Therapy in the Treatment of Linked Pathologies: Scoliosis, Costovertebral Dysfunction, and Thoracic Outlet Syndrome." As the title suggests, this case also involved a client with multiple conditions. The client presented with pain and weakness in the right shoulder and arm that had increased progressively over the previous 8 months. She was regularly awakened by symptoms and ultimately had to quit her job as a waitress. Chiropractic diagnoses included scoliosis, costovertebral dysfunction, and thoracic outlet syndrome. The client received eight 60-minute treatments over the course of 4 weeks, which included deep tissue massage, neuromuscular therapy, and muscle energy techniques. Following this treatment plan, the client slept better, ROM increased, postural imbalances in the ilia and spine showed improvement, and pain with shoulder activity reduced by 50%. Other longstanding postural imbalances responded less significantly. As the author suggests, further research is needed. He recommends using more precise measurements of bony alignments that will allow for more accurate results upon follow-up, and using a standard measure for psychological stress to include this dimension of musculoskeletal dysfunction. The author also recommends a larger-scale study of massage to treat linked diseases concurrently. The study offers minimal data regarding increased strength or changes in neurogenic or vascular symptoms common to thoracic outlet syndrome. Although the results are encouraging, further research that considers thoracic outlet syndrome independently is needed.

WORKING WITH THE CLIENT

Client Assessment

Assessment begins with your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific pain so that you can prepare yourself. It is essential that your assessment is thorough. If you suspect an underlying condition that requires medical attention, refer the client to a health care provider for assessment. If the client is diagnosed with an underlying condition, research the contraindications or special considerations for the condition. During your assessment, ask questions that will help you to differentiate the possible causes of thoracic outlet syndrome.

Table 6-2 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to enter the room ahead of you while you assess his or her posture and movements. Look for imbalances or patterns of compensation due to pain or restriction. In the case of thoracic outlet syndrome, have the client turn the doorknob to enter the room, pick up a pen, or grasp a cup

Table 6-2 Health History

Questions for the Client	Importance for the Treatment Plan
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors.
Describe what your symptoms feel like.	Differentiate between possible origins of symptoms, and determine the involvement of nerves or blood vessels.
How long have you had symptoms?	Onset may coincide with an illness or trauma and may help you to assess the extent of the injury.
Do any movements make it worse or better?	Locate tension, weakness, or compression in structures producing such movements.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	A cervical rib or other bony prominence is most accurately assessed with an X-ray. Vascular insufficiency should be assessed by a health care provider.
Have you been diagnosed with a condition such as diabetes, rheumatoid arthritis, a thyroid condition, or a respiratory condition? Are you pregnant?	Systemic conditions may contribute to signs and symptoms, may require adjustments to treatment, and may impact treatment outcomes. Fluid retention and changes in posture during pregnancy can contribute to signs and symptoms.
Have you had an injury or surgery?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM. The use of crutches may contribute to thoracic outlet syndrome.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures that increase thoracic flexion, protracted scapulae, cervical extension, or a head-forward posture may contribute to the client's condition.
Are you taking any prescribed medications or herbal or other supplements?	Medication of all types may contribute to symptoms or involve contraindications or cautions.
Have you had a cortisone shot in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction causes inflammation and should not be performed if the client has recently taken anti-inflammatory medication.

of water without making him or her aware that you have begun your assessment. Do not hand these things to the client but allow him or her to pick them up. If the client performs these tasks clumsily with the affected arm, or performs them with the unaffected arm, particularly if it is the nondominant side, it could indicate a compensation pattern due to weakness in the affected arm.

Because the symptoms of thoracic outlet syndrome can be confused with those of other musculoskeletal conditions, it is important to asses the client's posture thoroughly. If you are performing 30 minutes of treatment in the area of compression, it is best to use the remaining time to target related contributing factors. For example, if your assessment of the client reveals lateral flexion of the thorax, spend some time lengthening the muscles that flex the thorax. Clients with thoracic outlet syndrome may also present with hyperkyphosis. The head-forward posture, a drooped or elevated shoulder, and internally rotated shoulders typically contribute to the compression of the brachial plexus. Figure 6-4 compares the anatomic position to the posture affected by thoracic outlet syndrome.

ROM ASSESSMENT

Test the ROM of the neck and shoulders, assessing the length and strength of both agonists and antagonists that cross the joints being tested. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage

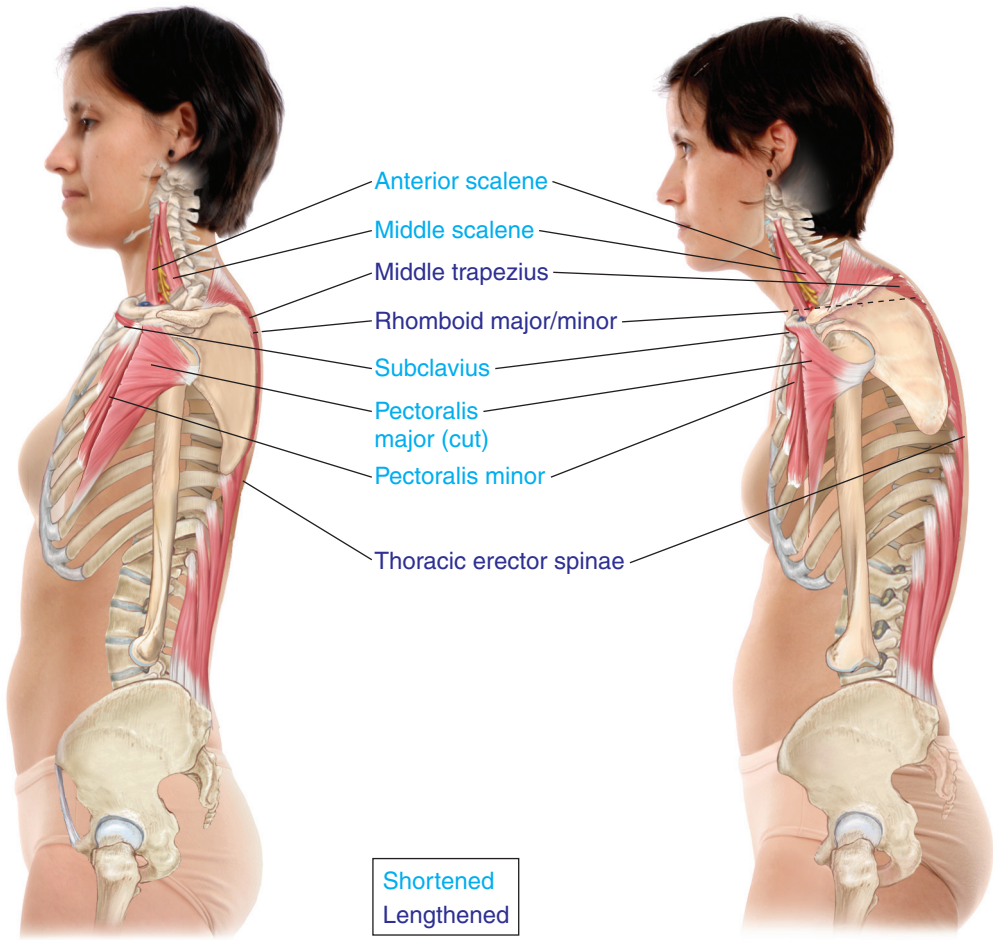


Figure 6-4 Postural assessment comparison. Compare the anatomical posture on the left to the deviated posture on the right. Note how the shortened scalenes, subclavius and pectoralis minor may contribute to compression of the contents in the thoracic outlet.

of an injury to prevent undue pain or re-injury. Box 6-1 presents the average active ROM results for the joints involved in thoracic outlet syndrome.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 6-1. Pain and other symptoms may not be reproduced with active ROM assessment, because the client may limit movement to the symptom-free range.

- **Active contralateral rotation and ipsilateral lateral flexion of the cervical spine** on the affected side may cause pain due to trigger points in the scalenes. Ipsilateral rotation and contralateral lateral flexion may also be reduced and produce symptoms when the shortened scalenes are stretched, or cause discomfort on the unaffected side because of weakened antagonists. Active rotation and flexion of the cervical spine may reproduce symptoms.
- **Active extension of the cervical spine** may be reduced or reproduce symptoms and pain when the shortened anterior scalene is stretched.
- **Active external rotation, abduction, and flexion of the shoulder** may be reduced or produce symptoms when trigger points or hypertonicity in the pectorals limits motion in the shoulder.

PASSIVE ROM

Compare the client's P ROM on one side to the other when applicable. Note and compare the end feel for each range (refer to Chapter 1 for an explanation of end feel). The client may resist even

Box 6-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN THORACIC OUTLET SYNDROME

Cervical Spine

Flexion 60°
- SCM (bilateral)
- Anterior scalenes (bilateral)
- Longus capitis (bilateral)
- Longus colli (bilateral)

Extension 55°
- Upper trapezius (bilateral)
- Levator scapulae (bilateral)
- Splenius capitis (bilateral)
- Splenius cervicis (bilateral)
- Rectus capitis (bilateral)
- Oblique capitis superior (bilateral)
- Semispinalis capitis (bilateral)
- Longissimus capitis (bilateral)
- Longissimus cervicis (bilateral)
- Iliocostalis cervicis (bilateral)

Lateral Flexion 20–45°
- Upper trapezius (unilateral)
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- SCM (unilateral)
- Longus capitis (unilateral)
- Longus colli (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Ipsilateral Rotation 70–90°
- Levator scapulae (unilateral)
- Splenius capitis (unilateral)
- Splenius cervicis (unilateral)
- Rectus capitis (unilateral)
- Oblique capitis (unilateral)
- Longus colli (unilateral)
- Longus capitis (unilateral)
- Longissimus capitis (unilateral)
- Longissimus cervicis (unilateral)
- Iliocostalis cervicis (unilateral)

Contralateral Rotation 70–90°
- Upper trapezius (unilateral)
- SCM (unilateral)
- Anterior scalene (unilateral)
- Middle scalene (unilateral)
- Posterior scalene (unilateral)

Shoulder

Flexion 180°
- Anterior deltoid
- Pectoralis major (upper fibers)
- Biceps brachii
- Coracobrachialis

Extension 50–60°
- Posterior deltoid
- Latissimus dorsi
- Teres major & minor
- Infraspinatus
- Pectoralis major (lower fibers)
- Triceps brachii

Internal Rotation 60–100°
- Anterior deltoid
- Latissimus dorsi
- Teres major
- Subscapularis
- Pectoralis major

External Rotation 80–90°
- Posterior deltoid
- Infraspinatus
- Teres minor

Abduction 180°
- Deltoids
- Supraspinatus

Adduction 50–75°
- Latissimus dorsi
- Teres major
- Infraspinatus
- Teres minor
- Pectoralis major
- Triceps brachii (long head)
- Coracobrachialis

Horizontal Abduction 45°
- Posterior deltoid
- Infraspinatus
- Teres minor

Horizontal Adduction 130°
- Anterior deltoid
- Pectoralis major (upper fibers)

passive movement if this movement causes pain in his or her daily life. Symptoms of pain, numbness, and tingling may also occur.

- **Passive ipsilateral rotation and contralateral lateral flexion of the cervical spine** on the affected side may be reduced and may reproduce symptoms as the hypertonic scalenes are stretched.
- **Passive extension of the cervical spine** may be reduced and may reproduce symptoms when the anterior scalene is stretched.
- **Passive external rotation, abduction, or flexion of the shoulder** may be reduced due to myofascial restrictions and hypertonic pectorals.

RESISTED ROM

Use resisted tests to assess the strength of the muscles that cross the joints involved. Compare the strength of the affected side to the unaffected side.

- **Resisted contralateral rotation and ipsilateral lateral flexion of the cervical spine** on the affected side may cause pain and reproduce symptoms. Resisted ipsilateral rotation and contralateral lateral flexion may reveal weakness in the antagonists.
- **Resisted flexion of the cervical spine** may reproduce symptoms.
- **Resisted internal rotation, abduction, or flexion of the shoulder** may reproduce symptoms or result in pain.
- **Resisted extension or external rotation of the shoulder** may reveal weakness in the antagonists with regard to flexion and internal rotation of the shoulder.

Figure 6-5 Roos stress test. Ask the client to abduct and laterally rotate the shoulder, flex the elbows, retract the scapulae, and then flex and extend the fingers repeatedly to test for thoracic outlet syndrome.

Figure 6-6 Adson's test. With the shoulder passively abducted and externally rotated and the cervical spine actively extended and rotated toward the affected side, place your fingers on the radial pulse, and note its strength to assess for compression of the neurovascular bundle by the scalenes.

- **Resisted flexion of the elbow, flexion or extension of the wrist and fingers, and grasping** may reveal weakness if thoracic outlet syndrome has led to atrophy of the muscles involved in those actions.

SPECIAL TESTS

The **Roos elevated arm stress test** is intended to test for thoracic outlet syndrome (Fig. 6-5).

1. Ask the client to abduct the shoulders 90°, laterally rotate the shoulders 180°, flex the elbows 90°, and slightly retract the scapulae.
2. Once in this position, ask the client to flex and extend the fingers (open and close the hands) for as long as the client can tolerate, up to a maximum of 3 minutes.
3. If the client is unable to hold the position for 3 minutes, feels intense heaviness or weakness in the affected arm, or feels numbness and tingling in the fingers of the affected side, the test is considered positive for thoracic outlet syndrome. Minor weakness or fatigue do not suggest thoracic outlet syndrome.

Adson's test assesses the compression of the neurovascular bundle by the scalenes (Fig. 6-6).

1. Stand behind the seated client.
2. Passively abduct and externally rotate the shoulder on the affected side.
3. Place your fingers on the radial pulse and note its strength.
4. Once you have assessed the strength of the pulse, ask the client to extend the neck and rotate it toward the affected side. In this position, the client should take a full, deep breath and hold it for 15–20 seconds or as long as possible, up to 20 seconds. Taking a breath raises the first rib and contracts the anterior scalene.
5. A decreased or absent pulse or the recurrence of pain or tingling in the arm and hand indicates a positive test for compression of the nerves and vessels by the anterior scalene.

The **costoclavicular maneuver** assesses for compression of the neurovascular bundle between the clavicle/subclavius and the first rib (Fig. 6-7).

1. Stand behind the seated client.
2. Place your fingers on the radial pulse, and note its strength.
3. Once you have assessed the strength of the pulse, ask the client to depress and extend the shoulder.

Figure 6-7 Costoclavicular maneuver. With the shoulder depressed and extended, place your fingers on the radial pulse, and note its strength to assess for compression of the neurovascular bundle between the clavicle/subclavius and the first rib.

Figure 6-8 Wright's test. Assess for compression by the pectoralis minor.

4. In this position, ask the client to take a breath deep enough to expand the chest and hold for 15–20 seconds or as long as possible, up to 20 seconds.
5. A decreased or absent pulse or the recurrence of pain or tingling in the arm and hand indicates a positive test for compression of the nerves and vessels between the clavicle/subclavius and the first rib.

Wright's test assesses compression of the neurovascular bundle by the pectoralis minor muscle (Fig. 6-8).

1. Ask the client to sit in a chair while you stand behind him or her.
2. Place your fingers on the radial pulse, and note its strength.
3. Once you have assessed the strength of the pulse, passively laterally rotate, abduct, and slightly extend the affected arm while keeping your fingers on the radial pulse.
4. A decreased or absent pulse or the recurrence of pain or tingling in the arm and hand indicates a positive test for compression of the nerves and vessels beneath the pectoralis minor.

PALPATION ASSESSMENT

Assess the tissues of the neck, chest, shoulder, arm, forearm, and hand. Compare the affected to the unaffected side. Check the temperature, color, and texture of the superficial tissues. You may find fascial restrictions and tenderness in the lateral neck, beneath the clavicle, or around the anterior glenohumeral joint as well as in the muscles involved in any accompanying postural deviations such as the head-forward posture or hyperkyphosis. Depending on the duration and degree of compression of the brachial plexus, you may find atrophy, pale skin, swelling, reduced hair growth, ulcers, cyanosis, and possibly even necrosis of the tissues of the fingers and hand. If ulcers, cyanosis, or necrosis is present, refer the client to a health care provider for medical assessment.

Condition-Specific Massage

Since the causes of pain, numbness, and tingling in the arm and hand vary, it may be difficult to pinpoint the area of compression. Moreover, it is common for more than one area to be compressed at the same time. A client who works at a desk for long periods everyday is likely to be seated with the head jutting forward (affecting the scalenes), one or both scapulae elevated or depressed, one or both shoulders internally rotated (affecting the pectorals), the forearms pronated (affecting the pronator teres), and the wrists and fingers in flexion, extension, or moving constantly between these (affecting the contents of the carpal tunnel).

It is essential for treatment to be relaxing. You are not likely to eliminate the symptoms of thoracic outlet syndrome, or any of the conditions associated with it, in one treatment. Do not try to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure you are applying keeps him or her from relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised.

It is also important for the client to let you know if any part of your treatment reproduces symptoms. Adjust the client to a more neutral position, reduce your pressure, or move slightly off the area if this occurs, and make a note about it as this may help you understand more clearly exactly which neuromuscular conditions are contributing to symptoms. Instruct your client to use deep but relaxing breathing to help with relaxation.

If deep palpation of a trigger point refers pain elsewhere, explain this to your client, and ask him or her to breathe deeply during the technique. As the trigger point is deactivated, the referred pain will also diminish. Scalene trigger points refer pain across the shoulder and along the medial border of the scapulae, into the chest, and down the lateral arm and forearm into the lateral hand. Subclavius trigger points refer pain across the clavicle, into the areas around the biceps and brachioradialis, and into the lateral hand. Pectoralis minor trigger points refer pain across the chest and into the areas of the anterior deltoid, down the medial arm and forearm, and into the palm and three middle fingers. Other muscles with trigger points that refer pain into the arm, forearm, and hand include the pectoralis major, sternalis, serratus anterior, serratus posterior superior, latissimus dorsi, muscles of the rotator cuff, and the triceps brachii. Most of the muscles of the arm and forearm refer pain into the wrist, hand, and fingers. Common trigger points and their referral patterns are shown in Figure 6-9.

The following suggestions are for treatment that considers several neuromuscular factors involved in producing pain, tingling, or numbness along the arm and into the hand. The section of this treatment that focuses on the anterior and middle scalene, subclavius, and pectoralis minor is specific for thoracic outlet syndrome. If the client has an acute injury, follow the PRICE (protect, rest, ice, compression, elevation) protocol. In this case, you may work conservatively proximal to the site but will have to avoid the injured area until the subacute or chronic stage.

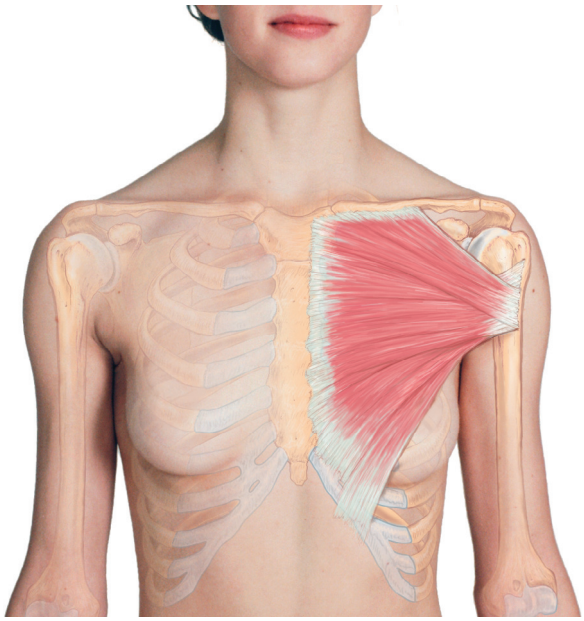
- Begin in the supine position, and initiate treatment on the affected side. If both arms are affected, begin on the dominant side. If edema is present, bolster the arm so that gravity will encourage venous return and the draining of fluid toward the proximal lymph nodes. If hyperkyphosis is a consideration, see Chapter 4 for additional bolstering.


- Moist heat is indicated on the chest, neck, and shoulder unless the client has cardiovascular disease.

- Before applying emollient, assess the tissues of the upper cross for myofascial restrictions, and release them if indicated. Restrictions are often found around the glenohumeral joint, along the anterior deltoid, and along the lateral and posterior neck.

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

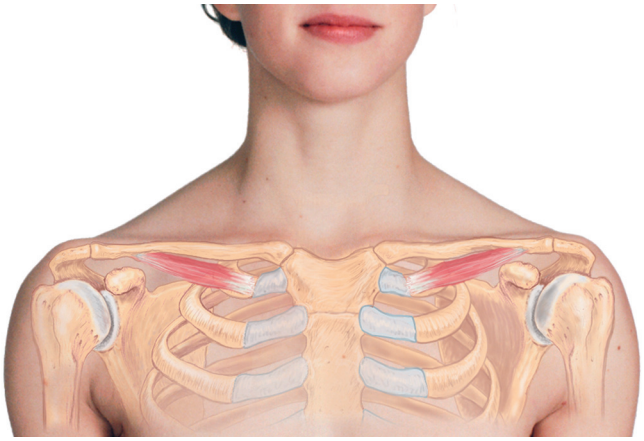
Figure 6-9 **Common trigger points and referral.** Common trigger points and referral patterns associated with thoracic outlet syndrome.



PECTORALIS MAJOR

Origin	*Medial half of clavicle, sternum, and cartilage of ribs*
Insertion	*Crest of greater tubercle of humerus.*
Action	***All fibers*** *adduct shoulder, internally rotate shoulder, assist in elevating thorax in forced inspiration;* ***upper fibers*** *flex shoulder, horizontally adduct shoulder;* ***lower fibers*** *extend shoulder.*
Nerve	*Medial and lateral pectoral.*

Figure 6-10 **Pectoralis major.** Short, tight pectorals contribute to the internal rotation of the shoulders.



SUBCLAVIUS

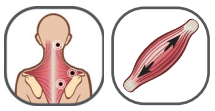
Origin	*First rib and costal cartilage.*
Insertion	*Inferior, lateral aspect of clavicle.*
Action	*Draws rib inferiorly and anteriorly, elevates first rib in inhalation.*
Nerve	*Subclavian.*

Figure 6-11 **Subclavius.** The subclavius may be adhered and hypertonic when the thorax is flexed.

- Use warming strokes to superficially assess the tissues from the neck down to the hand and to begin superficial draining of accumulated fluid toward the nearest lymph nodes. You should be able to minimally assess the degree of tension in each area, which may help you to determine where to focus your time.

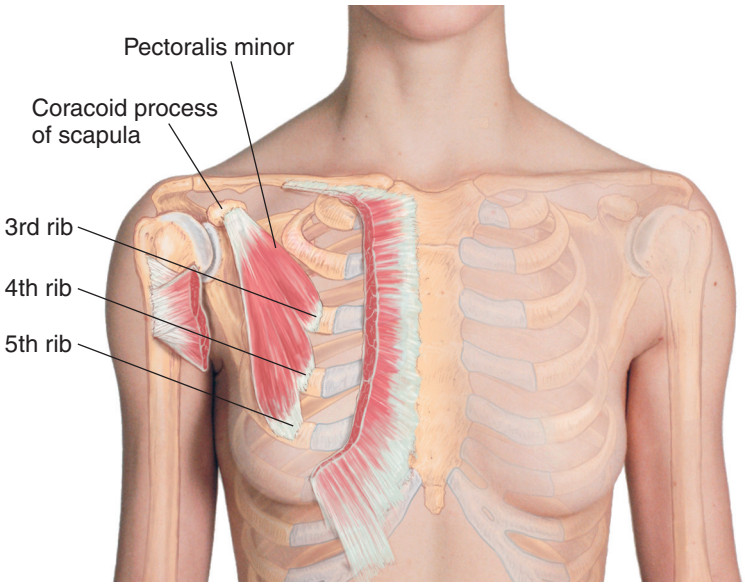
- Use broad strokes along the full length of the pectoralis major (Fig. 6-10) to soften tissues, allowing you to access the deeper structures.

- Assess pectoralis major for trigger points, and treat them if found. Common trigger points in the pectoralis major are found along the mid sternum, at the clavicular attachments, along the inferior fibers, and near the axilla.



- Assess and treat the subclavius for hypertonicity and trigger points (Fig. 6-11). The subclavius is a slight, thin muscle and may not be easily palpated. Trust your knowledge of anatomy as you palpate along the inferior edge of the middle third of the clavicle toward the costal cartilage of the first rib. If you find and treat trigger points in the subclavius, use a pin and stretch technique to lengthen the muscle fibers.

- You can access the pectoralis minor through the pectoralis major or by pushing the lateral fibers of the pectoralis major medially as you palpate ribs 3, 4, and 5 (Fig. 6-12). This may be performed more easily by kneeling next to the client and placing his or her hand on your shoulder nearest the table, which will gently lift the pectoralis major out of the way. This is also preferable to externally rotating the shoulder, which may put tension on the pectorals and reproduce symptoms. Once you believe you have found it, ask the client to depress the shoulder and feel for a contraction. As you assess and treat the pectoralis minor for tension

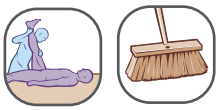


PECTORALIS MINOR

Origin	*Third, fourth, and fifth ribs.*
Insertion	*Coracoid process of the scapula.*
Action	*Depress scapula, protract scapula, tilt scapula anterior, assist in inhalation.*
Nerve	*Medial pectoral.*

Figure 6-12 Pectoralis minor. The pectoralis minor may be shortened if the scapulae are protracted. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

and trigger points, ask the client about the reproduction of symptoms. If they occur, adjust the client to a more neutral position, reduce pressure, or move away from the area. You may be able to revisit the pectoralis minor later in the treatment without reproducing symptoms.

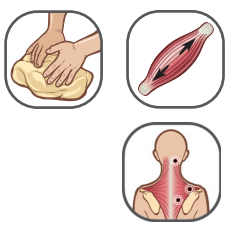


- If you found myofascial restrictions, hypertonicity, and trigger points in the pectoral area, perform a full stretch to the pectorals and close with clearing strokes. If the tissue is resistant to lengthening, apply postisometric relaxation within the client's tolerance to encourage a normal resting tone. If you found the area to be only minimally affected, close with clearing strokes.

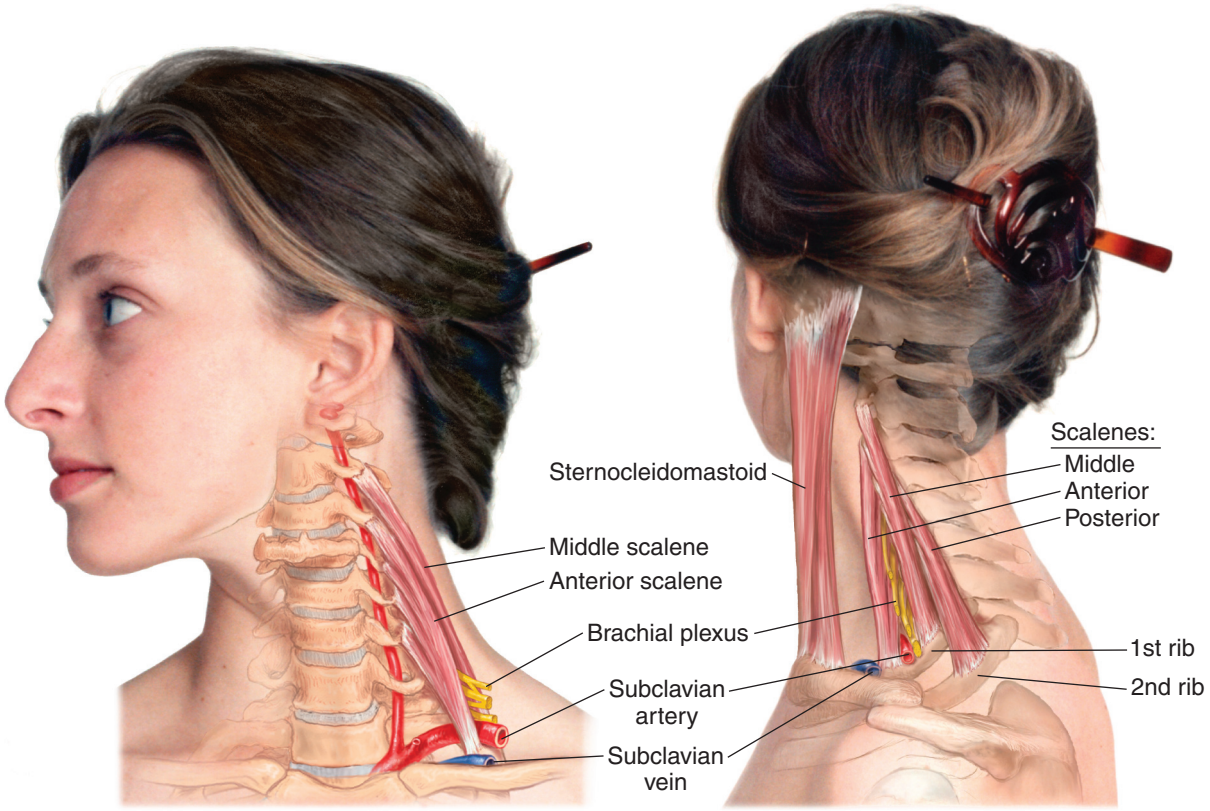
- Warm and lengthen the superficial neck muscles, namely the upper trapezius. Be careful to avoid endangerment areas, and back away gently if you feel a pulse.

- Reduce tension in the SCM, and treat any trigger points found. Trigger points in the SCM may cause vertigo, nausea, or ringing in the ears. Ask the client to let you know if he or she feels any unusual sensations, and explain that these are common referrals from SCM trigger points.

- Once you have softened the SCM and trapezius, you will have greater access to the scalenes (Fig. 6-13). To access the anterior scalene, gently push the SCM medially with one or two fingertips as you feel for the deeper scalenes. As you move the SCM medially, your fingers should gently rest on the transverse processes of the cervical vertebrae. Use this as your guide for palpating the anterior scalene. Once you have found it, ask the client to take a quick, forced breath into the chest and feel for a contraction.



- Reduce tension and lengthen the anterior scalene. Treat any trigger points found. It is often helpful, once you have found a trigger point in the scalenes, to compress it gently while slowly rotating the head. Trigger points in the anterior scalene are often quite sensitive, and the client may feel cautious about you working deeply in the neck. Begin gently and slowly to avoid frightening the client or causing him or her to jerk the head. Remember that you are working in an area of many nerves and abundant vasculature.



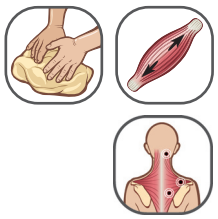
SCALENES

Origin	*Anterior-TVP 3–6, middle-TVP 2–7, posterior-TVP 5–6.*
Insertion	***Anterior**, 1st rib; **middle**, 1st rib; **posterior**, 2nd rib.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, elevate ribs in inhalation and flex head and neck.*
Nerve	*Cervical.*

STERNOCLEIDOMASTOID

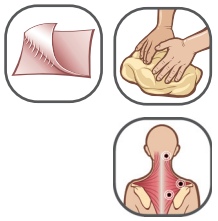
Origin	*Top of manubrium and medial third of clavicle.*
Insertion	*Mastoid process and superior nuchal line.*
Action	***Unilateral**, ipsilateral lateral flexion and rotation of head and neck; **bilateral**, flexion of the neck, assist in inhalation.*
Nerve	*Spinal accessory XI.*

Figure 6-13 SCM and scalenes. The SCM and scalenes may be short and tight. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



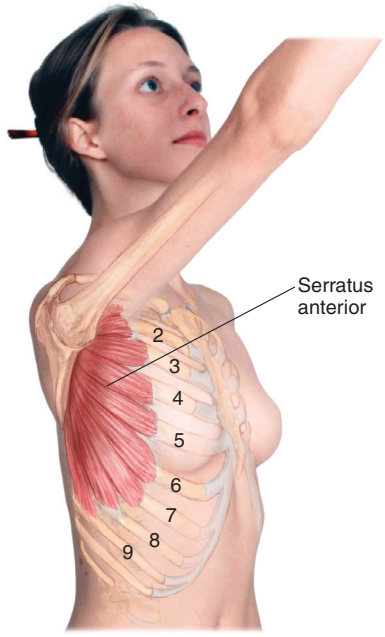
- Find the middle scalene by gently palpating the transverse processes and then moving slightly posterior. The middle scalene crosses the transverse processes and heads toward the first rib. Once you have found it, ask the client to take a quick, forced breath into the chest and feel for a contraction. Take the same cautions with the middle scalene as with the anterior scalene to avoid frightening the client. Lengthen the muscle and treat any trigger points found.

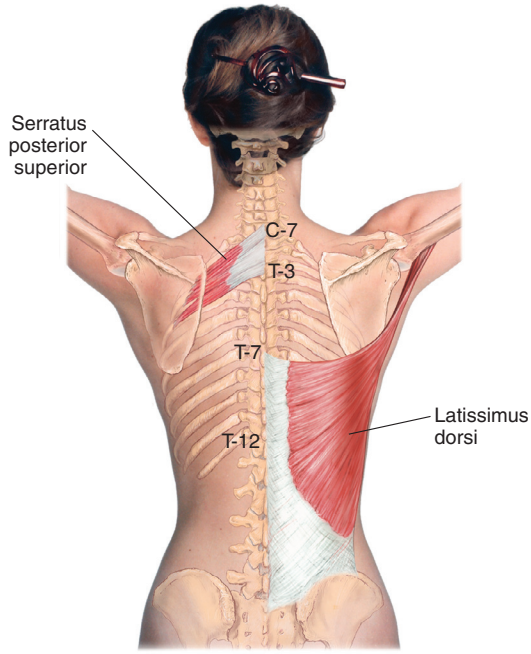
- Stretch the scalenes by increasing the distance between their origins and insertions. Options for stretching include contralateral lateral flexion and ipsilateral rotation of the cervical spine (Fig. 6-14). If the tissue resists lengthening, apply postisometric relaxation within the client's tolerance to encourage a normal resting tone. If you found the area to be minimally affected, apply clearing strokes and move on to the arm and hand.



- Warm the whole arm and assess the muscles for myofascial restrictions, hypertonicity or hypotonicity, and trigger points. If the client has had symptoms for a long time, the muscles of the arm may be compensating. If you suspect pronator teres syndrome or carpal tunnel syndrome to be involved, assess and treat as time permits. You may be able to revisit these areas in a subsequent visit when primary symptoms subside. If you do not find compromised tissue in the arm, be conservative in your treatment of the arm to save time, but do not ignore it. It is important to perform at least the Swedish techniques to the arm to restore neuromuscular memory and function.

Figure 6-14 Scalene stretch. Passively stretch scalenes following trigger point therapy.





SERRATUS ANTERIOR

Origin	*Lateral surface of upper 8 or 9 ribs.*
Insertion	*Anterior surface of medial border of scapula.*
Action	*Abduct and depress scapula, stabilize scapula against rib cage, forced inhalation.*
Nerve	*Long thoracic.*

SERRATUS POSTERIOR SUPERIOR

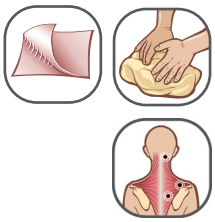
Origin	*Spinous processes of C7-T3.*
Insertion	*Posterior surface of ribs 2-5.*
Action	*Elevate ribs during inhalation.*
Nerve	*Spinal nerves 1-4.*

LATISSIMUS DORSI

Origin	*Spinous process of T7-12, ribs 8-12, thoracolumbar aponeurosis, and posterior iliac crest.*
Insertion	*Crest of lesser tubercle of humerus.*
Action	*Extend, adduct and medially rotate shoulder.*
Nerve	*Thoracodorsal.*

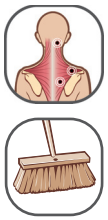
Figure 6-15 Latissimus dorsi, serratus anterior, and serratus posterior superior. Trigger points in these muscles may mimic the pain involved in thoracic outlet syndrome. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Treat the unaffected side—superficially if you find no compromised tissue and comprehensively if the client's thoracic outlet syndrome is bilateral.



- Try to leave at least 10 minutes for work in the prone position. Referral patterns for trigger points in the latissimus dorsi, serratus anterior, and serratus posterior superior may be similar to the common pain pattern found in thoracic outlet syndrome (Fig. 6-15). Assess and treat these muscles as time permits.

- Because hyperkyphosis is commonly associated with thoracic outlet syndrome, the muscles of the upper back are likely to be tender or painful, and this may be one of the client's primary complaints along with numbness and tingling in the arm and hand. Treat the back conservatively if time does not allow you to assess and treat trigger points. You can return to this in a subsequent visit once the symptoms of thoracic outlet syndrome begin to subside.



- If the scapulae are protracted, remember to treat the rhomboids and middle trapezius from the scapulae toward the spine to avoid stretching them further. Trigger points can develop in overstretched muscles as well as hypertonic ones.
- Use a local pin and stretch to lengthen fibers that contained trigger points, and clear the area treated.

The treatment overview diagram summarizes the flow of treatment (Fig. 6-16).

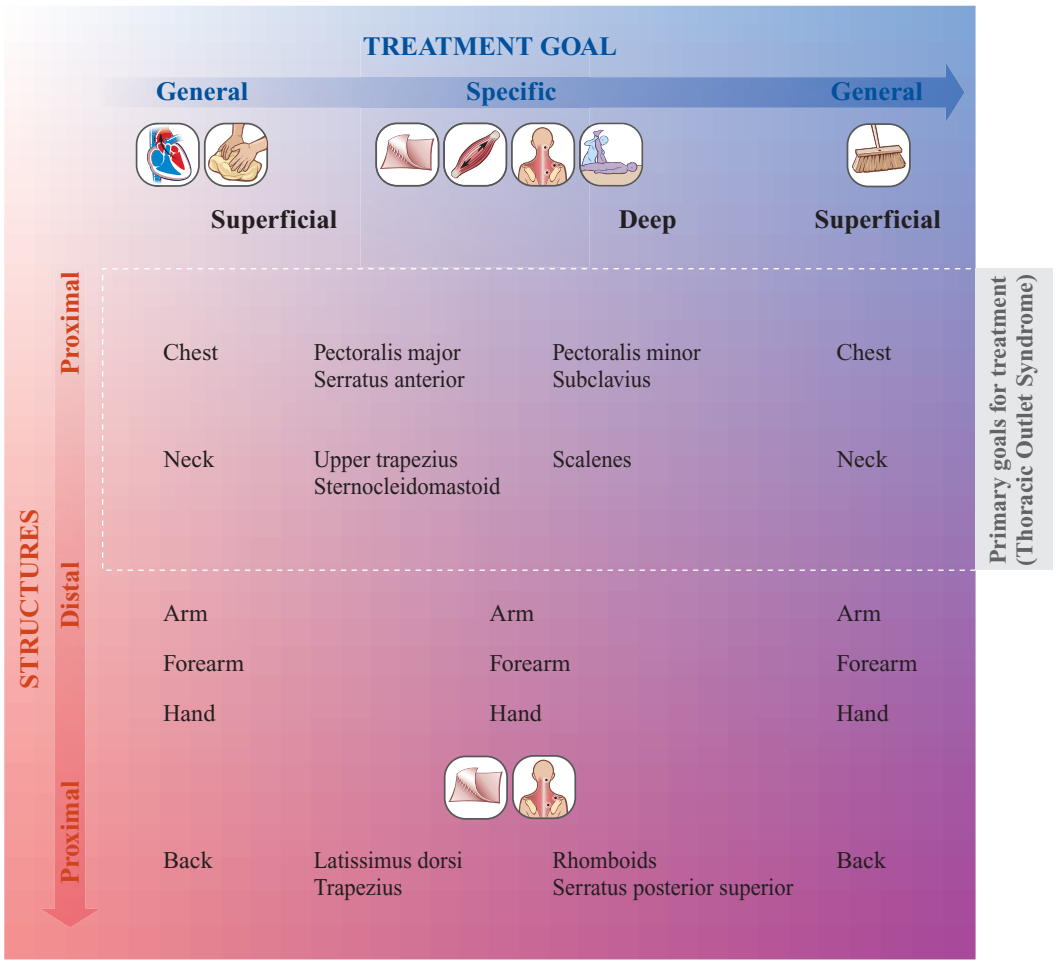


Figure 6-16 **Thoracic outlet syndrome treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating thoracic outlet syndrome.

CLIENT SELF-CARE

The following are intended as general recommendations for stretching and strengthening muscles involved in thoracic outlet syndrome. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines:

- Instruct the client to perform self-care activities throughout the day, such as while taking a phone call, reading e-mail, watching television, or performing other activities of daily living, instead of setting aside extra time.
- Encourage your client to take regular breaks from repetitive actions or static postures.
- Demonstrate gentle self-massage to keep adhesions and hypertonicity at bay between treatments.
- Instruct the client on proper posture in the seated position to keep pressure off the weakened joints. Instruct clients with symptoms of thoracic outlet syndrome to sleep in positions without raising the arm over the head and without lateral flexion or rotation of the cervical spine.
- Instruct an athlete whose sport strengthens the pectorals and internal rotators of the shoulder to reduce pectoral resistance exercises and increase scapular retraction and thoracic extension to strengthen the middle trapezius, rhomboids, and thoracic erector spinae, balancing strength in the thoracic area.
- Instruct a client who regularly performs heavy lifting to lift with the legs instead of the back.
- Demonstrate all strengthening exercises and stretches to your client and have him or her perform these for you before leaving to ensure that he or she is performing them properly and will not harm himself or herself when practicing alone.

Stretching

Instruct the client to stretch the scalenes. Have the client hook the hand of the affected side under the chair while slowly and gently extending and laterally flexing the neck in the opposite direction until he or she feels a deep but comfortable stretch (Fig. 6-17). To increase the stretch, instruct the client to pull gently on the head with the opposite hand.

To stretch the pectoralis major and minor, instruct the client to clasp the hands behind the head, then retract and elevate the scapulae. For a deeper stretch, instruct the client to stand in a doorway with the hands on the frame and then step forward, which will bring the arms slightly posterior. It is essential that the client steps forward rather than leans forward, because leaning would affect the muscles of the neck, back, and hips (Fig. 6-18).

Strengthening

If thoracic outlet syndrome is unilateral and the scalenes are involved, remember that the scalenes of one side antagonize those of the other. If the scalenes of the unaffected side are weak, it is important to strengthen them in order to bring the neck back to a neutral position. Resisted rotation toward the affected side will strengthen the scalenes on the unaffected side. This should be performed only if it does not reproduce symptoms on the affected side or cause pain in the posterior neck or shoulder. Instruct the client to rest the palm of the hand on the side of the head with the affected scalenes and rotate the head toward the affected side (Fig. 6-19).

The client can also strengthen the middle trapezius and rhomboids to reduce protraction of the scapulae. Instruct the client to stand with the arms comfortably hanging at the sides while squeezing the scapulae together (Fig. 6-20). When this is done properly, only the middle trapezius and rhomboids should contract while the shoulders remain relaxed.

Figure 6-17 Scalene stretch. Lateral flexion to the opposite side increases the distance between the origin and insertion of the scalenes.

Figure 6-18 Pectoralis minor stretch. Increase the distance between the coracoid process of the scapulae and the ribs to stretch the pectoralis minor.

Figure 6-19 Strengthen contralateral scalenes. The client rests the flat of the hand on the side of the head with the affected scalenes and rotates the head toward the affected side.

Figure 6-20 Middle trapezius and rhomboid strengthening. Instruct the client to squeeze the scapulae together without using any muscles other than the middle trapezius and rhomboids.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client with symptoms of thoracic outlet syndrome will have treatments twice a week for the first week or two or until symptoms are absent for at least 4 days. This should be followed by weekly treatments until the symptoms are absent for at least 7 days and ROM and strength are restored. As treatment continues, the period of symptom-free days should increase until the symptoms become occasional or are relieved completely. After this, the client can schedule appointments as necessary. If the thoracic outlet syndrome is caused by muscle tension, the client should have some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting his or her activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest.
- The client's thoracic outlet syndrome is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical or medical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy altogether and hinder healing.
- The symptoms have an undiagnosed, underlying cause. Discontinue treatment until the client sees a health care provider for medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be able to take this client through the full program of healing. Still, if you can bring some relief, it may encourage that client to discuss this change with his or her health care provider and to consider manual therapy rather than more aggressive treatment options. If the client returns for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. As the client's symptoms change, you may be able to focus more of your treatment on a specific area or on other postural imbalances.

PROFESSIONAL GROWTH

CASE STUDY

Salim is a 53-year-old father of two adult children. He and his brother own a house painting company. In recent months, business has been slow. To reduce expenses, he and his brother have been doing much of the painting themselves. He began feeling numbness and tingling in his hand a few weeks ago and now feels weak when painting. Salim's primary health care provider, Dr. Johnson, practices in an integrative medicine clinic with massage therapists on staff.

Subjective

Salim stated that a few weeks ago he started feeling pins and needles in his left hand and noticed that from time to time he cannot feel the object he is holding in that hand, as if the tips of his ring finger and little finger had no sensation. During the past week, he has felt fatigue and weakness in his left shoulder and arm, and now his neck is sore on the right side too. In the beginning the symptoms would appear in the middle of the day, but now they happen almost as soon as he starts to paint and sometimes when he sleeps. Recently, he has been awakened from sleep by the sensation. When asked, Salim answered that he has never noticed any swelling in the arm or hand.

Objective

Salim's visit with Dr. Johnson included blood and other tests for systemic conditions, the results of which were negative. Positive Wright and Roos tests suggest thoracic outlet syndrome. Palpation revealed no cervical rib, and no X-ray was ordered. The doctor stated that he believed muscle tension to be the cause and referred Salim to the massage therapy clinic with the caveat that if symptoms were not reduced after two treatments per week for 2 weeks, he would recommend an MRI. Dr. Johnson saw no need to be conservative or cautious with massage.

Salim stood with most of his weight on his left leg while discussing his symptoms, with his pelvis rotated toward the right. The right hip is slightly flexed and externally rotated. The thorax is laterally flexed left, and the left hip is elevated. The right shoulder is elevated compared to the left. The left scapula is tilted anteriorly. The cervical spine is rotated to the right, laterally flexed to the left. The shoulders are internally rotated bilaterally with increased pronation in the right forearm. Slight scoliosis is evident.

The pectoralis major is dense and adhered bilaterally. Nothing is remarkable in either subclavius. The left pectoralis minor is hypertonic and tender to the touch with taut bands but no referral. Superficial fascial restrictions are present along the lateral neck and into the shoulder. The left scalenes are hypertonic. There is a trigger point in both the anterior and middle scalenes with referred pain into the shoulder. The left latissimus dorsi is adhered and tender. No trigger points were found. The left serratus anterior is dense, and the left side of the ribcage is slightly compressed. There is a trigger point in the serratus anterior with referred pain into the forearm. The right levator scapulae and upper trapezius are hypertonic and tender. There is crepitus around the right superior angle of the scapula. The erector spinae are taut bilaterally along the full spine. The left external obliquus and quadratus lumborum are shortened and hypertonic. The right quadriceps femoris and iliotibial band are thick and adhered. I did not investigate the gluteals or lower limbs; these will be revisited in a subsequent visit.

Action

I applied moist heat to the left pectoral area while palpating/assessing tissues around the hips. I moved the heat to the right pectoral area. I performed myofascial release around the glenohumeral joint and across the pectorals bilaterally. With the arm laterally rotated and abducted, I applied effleurage and cross-fiber friction followed by muscle stripping to the pectoralis major, latissimus dorsi, and serratus anterior. I applied trigger point therapy to the serratus. The pain reduced from level 8 to 3 and referral ceased. I applied petrissage to the origin and insertions of the pectoralis minor followed by stripping to the muscle belly. This reproduced symptoms. I returned the client's arm to the neutral position, which eased symptoms, then palpated the pectoralis minor again. No symptoms were reproduced the second time. The pectoralis minor may be too dense to reach trigger points in taut bands. I applied kneading and lengthening strokes to reduce tension, and will attempt to treat trigger points in a subsequent session. I applied a stretch to the pectorals, taking care not to reproduce symptoms. The left scalenes are solid and dense, and the fibers are barely palpable. There are trigger points in the anterior and middle scalene that referred pain across the shoulder but did not reproduce symptoms. I applied cross-fiber friction followed by several rounds of muscle stripping, which reduced referred pain slightly. I used three rounds of brief compression to a trigger point that caused pain at level 7, which then reduced to level 2. I applied general treatment to the upper trapezius, levator scapulae, and neck extensors as well as to the arms bilaterally. In the prone position, I applied general deep tissue massage to the upper back with minor attention to the low back and hips, primarily attempting to lengthen the left latissimus dorsi, abdominals, and quadratus lumborum and to reduce the flexion of the thorax.

The client remained very relaxed throughout the session, seemingly on the verge of sleep if not for my questions regarding symptoms. He stated that he felt looser but a little sore in the pectoral area.

Plan

I recommended taking time throughout that day to mobilize the neck and arm within his comfort level, in positions other than the one(s) he uses while painting. For example, I suggested that he slowly rotate the neck from left to right and bring the ear to the shoulder on both the left and right sides. I demonstrated stretches for pectorals and scalenes and those needed to reduce flexion in the thorax. I demonstrated strengthening for the shoulder retractors and lateral rotators of the shoulder. The client will return for treatment in 3 days and keep an account of symptoms during that time.

As Salim's condition improves and he becomes more able to perform activities of daily living without symptoms, I will focus attention on deviations in his hips and spine that may be contributing to the imbalance in the upper body. I will assess legs, knees, and ankles at that time.

CRITICAL THINKING EXERCISES

1. Develop a 10-minute stretching and strengthening routine for a client covering all of the muscles commonly involved in thoracic outlet syndrome. Use Box 6-1 and Figure 6-4 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles and otherwise weakened muscles. Describe each step of the routine in sufficient detail that the client can perform it without your assistance.
2. Sometimes an assessment reveals signs and symptoms that differ from the average presentation for a client with thoracic outlet syndrome. The following is a list of possible findings. For each, discuss how or why a client may have developed the imbalance, and how the treatment plan should be adapted:
   - Drooped shoulder on the affected side
   - Elevated shoulder on the affected side
   - Trigger point in the scalenes on the unaffected side, with referred pain, but no other symptoms
   - Lateral flexion of the thorax with internal rotation of the shoulder on the affected side, without scoliosis
   - Symptoms when carrying heavy objects with the arms hanging, no symptoms when raising the arm above the head
   - Previous injury to the shoulder on the unaffected side
3. Your client first had symptoms of numbness, tingling, and weakness in the right arm 6 years ago. Following 2 years of treatment including pharmaceutical injections in the scalenes, oral medications, and 6 months of physical therapy intended to strengthen the muscles of the chest and shoulder, the client had no long-term relief. Ultimately, the client was diagnosed with thoracic outlet syndrome and, after another year of medication and physical therapy with no long-term relief, had decompression surgery that involved dividing the anterior scalene and removing a portion of the first rib. The client had considerable relief, but from time to time, particularly when reaching for something, the tingling would return. Over the past 3 months, the symptoms have worsened. Discuss possible reasons why the injections, physical therapy, and surgery were not successful treatments for the client's symptoms, and explain how manual therapy planned according to a current assessment may reduce the client's symptoms.
4. Discuss special considerations and adjustments to treatment for a client who has been diagnosed with a condition such as hypertension or atherosclerosis that is currently under control and being monitored by a health care provider.
5. Discuss how stress might contribute to the symptoms of thoracic outlet syndrome. Consider possibilities that include nerve conduction, muscle tension, diet and exercise, and life outlook. Knowing that a stressed client will see you for 6 treatments over the course of 4 weeks, plan treatment that takes the client's stress into consideration.

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CHAPTER 7

Carpal Tunnel Syndrome

UNDERSTANDING CARPAL TUNNEL SYNDROME

Carpal tunnel syndrome occurs when the median nerve is compressed within the carpal tunnel of the wrist. The carpal tunnel is a small space in the wrist between the carpal bones and the flexor retinaculum (also referred to as the transverse carpal ligament) (Fig. 7-1). The four tendons of flexor digitorum superficialis, the four tendons of flexor digitorum profundus, the tendon of flexor pollicis longus, the ulnar and radial arteries, and the median nerve pass comfortably through this space when the structure and its contents are healthy. When the tissues become inflamed or adhered, or if the structure and its contents are otherwise compromised, the amount of space in the tunnel is reduced and the nerve and the blood vessels may become compressed. Compression of the median nerve slows the impulses transmitted, which results in pain, numbness, and tingling along its distribution. Compression of the blood vessels may reduce circulation, affecting the health and function of the nerve and other tissues nourished by compromised vessels. Movement of the wrist and hand frequently intensifies the symptoms. A client diagnosed with carpal tunnel syndrome often wears a splint to keep the wrist immobilized in an attempt to reduce symptoms.

The carpal tunnel is not the only place where compressed nerves and vessels may result in similar symptoms. The roots of the brachial plexus exit the spine between C5 and T1 (see Chapter 6). These five roots merge, divide, and merge again to form three cords. The median nerve arises from the medial and lateral cords. The nerve wraps around to the front of the neck, travels under the lateral clavicle, passes beneath the coracoid process, and follows down the anterior, medial arm, through the middle of the cubital fossa and forearm, through the carpal tunnel, and into the palm (Fig. 7-2). Because postures and activities that commonly contribute to carpal tunnel syndrome may also involve the elbow, shoulder, and neck, symptoms can be intensified by compression of the nerve at more than one location. This is referred to as "double crush," a condition in which innervation is interrupted at more than one site along the path of a nerve. Trauma, tension, and trigger points in the scalenes, pectoralis minor, or pronator teres can cause similar pain, tingling, and numbness. It is always best to allow time in your treatment to at least superficially treat the whole neck and arm on the affected side.

Muscles innervated by the median nerve include:

- Flexor carpi radialis
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis brevis
- Flexor pollicis longus
- Palmaris longus

- Pronator teres
- Pronator quadratus
- Opponens pollicis
- Abductor pollicis brevis
- 1st and 2nd lumbricals of the hand

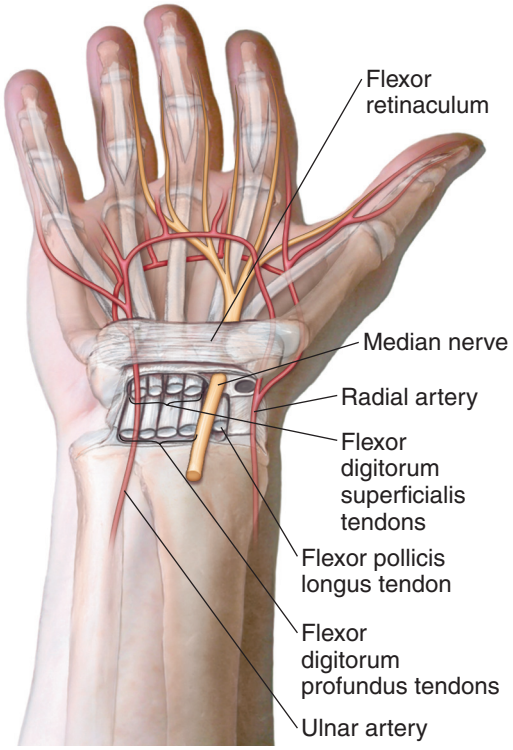


Figure 7-1 **The carpal tunnel.** Several tendons, blood vessels, and the median nerve pass through the carpal tunnel of the wrist. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

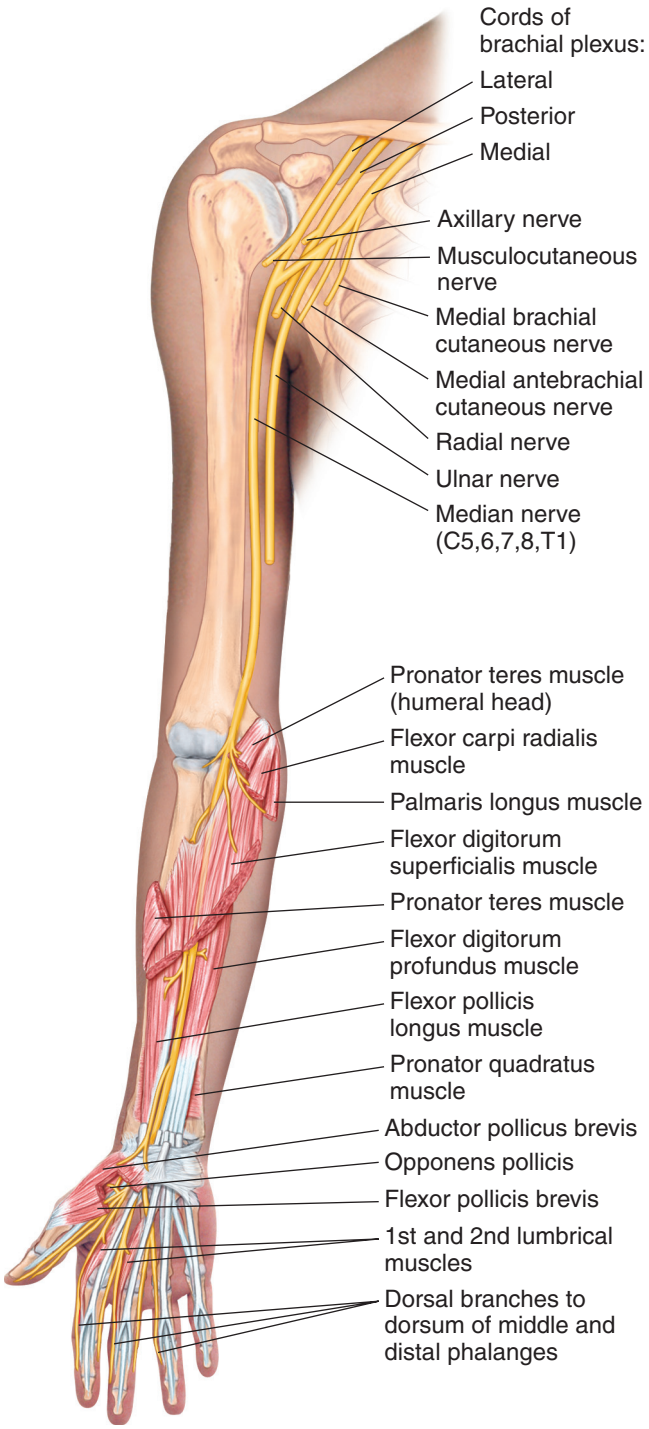


Figure 7-2 **Path of median nerve.** Nerve roots forming the median nerve exit the spine between C5 and T1, merge into trunks, and form divisions and cords. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

Figure 7-3 Carpal tunnel symptoms area. Compression of the median nerve in the carpal tunnel causes pain, numbness, and/or tingling in the thumb, index and middle fingers, the lateral half of the ring finger, and the wrist and palm of the hand. From Clay JH, Pounds DM. Basic Clinical Massage Therapy: Integrating Anatomy and Treatment, 2nd edition. Philadelphia: Lippincott Williams & Wilkins, 2008.

Common Signs and Symptoms

Carpal tunnel syndrome usually begins gradually with pain, numbness, and/or tingling in the thumb, index and middle fingers, lateral half of the ring finger, wrist, and palm of the hand (Fig. 7-3). In the early stages, these symptoms typically occur with movement, especially repetitive movements that cause friction to the structures and increase inflammation, or when the wrist is held in a flexed position for a long time, increasing pressure in the tunnel. Symptoms usually occur in the dominant hand because it is more likely subjected to greater stress but can also occur in the nondominant hand, especially if the nondominant hand has been subjected to trauma or over use, and can occur in both hands. Sleeping with the wrists flexed can intensify symptoms, often waking the person. Disturbed sleep may then become a contributing factor in the progression of the syndrome, possibly contributing to anxiety and depression, which may in turn increase the symptoms. As the syndrome progresses, the client may experience symptoms during the day, with or without movement. With reduced innervation the muscles become weaker, making it difficult to grasp items like a cup or a pen or to perform other fine motor skills. Pain begins to travel up the arm and often reaches the shoulder and neck. Ultimately, the thenar muscles may atrophy and the client may begin to lose sensation in the hand, making it difficult to sense temperature or other normally painful stimuli. Each client may experience this progression differently, with symptoms developing over the course of weeks, months, or years depending on the contributing factors and the client's general health. The further the syndrome progresses, the greater the chance that the nerve itself will become damaged and the muscles innervated by it will lose tone and strength. Therefore, it is important for someone suffering from even mild symptoms of carpal tunnel syndrome to get treatment as soon as possible.

Possible Causes and Contributing Factors

Carpal tunnel syndrome does not have a single primary cause, although certain factors commonly contribute. The minimal space in the tunnel can be reduced by an anatomical variation, bone dislocation, abnormal growth of bone, a cyst, a tumor, or another obstacle. Though massage therapy may reduce the discomfort caused by such obstacles, it cannot eliminate them. Carpal tunnel syndrome may also occur when soft tissues within the tunnel increase in size or change shape because of acute injury, scarring, fibrotic tissue buildup, inflammation, hypertonicity, trigger points, tendinopathy, sprains, and strains. Likewise, the flexor retinaculum may become larger or inflamed because of injury or because adhered tissues increase the amount of friction that occurs with movement. Friction is a common cause of inflammation.

Clients whose activities of daily living include repetitive or forceful actions or vibrations at the wrist are prone to developing carpal tunnel syndrome. Careers in which employees have a high rate of carpal tunnel syndrome include data entry, assembly, meat or fish packing, construction, electrical work, hair styling, driving, and any other job that involves forceful, repetitive actions or

that keeps the wrist in flexion for long periods. Unless acute injury is the primary contributing factor, when the cause of carpal tunnel syndrome is neuromuscular, the client may not feel symptoms until long after the contributing postures or activities have become part of his or her activities of daily living. Similarly, once treatment reduces symptoms, the client must diligently address contributing factors to avoid recurrence.

Other factors associated with nerve impairment include obesity, hypothyroid condition, arthritis, diabetes, gout, hormonal changes, lymphedema, rheumatoid arthritis, lupus, and Lyme disease. In these cases, the symptoms may quickly resolve once the associated condition is controlled. During pregnancy, body fluids increase and may contribute to compression, though this is likely to resolve shortly after childbirth. Cigarette smoking, though not a cause of carpal tunnel syndrome, exacerbates the inflammatory process and can intensify symptoms. Alcoholism, poor nutrition, vitamin B deficiency, and general stress may also contribute. Some evidence suggests that genetics may also play a role in carpal tunnel syndrome. Bone structure, abnormal collagen production, and abnormal myelin regulation are genetic factors that may predispose a client to the syndrome. Symptoms are likely to arise in these individuals in adolescence and are more likely to be bilateral.

Because so many factors can contribute to peripheral neuropathies, be sure to understand the client's health history before proceeding with treatment. Many of the conditions listed above have contraindications for massage therapy or require adjustments to treatment. Moreover, when a systemic condition contributes to a peripheral neuropathy, especially if that systemic condition is not being monitored by a health care provider, massage therapy alone may bring only temporary relief of symptoms. Refer the client to his or her health care provider if you suspect a systemic condition or obstruction in the wrist, and discuss treatment with the client's health care provider if such a condition has been diagnosed

Table 7-1 lists conditions commonly confused with or contributing to carpal tunnel syndrome.

Contraindications and Special Considerations

It is essential to understand the factors contributing to carpal tunnel syndrome. If a systemic condition or structural abnormality is present, work with the client's health care provider and consult a pathology text for massage therapists before proceeding. Following are a few general contraindications:

- **Underlying pathologies.** The signs and symptoms of carpal tunnel syndrome may result from a wide variety of underlying conditions. If you suspect one of these (consult Table 7-1 and your pathology book for signs and symptoms), refer the client to his or her health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not a contraindication for massage, work with the health care provider when necessary to develop an appropriate treatment plan.
- **Acute injury.** If the client has an acute injury, PRICE (protection, rest, ice, compression, elevation) is the protocol. You may work conservatively proximal to the site but avoid the wrist, hand, fingers, and any other area affected by the injury until it is in the subacute or chronic stage.
- **Edema.** If edema is present, do not work directly on the site. Work proximally, moving the fluid toward the nearest proximal lymph nodes. If vascular compression is a consideration but massage is not contraindicated for the client, do not allow the arm to fall below the heart because gravity may draw fluid into the arm and hand. Bolster the arm if necessary to keep fluid from accumulating.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised, or if the client is taking an anti-inflammatory medication. Friction creates an inflammatory process, which may interfere with the intended action of the anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours prior to treatment if his or her health care provider is in agreement.
- **Mobilizations.** Be cautious with mobilizations if the client has degenerative disc disease, rheumatoid arthritis, a bony obstruction, hypermobile joints, or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Table 7-1 Differentiating Conditions Commonly Confused with or Contributing to Carpal Tunnel Syndrome

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Herniated disc	Symptoms increase when coughing, laughing, or straining	Kemp's test Spurling's test CT scan Myelography MRI	Massage is indicated with caution and proper training. Acute inflammation and acute injury are contraindications. Work with health care team.
C4-5	Weak deltoid Shoulder pain Usually no radiating pain or paresthesia		
C5-6	Weak biceps and wrist extensors Pain and paresthesia in radial nerve distribution		
C6-7	Weak triceps and finger extensors Pain and paresthesia down the posterior arm into third digit		
C7-T1	Weak hand grip Pain and paresthesia in ulnar nerve distribution		
Thoracic outlet syndrome	Pain in neck, shoulder, chest, arm, and hand Swelling, vascular changes, weakness or clumsiness in arm and hand Paresthesia in ulnar nerve distribution	Adson's test Travell's variation Scalene cramp test Eden's test Wright's hyperabduction Pectoralis minor test Upper limb tension test	See Chapter 6
Pronator teres syndrome	Symptoms can be identical to Carpal tunnel syndrome Pain in forearm—worsened by elbow flexion/extension Absence of pain at night	Resisted pronation of forearm (excluding resistance to wrist) Tinel's sign at the median nerve as it passes under pronator teres	Massage is indicated
Tendinopathy	Local inflammation and point tenderness	Pain on full, passive stretch of joint that tendon crosses; pain with resisted activity	See Chapter 14
Bursitis	Heat and swelling at joint Pain with active and passive movement of joint	Physical examination	Contraindicated locally, peripheral treatment may increase ROM.
Cubital tunnel syndrome	Numbness, pain, paresthesia, or weakness in the ulnar nerve distribution	Symptoms proximal to wrist Tinel's sign at cubital tunnel	Massage is indicated with caution to the area at the elbow where the ulnar nerve is most superficial.
Osteoarthritis	Stiff, painful joints Usually affects more than one joint	Physical examination	Massage is indicated when no acute symptoms are present.

(*continued*)

Table 7-1 Differentiating Conditions Commonly Confused with or Contributing to Carpal Tunnel Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Hypothyroid condition	Weakness, fatigue, intolerance to cold, constipation, unintentional weight gain, brittle hair and nails, dry skin, puffy skin, hoarse voice	Physical examination T3, T4, and serum thyroid-stimulating hormone laboratory tests	Massage is indicated when no other contraindicated condition, such as circulatory complication, is present.
Gout	Red, hot, swollen joints Extreme pain Sudden onset	Physical examination X-ray Synovial fluid test Uric acid blood and urine tests	Massage is contraindicated during acute attacks. Gout may indicate other systemic conditions. Work with health care team.
Lupus	Skin rash Ulcers in mouth, nose, or throat Painful joints Headaches Kidney and nervous system disorders	Physical examination Diagnosis is complex Assessment includes presence of symptoms; blood, kidney, urine tests; chest x-ray; ECG	Massage is contraindicated during flare-ups. Work with health care team.
Lyme disease	Circular, bull's eye rash Red, itchy skin Fever Fatigue Joint pain Irregular heartbeat	Physical examination Assessment of symptoms and antibody tests Laboratory tests may be inconclusive in early stage of disease	Massage is indicated in nonacute stages. Work with health care team.
Rheumatoid arthritis	Fatigue, loss of appetite, low-grade fever, bilateral nonspecific muscle pain, rheumatic nodules, periods of flares and remission	Physical examination Blood tests Radiography	Massage is indicated in nonacute stages. Work with health care team.
Diabetes	Frequent urination, frequent thirst, increased appetite, fatigue, nausea	Physical examination Fasting blood sugar test	Massage is indicated when tissues and circulation are not compromised.

- **Pressure points.** Because pressure points in the hand may induce labor, avoid these in pregnant women.
- **Reproducing symptoms.** Symptoms may occur during treatment if you manually compress the nerve or if the client's posture causes structures to compress the nerve. If treatment reproduces symptoms, first adjust the client's posture to relieve compression. If this does not relieve the symptoms, reduce your pressure or move away from the area. You may be able to treat around the site that reproduced the symptoms, but work with caution.
- **Hydrotherapy.** Do not use heat in areas of edema or inflammation because heat dilates vessels and may increase the accumulation of fluid. Do not use moist heat on the neck or chest if the client has a cardiovascular condition that may be affected by dilation of blood vessels. Severe hypertension and atherosclerosis are two examples. Consult your pathology book for recommendations.
- **Initiating inflammatory process.** If treatment causes inflammation, end with cool hydrotherapy to inhibit the inflammatory process.

Massage Therapy Research

In 2004, Field et al. published a study titled "Carpal Tunnel Syndrome Symptoms Are Lessened Following Massage Therapy." The study involved 16 adults between the ages of 20 and 65 years, of middle socioeconomic status and varied ethnicity. Each participant had been previously diagnosed with carpal tunnel syndrome, worked extensively at a computer, and had unilateral symptoms at the time. The participants were divided randomly into a group that received massage therapy and a group that did not. Those in the massage group received a 15-minute massage to the affected arm once per week for 4 weeks. These participants were also taught self-massage and were instructed to perform it daily before bedtime. The control group received no massage but was taught self-massage after the study was completed. The study's results showed that the group receiving massage had significantly reduced symptoms, increased strength, increased nerve conductivity, and decreased anxiety and depression. The control group showed little change. The study's authors concluded that massage therapy has demonstrable benefits in the treatment of carpal tunnel syndrome. The study further notes that although carpal tunnel release surgery is successful in 75% of cases, complications including injury to the median nerve, scarring, loss of motion, and infection may occur, and symptoms recur in up to 19% of cases.

In 2007, Burke et al. published a study titled "A Pilot Study Comparing Two Manual Therapy Interventions for Carpal Tunnel Syndrome." This study compared the benefits of soft tissue manipulation conducted with the therapist's hands (STM group) to the benefits of manipulation conducted with patented tools used in the Graston Technique (GISTM group). The study involved 22 patients with carpal tunnel syndrome randomly divided into the two groups. On average, each participant received treatment twice per week for 4 weeks, then once per week for 2 weeks. Participants in both groups were treated by the same clinician who was trained in both techniques. Evaluations were made within 1 week of the final treatment, 6 weeks after last treatment, and 3 months after treatment. Although the clinical findings were not significantly different between the STM and GISTM groups, the study showed evidence that manual therapy increased ROM and grip strength in wrists affected by carpal tunnel syndrome. The authors of the study reported that these findings suggest that manual therapy may increase myofascial mobility, increase blood flow, and reduce ischemia, in turn alleviating symptoms of carpal tunnel syndrome.

In 2008, Moraska et al. published a study titled "Comparison of a Targeted and General Massage Protocol on Strength, Function, and Symptoms Associated with Carpal Tunnel Syndrome: A Randomized Pilot Study." In this study, 27 subjects previously diagnosed with carpal tunnel syndrome were randomly assigned to receive 30 minutes of either targeted or general massage therapy twice weekly for 6 weeks. The general protocol was typical of general relaxation massage intended to reduce tension and increase circulation to the back, neck, and both arms. The targeted protocol focused on sites of entrapment of the median nerve by reducing inflammation, adhesions, and hypertonicity along the full course of the brachial plexus and median nerve. Assessments were made at the beginning of the 8th and 12th treatments, and outcome assessments including strength and function were made 2 days after the 7th and 11th sessions. Both groups showed improvement in symptoms, but only the group receiving targeted treatment showed improvement in grip strength. The study's authors concluded that massage therapy may be effective in treating compression neuropathies including carpal tunnel syndrome.

WORKING WITH THE CLIENT

Client Assessment

Assessment begins at your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask whether the client is seeking treatment for specific

Table 7-2 Health History

Questions for the Client	Importance for the Treatment Plan
Where do you feel symptoms?	Location of symptoms gives clues to location of compression, trigger points, injuries, or other contributing factors.
Describe the character of your symptoms.	Differentiate possible origins of symptoms. Nerve compression often results in numbness and tingling along the distribution of that nerve. See Chapter 1 for a more detailed description of symptoms and possible origins.
Do any movements make the symptoms worse or better?	Locate tension, weakness, or compression in structures producing such movements.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	If no tests were performed by the health care provider making a diagnosis, use the tests described later in this chapter for your assessment. If your assessment is inconsistent with the diagnosis, ask the client to discuss your findings with his or her health care provider, or ask for permission to contact his or her provider directly.
Have you been diagnosed with a condition such as diabetes, hypo- or hyperthyroid condition, rheumatoid arthritis or osteoarthritis, or systemic lupus?	Systemic conditions may contribute to symptoms, may require adjustments to treatment, and may impact treatment outcomes.
Are you pregnant?	Increased body fluid during pregnancy may contribute to symptoms that resolve after childbirth.
Have you had an injury or surgery?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypo-tonicity, trigger points, atypical ROM, and the signs and symptoms of carpal tunnel syndrome.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures may contribute to the client's condition.
Are you taking any prescribed medication or herbal or other supplements?	Medications of all types may contribute to symptoms or involve contraindications or cautions.
Have you had a cortisone shot in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken an anti-inflammatory medication within the past 4 hours?	Deep friction may initiate an inflammatory process and should not be performed if the client has recently taken an anti-inflammatory medication.

symptoms so that you can review or research treatment options and contraindications to prepare yourself for the session.

Table 7-2 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to walk into the room ahead of you while you assess posture and gait. Look for imbalances or patterns of compensation. If you suspect carpal tunnel syndrome, have the client turn the doorknob to enter the room or pick up a pen or a cup of water without making him or her aware that you have begun your assessment. Do not hand the object to the client, but have the client pick it up himself or herself. If the client performs the task with the unaffected hand, especially if that hand is his or her nondominant hand, this could indicate a compensation pattern due to weakness in the affected hand. A client whose symptoms originate from compression superior to the carpal tunnel is not as likely to lose motor function of the hand unless the

condition has existed for a long time without treatment. This client may, however, compensate because of pain.

Because the symptoms of carpal tunnel syndrome are often confused with symptoms from compressions occurring elsewhere in the body, it is important to assess the client in the posture most common in his or her activities of daily living or in the posture or activity that produces symptoms. For example, if your assessment of the standing client reveals exaggerated internal rotation at the shoulder, this could indicate compression of the brachial plexus at the pectoral area. If your assessment of the seated client reveals an exaggerated kyphotic curve with head forward and neck extended, it is possible that the nerve compression begins at the neck, specifically at the scalenes. If you suspect that a client's posture indicates contributing or compensating factors, treat these as much as time and the client's tolerance permit. Figure 7-4 compares the anatomical position to the posture affected by carpal tunnel syndrome.

RANGE OF MOTION ASSESSMENT

Test the range of motion of the elbow, wrist, and fingers, assessing the length and strength of both agonists and antagonists that cross the joints tested. Because the client controls the amount of movement, keeping it within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or reinjury. Box 7-1 presents the average active ROM results for the joints involved in carpal tunnel syndrome.

Box 7-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN CARPAL TUNNEL SYNDROME

Elbow

Flexion 140–150°
- Biceps brachii
- Brachialis
- Brachioradialis
- Flexor carpi radialis
- Flexor carpi ulnaris
- Palmaris longus
- Pronator teres
- Extensor carpi radialis longus
- Extensor carpi radialis brevis

Extension 0° (5–10° Hyperextension)
- Triceps brachii
- Anconeus

Radioulnar (Forearm)

Pronation 80–90°
- Pronator teres
- Pronator quadratus
- Brachioradialis

Supination 80–90°
- Biceps brachii
- Supinator
- Brachioradialis

Wrist

Flexion 80–90°
- Flexor carpi radialis
- Flexor carpi ulnaris
- Palmaris longus
- Flexor digitorum superficialis
- Flexor digitorum profundus

Extension 65°
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor carpi ulnaris
- Extensor digitorum

Adduction (Ulnar Deviation) 30°
- Extensor carpi ulnaris
- Flexor carpi ulnaris

Abduction (Radial Deviation) 20°
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Flexor carpi radialis

Fingers 2–5

Flexion 85–90°
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor digiti minimi brevis
- Lumbricals
- Some interossei

Extension 30–45°
- Extensor digitorum
- Extensor indicis
- Lumbricals
- Some interossei

Abduction 20–30°
- Dorsal interossei
- Abductor digiti minimi

Adduction 0–5°
- Palmar interossei
- Extensor indicis

Thumb

Flexion 55°
- Flexor pollicis longus
- Flexor pollicis brevis
- Adductor pollicis

Extension 20°
- Extensor pollicis longus
- Extensor pollicis brevis
- Abductor pollicis longus

Adduction 30°
- Adductor pollicis

Abduction 60–70°
- Abductor pollicis longus
- Abductor pollicis brevis

Opposition (Flexion and Abduction)
- Opponens pollicis
- Flexor pollicis brevis
- Abductor pollicis brevis

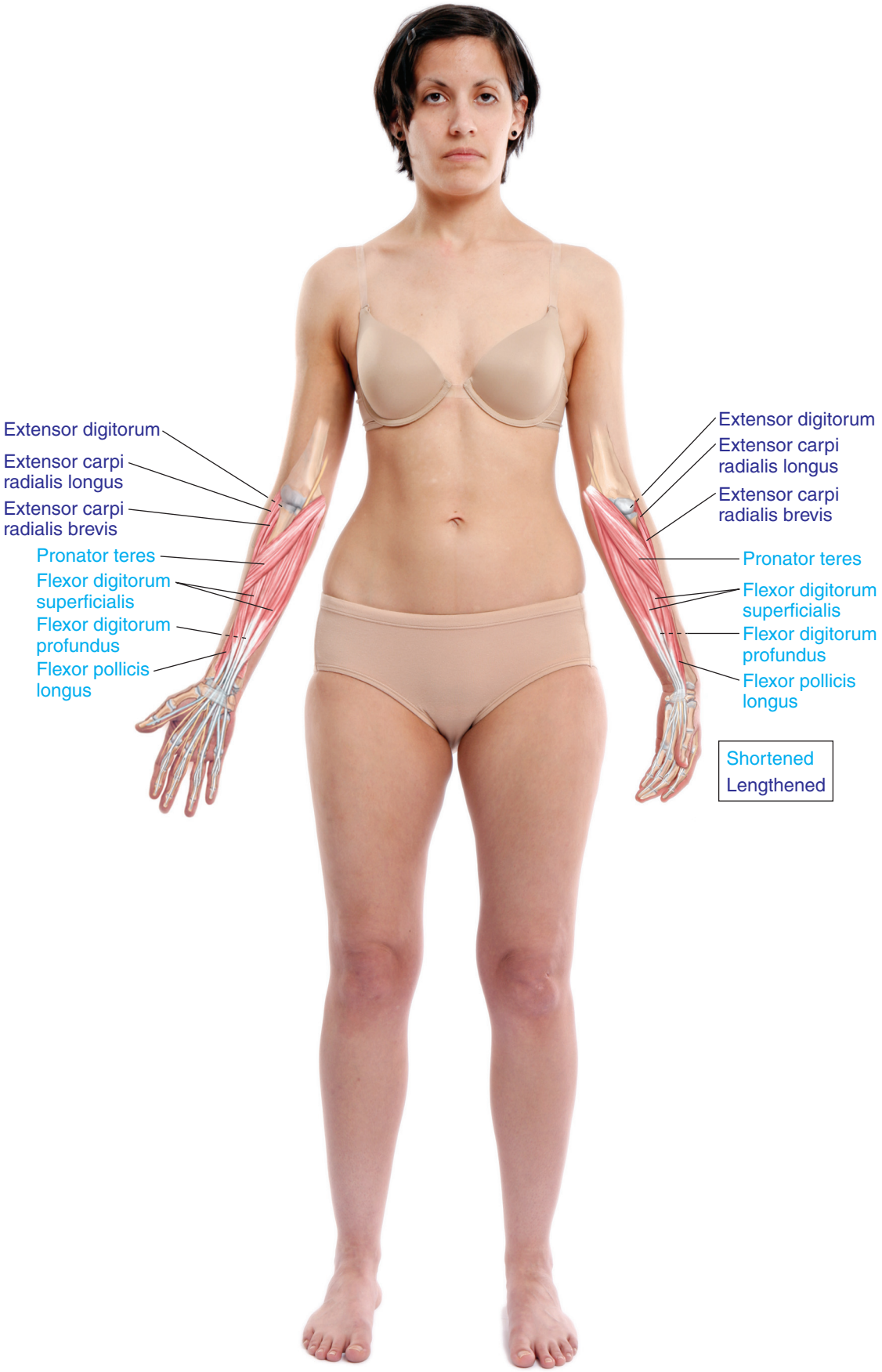


Figure 7-4 **Postural assessment comparison.** Compare the anatomical posture of the right arm to the deviated posture of the left arm. Note how the shortened flexors may contribute to compression of the contents in the carpal tunnel.

Active ROM

Compare your assessment of the client's active ROM with the ranges in Box 7-1. Carpal tunnel syndrome symptoms may not be reproduced with active ROM assessment because the client may limit his or her movement to the symptom-free range.

- **Active flexion of the wrist.** When muscle tension, adhesions, and trigger points contribute to carpal tunnel syndrome, an active, concentric contraction of the wrist flexors may be reduced. The client will likely be resistant to full, active flexion of the wrist if this produces symptoms during activities of daily living.
- **Active extension of the wrist** may be restricted because tight flexors may not allow the full range of extension in the wrist.
- **Active adduction of the wrist** may be restricted if the abductors of the wrist are shortened and hypertonic.

Passive ROM

Compare the client's passive ROM of the affected wrist with that of the unaffected wrist. Note and compare the end feel for each range in both wrists (refer to Chapter 1 for an explanation of end feel).

- **Passive flexion of wrist.** The client may resist even passive flexion of the wrist if flexion causes pain in daily life. Numbness and tingling may occur with full passive flexion if the space in the carpal tunnel is already reduced by other factors. Pain may be felt at the medial epicondyle of the humerus, on the anterior and medial forearm, and at the wrist itself. A hard end feel may indicate a bony structure as a contributing factor.
- **Passive extension of wrist.** In passive extension, a painful stretch to tight wrist flexors may be felt along the anterior and medial aspect of the forearm and the wrist. Numbness and tingling may occur with full passive extension of the wrist. Pain with full passive extension of the wrist may also suggest tendinopathy of a wrist flexor (see Chapter 14).
- **Passive extension of elbow.** Pain on a full passive extension of the elbow may indicate tendinopathy of the elbow or wrist flexors.
- **Passive adduction of wrist** may cause a painful stretch if the wrist abductors are shortened and hypertonic.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the joints involved. Compare the strength of the affected side with that of the unaffected side.

- **Resisted flexion of the wrist** may produce symptoms as tendons passing through the carpal tunnel shorten and widen, further decreasing space in the tunnel.
- **Resisted extension of the wrist** may reveal weakness. This may result from accumulating tension in the flexors, which may lengthen and weaken the extensors reducing their capacity to oppose flexion.
- **Resisted adduction of the wrist** may reveal weakness if the wrist abductors are shortened and hypertonic.
- **Resisted abduction of the thumb** may also reveal weakness, suggesting that the abductor pollicis brevis is affected.

SPECIAL TESTS

Phalen's maneuver may reveal median nerve compression in the carpal tunnel. To ensure that the symptoms originate from the carpal tunnel rather than another area along the median distribution, while performing this test the client must not pronate the forearm, internally rotate the shoulder, or put the neck in flexion, lateral flexion, extension, or rotation.

1. Apply full passive flexion to the affected wrist to test for compression of the median nerve at the carpal tunnel (Fig. 7-5).
2. If symptoms occur within 60 seconds of holding this position, the test is considered positive for median nerve compression with flexion of the wrist.

Figure 7-5 Phalen's test. Apply full passive flexion to the affected wrist without pronation of the forearm to test for compression of the median nerve at the carpal tunnel.

Figure 7-6 Resisted pronation of the forearm. Active resisted pronation of the forearm can be used to assess the involvement of pronator teres.

Pronator teres test may reveal compression of the median nerve by pronator teres. Note that unlike carpal tunnel syndrome, pronator teres syndrome does not typically involve symptoms that wake the client from sleep. Symptoms are most noted with repetitive or resisted flexion and extension or pronation and supination of the elbow.

1. Begin with the client's elbow passively flexed. Support the elbow with one hand if the client is unable to keep the flexed elbow relaxed. Instruct the client to pronate the forearm against your resistance, then passively extend the elbow to lengthen the contracting pronator teres. (Fig. 7-6). Apply resistance at the distal forearm instead of the hand to avoid flexion and undue pressure at the wrist and to distinguish between symptoms that originate at pronator teres from those that originate in the carpal tunnel.
2. The test is considered positive for compression of the median nerve under pronator teres if symptoms are reproduced within 60 seconds.

Tinel's sign can be used to test nerve conduction anywhere in the body. When testing for carpal tunnel syndrome, ensure that there is no active contraction producing flexion in the wrist, pronation of the forearm, flexion or internal rotation of the shoulder, or lateral flexion, extension, or rotation of the neck to ensure that any reproduced symptoms are originating from the carpal tunnel.

1. Tap on the median nerve in the carpal tunnel just distal to the crease of the wrist (Fig. 7-7).
2. The test is considered positive for carpal tunnel syndrome if the client feels tingling along the median nerve distribution.

Figure 7-7 Tinel's sign at the carpal tunnel. Tap on the carpal tunnel just distal to the crease of the wrist.

PALPATION ASSESSMENT

Assess the fascia along the full forearm, wrist, and hand. Skin rolling is a useful tool for assessing superficial fascial restrictions. Areas of restriction may be found nearest the attachment sites of the forearm flexors, though restrictions are possible anywhere in the forearm.

At the forearm, you may find that the flexors are shortened and hypertonic and the extensors weak and taut. When the extensors are weak, they cannot oppose flexion of the wrist efficiently, allowing exaggerated flexion to continue or worsen.

Check the temperature, color, and texture of the superficial tissues. Compression of the nerve or the vessels may cause cool or warm skin, pale skin, boggy texture, and even reduced hair growth.

Condition-Specific Massage

Because the causes of pain, numbness, and tingling in the wrist and hand vary so widely, it may be difficult to pinpoint a single cause. Moreover, more than one condition may be present at the same time. A client who works at a desk for long periods is likely to sit with the head forward and neck in extension (affecting the scalenes), the shoulder internally rotated (affecting the pectorals), the forearm pronated (affecting the pronator teres), and the wrist and fingers in flexion or extension or moving constantly between these (affecting the contents of the carpal tunnel). Likewise, patterns of compensation for any of these conditions can contribute to symptoms of the others.

It is essential for treatment to be relaxing. You are not likely to eliminate the symptoms of carpal tunnel syndrome, or any of the conditions associated with it, in one treatment. Do not try to do so by treating aggressively. Be sure to ask your client to let you know whether your pressure keeps him or her from relaxing. If the client responds by tensing muscles or has a facial expression that looks stressed, reduce your pressure. Remember that you are working on tissue that is compromised.

It is also important for the client to let you know whether any part of your treatment reproduces symptoms. Adjust the client to a more neutral position, reduce your pressure, or move slightly off the area if this occurs, and make a note about it as it may help you understand more clearly exactly which neuromuscular conditions are contributing to symptoms. Instruct your client to use deep but calming breathing to help him or her relax.

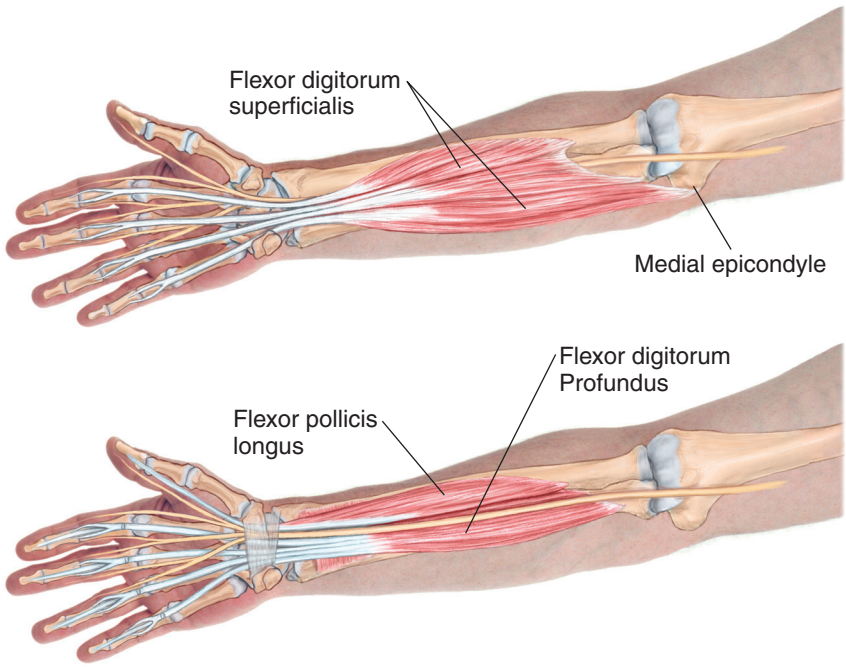
If palpation of a trigger point refers pain elsewhere, explain this to your client and ask him or her to breathe deeply during the technique. As the trigger point is deactivated, the referred pain will also diminish. Common trigger points and their referral patterns are shown in Figure 7-8.

The following suggestions are for treatment of symptoms including pain, tingling, or numbness due to compression of the median nerve at the carpal tunnel in the chronic stage. If the client has an acute injury, follow the PRICE (protect, rest, ice, compression, elevation) protocol. In this case, you may work conservatively proximal to the site but will have to avoid the injured area until the subacute or chronic stage.

- Begin in the supine position and initiate treatment on the affected side. If the affected side is too painful to approach, beginning with the unaffected side may help the affected side to relax. If both arms are affected, begin with the dominant side.
- If inflammation is present, bolster the arm so that gravity encourages venous return and the draining of fluid toward the proximal lymph nodes.

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

Figure 7-8 **Common trigger points and referral.** Common trigger points with referrals associated with carpal tunnel syndrome.



FLEXOR DIGITORUM SUPERFICIALIS

Origin	*Common flexor tendon at medial epicondyle, coronoid process of ulna and shaft of radius.*
Insertion	*Middle phalanges of digits 2-5.*
Action	*Flex digits 2-5, flex wrist.*
Nerve	*Median.*

FLEXOR DIGITORUM PROFUNDUS

Origin	*Anterior, medial surface of proximal ulna.*
Insertion	*Distal phalanges of digits 2-5.*
Action	*Flex digits 2-5, flex wrist.*
Nerve	*Ulnar and median.*

FLEXOR POLLICIS LONGUS

Origin	*Anterior surface of radius.*
Insertion	*Distal phalange of thumb.*
Action	*Flex thumb.*
Nerve	*Median.*

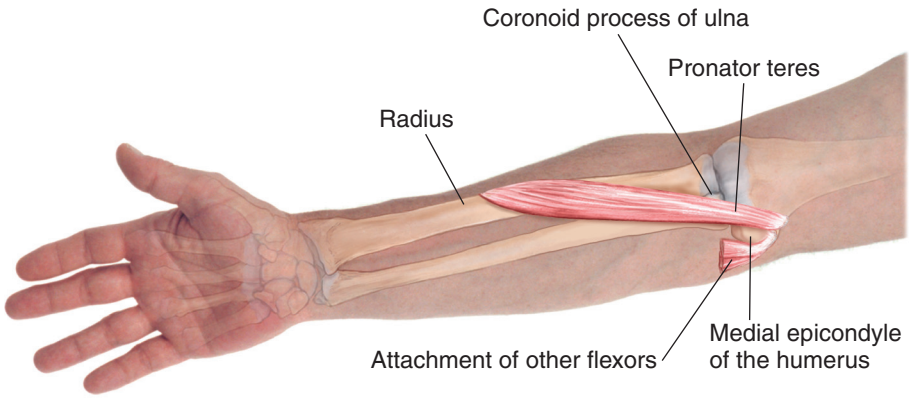
Figure 7-9 Flexor digitorum superficialis and profundus, flexor pollicis longus. The tendons of flexor digitorum superficialis and profundus, and flexor pollicis longus pass through the carpal tunnel of the wrist. Adapted from Clay JH, Pounds DM. Basic Clinical Massage Therapy: Integrating Anatomy and Treatment, 2nd edition. Philadelphia: Lippincott Williams & Wilkins, 2008.

- If you suspect a double crush that involves compression of the brachial plexus at the neck or the pectoral area, refer to Chapter 6 for suggestions for treating thoracic outlet syndrome.

- Assess the arm for adhesions and hypertonicity. The muscles of the arm may be compensating because of pain or weakness in the forearm and hand. If you find nothing remarkable, be conservative in your treatment of the upper arm to spare time. You can come back to this in a subsequent treatment once you have attended to the major contributing factors.

- Assess the wrist flexors for adhesions. Begin with the most superficial muscles and progress to the deepest. Reduce any adhesions found.

- Assess and treat the wrist flexors for hypertonicity. Beginning again with the most superficial tissues and progressing to the deepest, release tension in the wrist flexors.

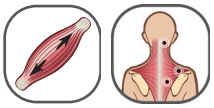


PRONATOR TERES

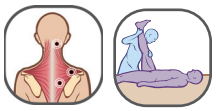
Origin	*Medial epicondyle of humerus, common flexor tendon, coronoid process of ulna.*
Insertion	*Middle, lateral surface of radius.*
Action	*Pronate forearm, flex elbow.*
Nerve	*Median.*

Figure 7-10 Pronator teres. The median nerve can become compressed as it passes under pronator teres. Adapted from Clay JH, Pounds DM. Basic Clinical Massage Therapy: Integrating Anatomy and Treatment, 2nd edition. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Lengthen the individual muscles whose tendons pass through the carpal tunnel. These muscles include the flexor digitorum superficialis, flexor digitorum profundus, and flexor pollicis longus (Fig. 7-9). You may also find the other flexors flexed and shortened. Treat these if indicated. Follow the length of these fibers from origin to insertion to comprehensively assess and lengthen them.

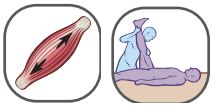


- Assess the pronator teres for hypertonicity and trigger points because it is a common area for median nerve compression (Fig. 7-10).



- Treat trigger points found in the wrist flexors and apply a passive stretch.

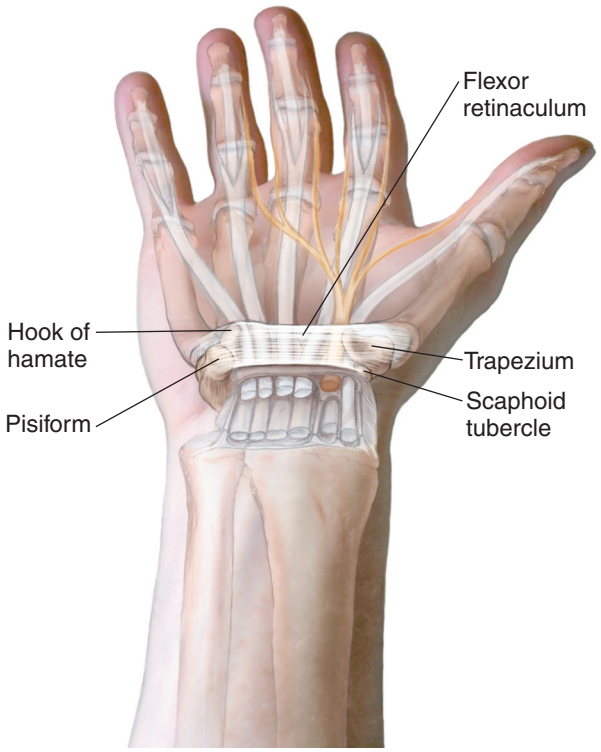
- Assess the flexor retinaculum for adhesions and release them if found (Fig. 7-11). Be sure to work within the client's pain tolerance and to lighten your pressure or discontinue this technique if it reproduces symptoms. It may be necessary to wait until a subsequent treatment to use this technique. As the client's symptoms are reduced with each treatment, the pressure at the carpal tunnel may diminish, allowing for more aggressive treatments such as friction.



- Find the attachments of the flexor retinaculum at the pisiform, hamate, scaphoid, and trapezium. Apply lengthening strokes in the direction of the fibers of the retinaculum. Follow this with a gentle stretch to the retinaculum by pinning the tissue at its attachments and gently pulling them away from each other (Fig. 7-12). To avoid repeated injury, be careful not to overstretch a ligament, especially if the client has a history of trauma.

- If the client has not lost tone or strength in the hand, knead the muscles and tendons in the palm, particularly the thenar muscles. Be careful not to reproduce symptoms when working in the palm. If the tissues of the hand are compromised, you may need to postpone treatment here until innervation and tone are restored. Gentle tapotement may help to build tone in these muscles. If performing tapotement, avoid the carpal tunnel if this action reproduces symptoms.

- Apply a full passive stretch to the wrist flexors. Extend the elbow and wrist fully and include the fingers and thumb in the stretch to ensure that the whole muscles are lengthened. Perform postisometric relaxation if necessary to encourage greater lengthening of the shortened wrist flexors.

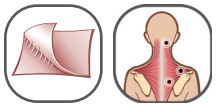


FLEXOR RETINACULUM

Attachments *Pisiform, hook of hamate, scaphoid tubercle, trapezium.*

Figure 7-11 **Flexor retinaculum.** Adapted from Clay JH, Pounds DM. Basic Clinical Massage Therapy: Integrating Anatomy and Treatment, 2nd edition. Philadelphia: Lippincott Williams & Wilkins, 2008.

Figure 7-12 **Retinaculum stretch.** Perform a passive stretch of the flexor retinaculum.



- Assess the wrist extensors for adhesions and trigger points and treat as necessary.

- Clear the whole arm with gentle strokes to move fluid toward proximal lymph nodes and encourage venous return. If inflammation occurred in the area during treatment, bolster the arm and cover the forearm and hand with a cool, wet towel.

- If time remains, consider treating the unaffected arm, neck, chest, or posterior thorax for patterns of compensation that may contribute to pain in these locations. If you do not have time for this in the first session, you may in subsequent sessions when the primary contributing factors require less treatment.

The treatment overview diagram summarizes the flow of the treatment (Fig. 7-13).

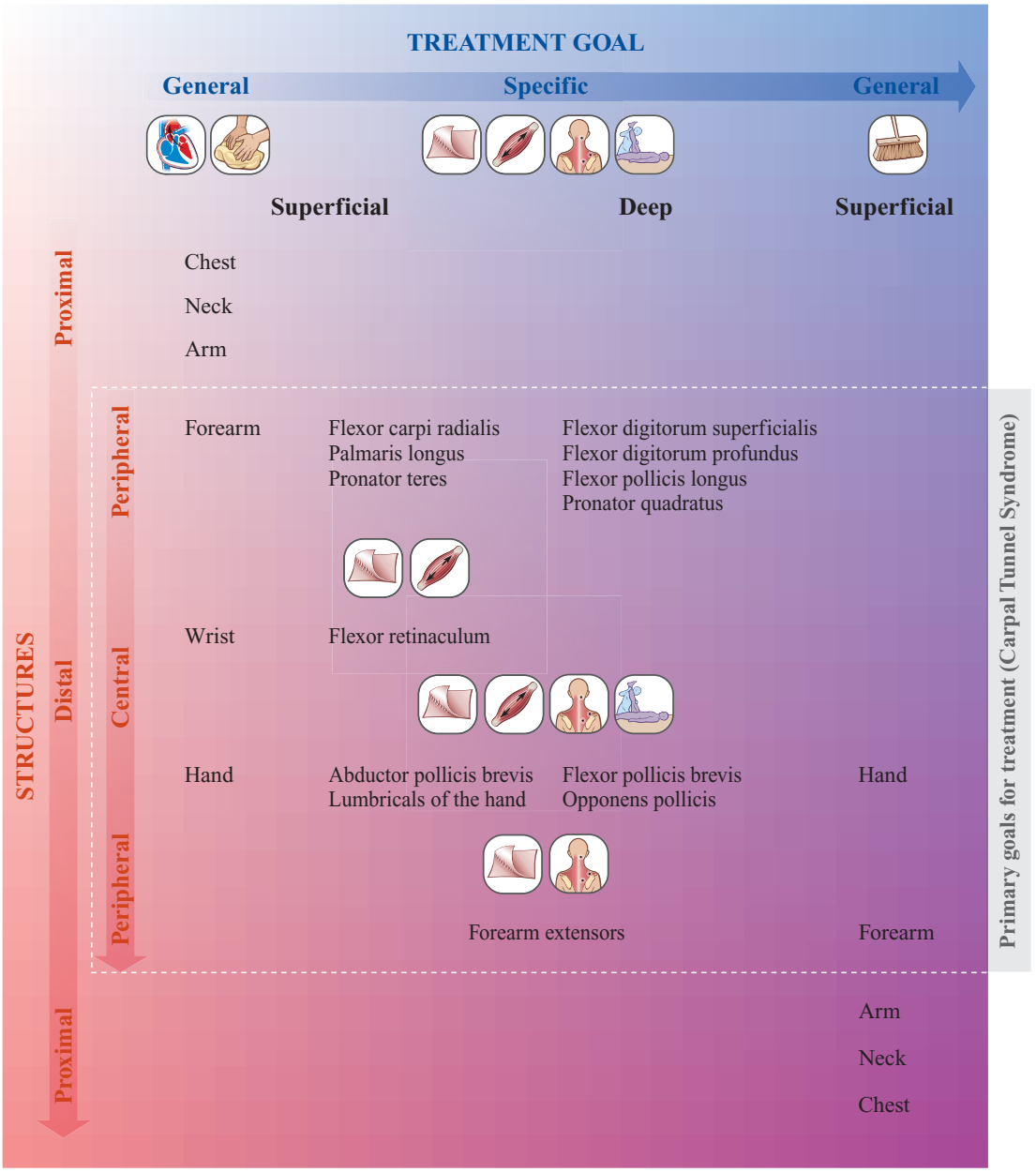


Figure 7-13 **Carpal tunnel treatment overview diagram.** Follow the general principles from left to bottom when addressing carpal tunnel syndrome.

CLIENT SELF-CARE

The following are intended as general recommendations for stretching and strengthening muscles involved in the client's condition. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises, or do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines.

- When possible, perform self-care activities during the workday, while taking a phone call, or during other activities of daily living instead of setting aside extra time.
- Encourage the client to take regular breaks from repetitive actions.
- Demonstrate gentle self-massage to keep hypertonicity at bay between treatments.
- Instruct the client on proper posture to keep pressure off the weakened joints. Instruct clients with symptoms of carpal tunnel syndrome to sleep in positions without flexing the wrist, and to adjust their workstation to minimize flexion or extension of the wrist while typing.
- Demonstrate all strengthening exercises and stretches to your client and have them perform these for you before leaving to ensure that they are performing them properly and will not harm themselves when practicing on their own.

Stretching

Instruct the client to stretch his or her forearm flexors (Fig. 7-14). Be sure that the elbow is extended, and include the fingers and thumb when performing the stretch. Each stretch should be held at least 15–30 seconds. Extend the wrist only to the point of a comfortable stretch. The stretch should be pain-free with the affected arm fully relaxed. The client should perform stretches frequently throughout the day within his or her tolerance.

Figure 7-14 Forearm flexor stretch. With the elbow extended, extend the wrist and fingers against a surface to stretch the forearm flexors.

Figure 7-15 Forearm extensor strengthening. With the elbow extended and wrist slightly flexed, extend the wrist against resistance to strengthen wrist extensors.

If pronator teres is involved, instruct the client to fully supinate the forearm with the elbow extended to stretch pronator teres. For stretches to other areas along the median nerve, see Chapter 6 on the thoracic outlet syndrome.

Strengthening

Because forearm flexion is opposed by the forearm extensors, it is important to assess the extensors for length and strength. If the forearm extensors are weak and unable to fully oppose flexion of the wrist, the flexors are likely to return to the shortened, hypertonic state following treatment. Encourage the client to strengthen the forearm extensors within his or her tolerance by extending the affected wrist while gently resisting the movement with the opposite hand or a stable surface (Fig. 7-15).

Immobility is often the muscle's enemy. Although splinting is often recommended when a client develops symptoms of carpal tunnel syndrome, if the cause is muscular, immobility may promote the development of adhesions and thickening of the fascia. In addition, splinting the wrist may increase compensatory actions at the elbow and shoulder, putting these areas at greater risk for injury. With consent from his or her health care provider, encourage the client to remove the splint occasionally and gently move the wrist through its full range of motion. The client should not force this movement because forceful movement of the wrist may increase symptoms. Gently drawing the alphabet in the air with the wrist and hand is a helpful exercise, but the client should stop when he or she feels fatigue, pain, or reproduced symptoms.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, clients with carpal tunnel syndrome will have treatments twice per week for the first week or two, or until symptoms are absent for at least 4 days. This can be followed by weekly treatments until the symptoms are absent for at least 7 days and range of motion and strength have improved. As treatment continues, the period of symptom-free days should increase until the symptoms become occasional or are relieved completely. After this, the client can schedule appointments as necessary. If the cause of symptoms is neuromuscular, some improvement should occur with each session. If the client is not improving, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client does not have carpal tunnel syndrome and you may be focusing treatment on the wrong area. Remember that the symptoms may arise from several different points along the neck, shoulder, and arm.
- The client is not adjusting his or her activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest.
- The syndrome is advanced or involves other complications beyond your basic training. Refer this client to a massage therapist with advanced clinical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy entirely and hinder his or her healing.
- There is an undiagnosed, underlying condition. Discontinue treatment until the client sees a health care provider for a medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be the therapist who takes this client through his or her full program of healing. Still, if you can bring some relief, the client may be encouraged to discuss this change with his or her health care provider and to seek manual therapy rather than more aggressive treatment options. If the client returns for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session.

PROFESSIONAL GROWTH

CASE STUDY

Caroline is a 34-year-old single mother of one 3-year-old child. She is an assistant to the president of a busy real estate firm, working at a computer an average of 40 hours per week. Caroline is very careful to prepare healthy, home-cooked meals for her family every day. She exercises three or four times per week including 30 minutes of aerobic exercise and 20 minutes of strength training with light weights. She began feeling tingling in her thumb and index finger about 3 weeks ago.

Subjective

Client complained of pain across her shoulder and has had tingling in her thumb and index finger for 3 weeks. She reports that the symptoms are most aggravating at work in the late afternoon and when she cooks. Recently she has been awakened from sleep by the sensation. She also noted that her coffee cup feels heavier in her hand than she had ever noticed before. In her most recent visit to her physician, no systemic conditions were diagnosed, though she was diagnosed with carpal tunnel syndrome and prescribed muscle relaxants and a brace for the wrist. Her physician suggested that if the symptoms do not dissipate, surgery is an option. Caroline requested deep tissue massage to relieve tension in her neck and asked whether massage could help relieve the tingling in her fingers.

Objective

Client wears a brace on her right wrist. She lifted the pen with her left hand and positioned it in her right before filling out her intake form. Shoulders are medially rotated, more notably on the right side. Resisted internal rotation of the shoulder produced no symptoms. There is slight left rotation and right lateral flexion of the neck. Resisted left rotation of neck produced symptoms after 27 seconds. Head is slightly forward. Pronator teres strength test was normal and reproduced no symptoms. Phalen's test is positive for carpal tunnel syndrome. Resisted extension of the right wrist showed weakness. Following the strength test, the client was resistant to other ROM testing of the wrist.

Bilateral pectoralis major and minor are hypertonic and tender to touch. Scalenes are hypertonic, especially right. Trigger point in right anterior scalene referred across shoulder. There is minimal swelling at the hand and wrist. Objective observation suggests "double crush" at scalenes and carpal tunnel.

Action

Right arm bolstered to increase venous return. Warm hydrotherapy applied to neck and shoulders. General warming of tissues from the neck to fingers bilaterally, followed by clearing strokes toward the axillary lymph nodes. Myofascial release across glenohumeral joints bilaterally. Petrissage to bilateral pectorals, followed by muscle stripping. No trigger points found. Full, passive bilateral pectoral stretch followed by clearing strokes toward axillary lymph nodes.

Superficial effleurage to neck bilaterally, especially sternocleidomastoid, followed by deeper effleurage to soften hypertonic neck extensors and scalenes. Slow muscle stripping followed by compression to trigger point 3/4 inch superior to the costal attachment of right anterior scalene. Client reported reduction in pain from level 8 to 6. Full stretch to neck extensors and lateral flexors. Postisometric relaxation to right scalenes. No symptoms reproduced.

Deep effleurage and petrissage followed by clearing strokes to right arm. Nothing remarkable. Myofascial release to right forearm, especially at the medial epicondyle, around the wrist and in the palm. Applied muscle stripping to right forearm flexors. Trigger point found in flexor digitorum profundus. Two rounds of compression for 20 seconds alternating with muscle stripping reduced pain from level 8 to 5.

Cross-fiber strokes to flexor retinaculum. Kneading to retinaculum attachments followed by gentle stripping plus pin and stretch along the length of retinaculum. Deep petrissage to lumbricals and interossei muscles of the hand followed by a full, passive stretch of the wrist, including fingers and thumb. Postisometric

relaxation to right wrist flexors. ROM in wrist extension increased slightly. Full, passive stretch with traction to right arm. No symptoms reproduced. Clearing strokes toward axillary lymph nodes.

Remainder of time focused on unaffected arm and posterior torso, ending with relaxing massage to the head and face.

Plan

Demonstrated forearm flexor stretches to client, with care to include the fingers and thumb. Recommended that client discuss with physician the possibility of wearing brace only when performing tasks that aggravate symptoms and at night to avoid prolonged flexion. Also suggested spending a minimum of 1 minute per hour moving the brace-free wrist in its full ROM by gently drawing the alphabet in the air within her tolerance. Scheduled 1-hour appointment 3 days from today, to be followed by reassessment. Depending on improvement, reschedule two times per week until client experiences four consecutive days without symptoms, and once per week following until client experiences longer periods symptom-free. Extensor strengthening exercises may be suggested following next appointment depending on improvement. Recommended drinking water following treatments to flush metabolites and keep the muscles hydrated.

CRITICAL THINKING EXERCISES

1. Activities of daily living, work-related postures, and repetitive motions may increase the risk of carpal tunnel syndrome. Choose a few such postures or activities and consider how they might also contribute to double crush or compression elsewhere that produces similar symptoms. For example, aside from the action at the wrist, what other postures or activities might contribute to numbness and tingling in the hand of a hair stylist?
2. Given evidence that noninvasive manual therapy is indicated for the treatment of carpal tunnel syndrome, discuss its benefits compared with more commonly prescribed treatments including surgery, medication, and immobilization. Are there side effects to medical treatments that can be avoided by treating with massage? What are some limitations of massage therapy in the treatment of carpal tunnel syndrome?
3. Discuss the possible course of treatment of a client who was diagnosed with carpal tunnel syndrome, had surgery to relieve compression of the median nerve, but has had a recurrence of symptoms. What may be some of the reasons that symptoms persist? How will you treat this client?
4. A client calls you the day after treatment and reports that her symptoms have increased. What are some possible reasons for the increase in symptoms? How might you proceed differently in the next treatment?
5. Conduct a short literature review to explain why the following conditions may put a client at greater risk for carpal tunnel syndrome:
   - Poor nutrition
   - Vitamin B deficiency
   - Obesity
   - Hypothyroid
   - Diabetes
   - Gout
   - Hormonal changes
   - Alcoholism

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CHAPTER 8

Hyperlordosis

UNDERSTANDING HYPERLORDOSIS

A healthy spine has four natural curves (Fig. 8-1). The two lordotic curves—cervical and lumbar—arc anteriorly. The two kyphotic curves—thoracic and pelvic—arc posteriorly. These curves are ideal for our species to maintain balance, absorb the impact of movement, and to allow maximum flexibility for our particular types of activity.

Hyperlordosis is an increase in the natural lordotic curve. This chapter focuses on lumbar hyperlordosis: an increased lumbar lordotic curve most often accompanied by shortened hip flexors, anterior pelvic tilt, and shortened lumbar extensors with weakened hamstrings and abdominals (Fig. 8-2). With the hips flexed, such as when sitting, the hip flexors are shortened. If this is a person's common posture, held for hours at a time, day after day, the muscles may develop a high resting tone, making it difficult to lengthen the muscle fully when necessary. As the individual extends the hips, such as when standing from the seated posture, the shortened psoas draws the lumbar vertebrae to which it attaches anteriorly, increasing the lumbar curve, while the iliacus and rectus femoris pull on the pelvis and tilt it anteriorly. The anterior pelvic tilt lengthens and weakens the hamstrings because the distance between the ischium and tibia is increased. The abdominals, which primarily function to maintain posture, weaken and fatigue against the force of the shortened, hypertonic muscles and the associated postural dysfunction. The anterior pelvic tilt and increased lordotic curve decrease the distance between the iliac crests and the ribcage, shortening the lumbar extensors, which may also become hypertonic when they are recruited to maintain an erect posture because the abdominals are not fully able to do so.

In a very short period relative to our evolution, human lifestyle has changed from being highly physical—hunting and gathering, walking, performing manual labor, and so on—to becoming increasingly sedentary. We spend a lot of time driving, sitting, working at a computer, watching television, and so on. These static postures put many of the body's joints in flexion. The hips, knees, thorax, and shoulders are nearly immobile for hours at time. Because of this, hyperkyphosis and hyperlordosis have become two very common postural deviations that lead to chronic pain and limited ROM along the spine and in the shoulders and hips. Both of these postures may lead to other conditions, but you may find that normalizing the curves of the spine and leveling the ilia and scapulae will reduce this client's pain and restriction and may facilitate your treatment of accompanying conditions.

Functional vs. Structural Postural Imbalance

The hyperlordosis described above is functional. Its cause is primarily soft tissue changes and postural deviations that result from an injury to the low back, pelvis, or hip joint or, more commonly, from activities of daily living and poor posture. These deviations can be treated with manual therapy,

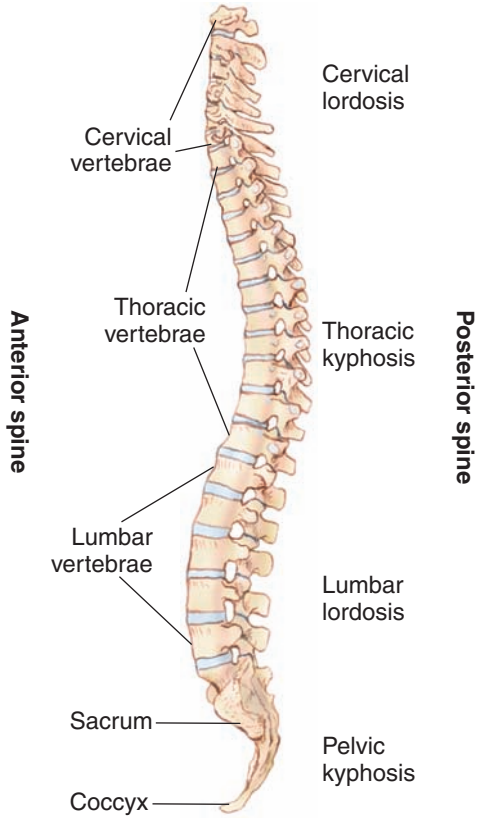


Figure 8-1 Curves of the spine. The cervical and lumbar lordotic curves arc anteriorly. The thoracic and pelvic kyphotic curves arc posteriorly.

Figure 8-2 Hyperlordosis. Hyperlordosis involves an increased lordotic curve most often accompanied by shortened hip flexors, anterior pelvic tilt, and shortened lumbar extensors with weakened hamstrings and abdominals.

self-care, and postural awareness. The therapeutic goal for a client with functional hyperlordosis is to lengthen the muscles that have shortened and become hypertonic and that are pulling the bones out of alignment; to strengthen the muscles that have stretched and become weak; and to reset the neuromuscular system to recognize proper posture and diaphragmatic breathing as normal.

A structural hyperlordotic curve, in contrast, is primarily caused by changes in bones and joints. Bone fusions, bony prominences, bone spurs, fractured bones that were not properly set, osteoporosis, and degenerative disc disease are a few contributing factors. Manual therapy may offer this client pain relief, small increases in ROM, and may slow the progression of postural imbalance but is unlikely to reverse the dysfunction. When hyperlordosis is structural in nature, it is best to discuss the client's condition with his or her health care provider to fully understand the causes. You may need to modify positioning, bolstering, length of treatment, and techniques to accommodate the client's particular needs. In some cases, massage may be contraindicated.

Muscles of the Lower Cross

Lumbar hyperlordosis is also called lower cross syndrome. Coined by Vladimir Janda, MD, DSc, lower cross syndrome refers to an imbalance and dysfunction of the agonists and antagonists that move and support the pelvis (Fig. 8-3). You may find the iliopsoas, rectus femoris, tensor fasciae latae, the lumbar erector spinae, and quadratus lumborum to be short and hypertonic, while the abdominals, gluteus maximus, and hamstrings are stretched and weak. The weakened muscles become less able to oppose the actions of the agonists that function in hip flexion and lumbar extension. As this happens, the imbalance can become more profound and the body less able to reverse the process without intervention (Table 8-1).

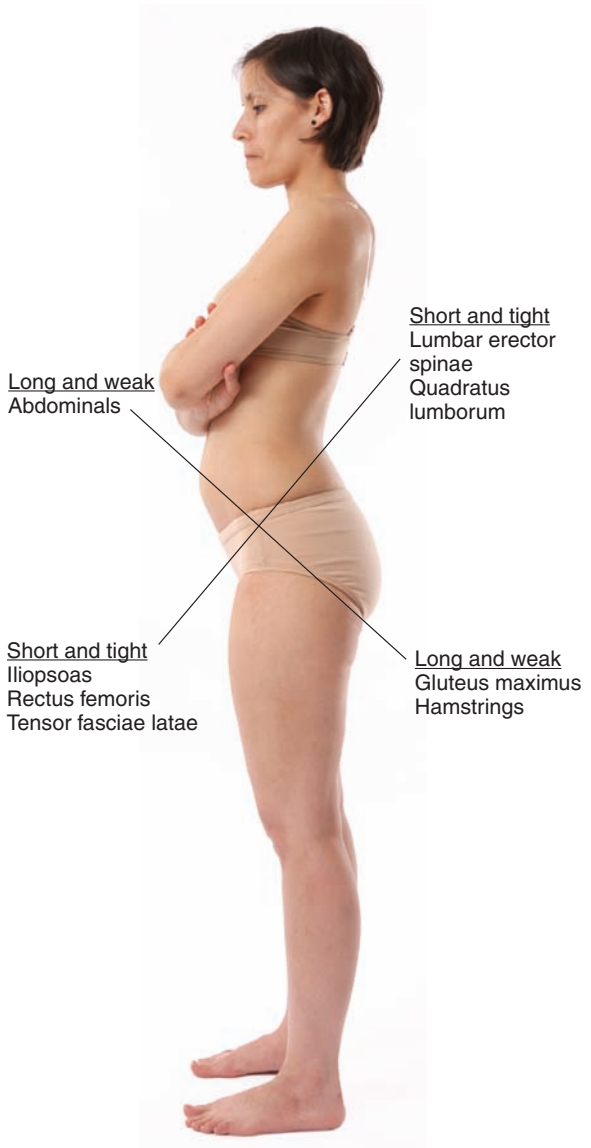


Figure 8-3 **Muscles of the lower cross.** Notice the relationship between the muscles that are short and tight and those that are long and weak.

Table 8-1 Muscles of the Lower Cross with Actions That Contribute to Hyperlordosis

Muscles That are Short and Tight (with Agonist Action)	Muscles that are Stretched and Weak (with Antagonist Opposition)
Psoas (hip flexion, increased lumbar curve)	Gluteus maximus (hip flexion)
Iliacus (hip flexion, anterior pelvic tilt)	Hamstrings (hip flexion, anterior pelvic tilt)
Rectus femoris (hip flexion, anterior pelvic tilt)	
Tensor fasciae latae (hip flexion, anterior pelvic tilt)	
Latissimus dorsi (anterior pelvic tilt)	
Quadratus lumborum (lumbar spine extension)	Rectus abdominus (lumbar spine extension)
Lumbar erector spinae (lumbar spine extension)	External abdominal obliques (lumbar spine extension)
	Internal abdominal obliques (lumbar spine extension)

Common Signs and Symptoms

The most common symptom of developing lumbar hyperlordosis is low back pain. The short, hypertonic psoas pulls the lumbar vertebrae anteriorly, increasing the lumbar curve, while the short, tight iliacus tilts the pelvis anteriorly. This stress on the spine and pelvis can reduce the mobility of the vertebrae, sacroiliac joint, and hips. As the muscles of the lower cross shorten or lengthen around these postural deviations, they become less able to perform their actions fluidly. Shortened muscles may not lengthen fully, and weakened muscles may not be able to oppose the actions of the shortened muscles. For example, weak abdominals may not be strong enough to maintain an erect posture when seated or standing, leaving the posterior lumbar muscles to work harder. When standing, lengthened or weakened hamstrings have difficulty opposing the action of the rectus femoris and iliopsoas, which flex the hips and tilt the pelvis anteriorly. The combination of hypertonicity and weakness through the lower cross results in pain when the client needs to recruit these muscles to perform activities or maintain a stable, erect posture.

As the condition progresses, other patterns may develop. The hip adductors may become hypertonic as a result of the increased activity needed to maintain posture or oppose the lateral rotation of the hips. With lateral rotation of the hips, the piriformis shortens and may become hypertonic while the iliotibial band distorts and creates torsional force throughout the thigh. The sacroiliac joint may become hypomobile, and facet joints may become irritated, putting a client who frequently bends and stands at greater risk for a herniated lumbar disc. As the body adjusts to a new center of gravity, the arch of the foot may flatten as the weight of the body is shifted to the ball of the foot. Hip or leg pain may also be present, particularly if another condition such as piriformis syndrome, patellofemoral syndrome, or plantar fasciitis is present (see Chapters 9, 10, and 11). If nerves become compressed by tight muscles or impinged between bones that have deviated from their natural alignment, numbness and tingling may also occur in the lower extremity. Compression of the vasculature or lymph nodes can lead to edema in the lower extremity.

The fascia across the anterior hip and the thoracolumbar fascia may be restricted. During palpation, you may find tenderness in the rectus femoris, particularly near the superior attachment, in the iliacus at the iliac fossa, and in the psoas deep in the abdomen. Tenderness may also be felt along the iliac crests, at the sacroiliac joint, over the sacrum, and around the greater trochanter. When extension of the lumbar spine contributes to hyperlordosis, the area between the lower ribs and iliac crests may be affected. The deep lateral rotators of the hips are likely to be tender if the hips are laterally rotated.

Whether a contributing factor to hyperlordosis or a result of it, compensatory hyperkyphosis may cause any or all of the pain patterns that are common in clients with an increased kyphotic curve, such as internally rotated shoulders and the head-forward posture (see Chapter 4).

Possible Causes and Contributing Factors

Low back pain may be a symptom of a more serious condition such as cancer, kidney stones, infection in the urinary system, endometriosis, spinal stenosis, or infection in the vertebrae. Refer to Table 8-2, and consult your pathology book to identify the client's signs and symptoms, and refer the client to a health care provider for medical assessment if you suspect a more serious condition.

Pathologies that affect the integrity of bones often cause structural hyperlordosis. Porous bones (osteoporosis) become unable to bear weight and may cause the lumbar vertebrae, pelvis, and femur to collapse upon each other, resulting in increased curvature. Herniated discs in the lumbar spine not only cause low back pain but may also cause compensating structures to become stressed and the vertebrae to collapse upon each other, altering the curve of the spine. Scoliosis—a lateral curve in the spine—increases stress on the spine and the structures involved in moving the spine. Spondylolisthesis—a condition in which a vertebra slips forward relative to other vertebrae—may also cause hyperlordosis. This happens most often at L4-5 or L5-S1.

Table 8-2 Differentiating Conditions Commonly Confused with or Contributing to Hyperlordosis

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Osteoporosis	Bone and joint pain, bone fractures, loss of height, slouching	Bone mineral density test CT X-ray Urinary calcium test	Massage is indicated in the early stages and with the approval of a health care provider in the later stages; may reduce pain. Take care not to use force that may fracture a bone.
Spondylolisthesis	Begins in the lumbar spine and may proceed to the thoracic spine Lumbar hyperlordosis Pain in low back, buttocks, and thighs Stiff back	X-ray Straight leg raise test	Massage is indicated. Stretching and strengthening are encouraged.
Ankylosing spondylitis	Pain often begins in the low back unilaterally and progresses bilaterally to the upper back and throughout the thorax Fatigue and anemia may develop	MRI Blood tests	Massage is indicated to reduce pain, maintain mobility, and slow progress of spinal distortion.
Achondroplasia	Dwarfism Low back pain Abnormal body proportions Bowed legs Decreased muscle tone Prominent forehead Short arms or legs Hyperkyphosis Hyperlordosis	Prenatal ultrasound and amniocentesis Genetic testing X-ray of long bones	Massage is indicated unless an underlying condition such as increased fluid in the brain or spinal stenosis is present.
Urinary and kidney pathologies	Back and flank pain Pain or burning during urination Frequent urge to urinate Fever Pressure in lower abdomen Cloudy, bloody, or foul smelling urine Nausea	Urinalysis or urine culture Ultrasound MRI	Massage is contraindicated until the condition is resolved. Avoid percussive strokes to the back of clients with a history of kidney stones.
Bone cancer	Pain, frequently in the long bones Weak bones easily fractured Swollen, tender joints Fatigue Fever Weight loss Anemia	X-ray CT scan Ultrasound MRI Bone scan Tissue biopsy	Massage may be supportive during treatment and recovery. Work with the health care provider to plan treatment that is best for the individual. A client with bone cancer is susceptible to fractures; take precautions to avoid this risk.

(*continued*)

Table 8-2 Differentiating Conditions Commonly Confused with or Contributing to Hyperlordosis (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Prostate cancer	Urinary problems Blood in urine or semen Swelling in the legs Pelvic pain Bone pain or fractures Compression of the spine	Prostate-specific antigen test Digital rectal exam Ultrasound Biopsy	Massage may be supportive during treatment and recovery. Work with the health care provider to plan treatment that is best for the individual.
Cervical/uterine cancer	Unusual vaginal discharge or bleeding Pelvic/abdominal pain Abdominal mass Pain during intercourse	Pap test HPV exam Ultrasound Cervical/uterine exam Biopsy	Massage may be supportive during treatment and recovery. Work with the health care provider to plan treatment that is best for the individual.
Osteomyelitis	Unrelenting back pain Fever, chills, nausea Swelling and redness Stiffness or pain Weakness, numbness, and tingling in the extremities Drainage at the wound site	X-ray CT scan MRI Blood test Culture to determine bacterial or fungal infection	Massage is contraindicated until infection is resolved and the health care provider approves the massage.
Herniated lumbar disc	Muscle spasm Weakness or atrophy Low back pain Pain in buttocks, legs, and feet, which worsens when coughing, laughing, or straining Numbness and tingling in the legs and feet	Physical exam including muscle reflexes and strength Straight leg raise test X-ray CT MRI EMG Myelogram	Massage is indicated with caution. Work with the health care team.
Nerve root compression	Muscle spasm, weakness, or atrophy Pain radiates to the extremities	Kemp's test Valsalva maneuver Neurological exam to test reflexes, sensation, and strength	Massage is indicated if cause and location are understood. Take care not to increase compression or reproduce symptoms.

Spondylolisthesis can be congenital or may develop from a degenerative disorder such as arthritis, from stress fractures, or from bone disease. Achondroplasia—a genetic disorder that slows the growth of bones—causes a variety of abnormalities affecting the length and shape of bones, particularly in the spine and extremities. Ankylosing spondylitis—an autoimmune disease that causes arthritis or swelling in the spine—may ultimately cause the bones to fuse, limiting the spine's mobility. Nutritional deficiencies of calcium and vitamin D as well as increased consumption of calcium oxalate and carbonated beverages may affect the body's ability to rebuild bone.

In some cases, contributing factors can lead to both structural and functional hyperkyphosis. In these cases, it is important to understand the level of stress to the bones before applying

manual therapy to the muscles in order to avoid injury. Age may play a role in developing hyperlordosis because the bones become weaker and activity that keeps the joints mobile decreases with age. A sedentary lifestyle and lack of physical fitness reduce functionality and can lead to pain and dysfunction. Weight gain, particularly when it occurs in the span of a few months or a year, rapidly shifts the center of gravity and increases demands on the musculoskeletal system. The increased size and weight of the abdomen increases the load that the spine must support and may pull the lumbar spine anteriorly, increasing the lordotic curve. Pregnancy may contribute to this pattern, which often resolves itself after delivery. Previous injury or surgery around the low back, pelvis, legs, and abdomen may contribute to hyperlordosis. Injuries that were not properly treated to restore mobility and musculoskeletal function can initiate patterns of compensation that put stress on the muscles and bones. Surgery that produces scar tissue can affect the functionality of fascia and muscle by reducing contractile strength or the ability of those tissues to lengthen sufficiently.

The primary contributing factors in most cases of functional lumbar hyperlordosis, however, are poor posture and repeated activities of daily living. Prolonged standing and prolonged sitting as well as repeated resisted activities that involve bending, twisting, and lifting can cause dysfunction in the muscles of the lower cross and misalignment of the joints that they cross. For example, as mentioned above, when a client sits for long periods, the hip flexors may become shortened as the origins and insertions rest closer to each other while the erector spinae may fatigue from long-term, involuntary contraction in an attempt to keep the posture erect. This is particularly true when the client's abdominal muscles are too weak to contribute to maintaining proper posture. When the client stands, the shortened hip flexors keep the joint from fully extending, and this can leave the hips in varying degrees of flexion. The tight rectus femoris and iliacus pull on the pelvis, causing an anterior pelvic tilt. Without adjusting the posture of the spine, the client's eyes would be facing down. Because hip extension is restricted by the tight hip flexors, the lumbar spine extends without bringing the ilia and sacrum with it, which increases the lordotic curve, shortening the quadratus lumborum and the lumbar erectors.

Try it yourself: Slowly stand up from the seated position without fully extending your hips. Try to stand straight and look ahead. Feel your pelvis stabilized in an anterior tilt while your lumbar spine curves to compensate. You may also notice your knees locking into extension, and the adductors and the gluteal muscles contracting to maintain your center of gravity. When this becomes a common posture, the lumbar spine curves anteriorly. Moreover, when a client regularly holds this posture, the cervical spine must extend to allow the person to look forward, which can lead to hyperkyphosis if it is not already present.

When a person stands for long periods with weight on one leg, the hip on that side is often elevated, causing the sacrum to rotate and tilt. This may cause the sacroiliac joint to become less mobile. Postures that increase lateral rotation or adduction of the hip, as are common with dancers, may increase the risk of hyperlordosis. Wearing high heels displaces the center of gravity and encourages anterior pelvic tilt, increasing lordosis.

Table 8-2 lists conditions commonly confused with or contributing to hyperlordosis.

Contraindications and Special Considerations

- **Underlying pathologies.** Spondylolisthesis, osteoarthritis, osteoporosis, degenerative disc disease, bone spurs, or fusions may be present. If you suspect one of these (consult Table 8-2 and your pathology book for signs and symptoms), refer the client to a health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not contraindicated for massage, work with the health care provider to develop a treatment plan that is appropriate for that individual.
- **Endangerment sites.** Be cautious near endangerment sites in the abdomen and femoral area. Gently palpate for the pulse of the abdominal aorta and the femoral artery before you begin working there. If you feel a pulse while working, back off slowly and reposition your stroke to avoid the endangerment site.
- **Menstruation.** Treating iliopsoas when a woman is premenstrual or menstruating may be uncomfortable. Offer to reschedule or to work all other structures, explaining that

lengthening the iliopsoas is an integral part of treatment for hyperlordosis and may require followup after menstruation has ended. If you are unable to massage the iliopsoas, stretching the hip flexors by passively extending the hip is a good alternative.

- **Treatment duration and pressure.** If the client is elderly, has degenerative bone disease, or has a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better than prolonged treatment with long intervals.
- **Positioning.** Use bolsters to position a client for comfort as well as to reduce postures that may contribute to hyperlordosis. In the supine position, a bolster under the knees will keep the hip flexors from fully lengthening and may reduce lordosis and pressure on the lumbar spine. In the prone position, a bolster under the anterior superior iliac spines may reduce anterior pelvic tilt, and a bolster under the ankles may reduce stress on the low back.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised, or if the client is taking anti-inflammatory medication. Friction creates an inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours before treatment if his or her health care provider agrees.
- **Tissue length.** It is important when treating myofascial tissues that you do not lengthen those that are already stretched. Assess for myofascial restrictions first and treat only those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. For example, because the abdominals and hamstrings tend to be overstretched, it is not advisable to perform myofascial release or a full stretch from origin to insertion on these muscle groups. If you treat trigger points in overstretched tissue, use heat or a localized pin and stretch technique instead of full ROM stretches.
- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Massage Therapy Research

A thorough literature review found no research, case studies, or articles about the specific benefits of massage therapy for the treatment of hyperlordosis, lordosis, or lower cross syndrome. Much of the literature about the use of manual therapies to treat hyperlordosis comes from other disciplines, primarily physical therapy. Closer examination is needed on the benefits of massage therapy to lengthen shortened and hypertonic tissues along with self-care to strengthen lengthened, weak muscles.

Several articles, however, confirm the benefit of massage therapy for low back pain—the most common symptom of hyperlordosis. In 2001, Hernandez-Reif et al. published a study titled "Lower Back Pain Is Reduced and Range of Motion Increased After Massage Therapy." In 2008, Jada Bell described a case study titled "Massage Therapy Helps to Increase Range of Motion, Decrease Pain and Assist in Healing a Client with Low Back Pain and Sciatica Symptoms." These studies are important because of the attention paid to hip flexion and to general areas or specific muscles known to contribute to hyperlordosis. Neither study mentions anterior pelvic tilt, and both also treated muscles that are not directly associated with hyperlordosis.

Hernandez-Reif et al. studied 24 participants who reported low back pain for at least 6 months prior, sought medical attention for the pain, and were cleared by their primary care providers to participate in the study. All participants were free of underlying conditions that can contribute to low back pain. The massage therapy group received 30-minute treatments twice per week for 10 weeks. The relaxation group (control group) was instructed to perform exercises for large muscle groups throughout the body. At the end of the study, the massage group reported less pain, less depression and anxiety, improved sleep, and improved ROM compared to the control group. Serotonin and dopamine levels, which are often depleted in patients with chronic pain, anxiety, and depression, increased in the massage group.

Bell's case study involved a 58-year-old client presenting with a 9-month history of low back pain that radiated into the lower extremity. MRI revealed spondylosis and a herniated disc that caused no nerve root impingement. The client occasionally used nonsteroidal anti-inflammatory medication,

muscle relaxants, and narcotic analgesics and was receiving chiropractic care as well as physical therapy. The 45-minute treatments were administered once per week for 6 weeks following a 4-week period during which base line measures were recorded. During the treatment period, activities of daily living and ROM improved and pain was reduced. A significant limitation of this study was the use of physical therapy in addition to massage. Although the client's symptoms improved to a larger extent during the massage treatment period than the physical therapy period, it is impossible to determine whether massage alone or the combination of therapies produced these benefits.

In 2000, Michele Preyde published a study titled "Effectiveness of Massage Therapy for Subacute Low-back Pain: A Randomized Controlled Trial." The study tested 98 subjects between the ages of 18 and 81 with low back pain for 1–8 months prior to the study and no other significant pathology. The subjects were randomly assigned to one of four groups: comprehensive massage therapy (soft-tissue manipulation, remedial exercise, and posture education), soft-tissue manipulation only, remedial exercise with posture education only, or a placebo of sham laser treatment. Participants received six treatments over the course of approximately 1 month. Participants in the comprehensive group received 30–35 minutes of soft tissue manipulation and were taught stretching exercises for the trunk, hips, and thighs. Those in the soft tissue manipulation group received the same soft tissue manipulation as those in the comprehensive group but no remedial exercise, and those in the remedial exercise group performed the same exercises as those in the comprehensive group but received no soft tissue manipulation. Those in the control group received only sham infrared laser treatment. Intensity of pain, quality of pain, and function measures were recorded after each treatment, after 1 month of treatment, and again 1 month after treatment ended. The comprehensive group showed significant improvement in function, pain intensity, and pain quality compared to the other groups. The comprehensive and the soft tissue manipulation groups showed clinically significant improvement in function. At the 1 month follow-up, no pain was reported by 63% of the comprehensive group, 27% of the soft tissue manipulation group, 14% of the remedial exercise group, and 0% of the control group. The authors conclude that massage therapy is beneficial for clients with low back pain. The study does not describe which soft tissues were treated, stating only that "The exact soft tissue that the subject described as the source of pain was located and treated with the specific technique indicated for the specific condition of the soft tissue." Although hip flexion and extension were included in the remedial exercises, and these ROMs are relevant in assessing for hyperlordosis, further research is needed to determine the extent to which massage improves hyperlordosis specifically.

Several literature reviews also explore the benefits of massage for low back pain or compare the benefits of massage to other complementary and alternative therapies. In 2003, Cherkin et al. published a review titled "A Review of the Evidence for the Effectiveness, Safety, and Cost of Acupuncture, Massage Therapy, and Spinal Manipulation for Back Pain." They concluded that massage has been found to be effective for persistent back pain, that spinal manipulation has minimal clinical benefits, and that the effectiveness of acupuncture is unclear. In addition, the review concludes that only massage is cost effective. In 2008, Imamura et al. published a review titled "Evidence-Informed Management of Chronic Low Back Pain with Massage," which concludes that there is strong evidence suggesting massage has long-lasting benefits for nonspecific chronic low back pain and may be cost-effective by way of reducing visits to health care providers. The review also reports that further research into the specific mechanism of improvement with massage therapy is needed.

WORKING WITH THE CLIENT

Client Assessment

Hyperlordosis is a common postural deviation causing chronic pain and restricted ROM in the low back and hips. It involves many joints and all of the muscles that cross them. A wide variety of possible factors can contribute to the development of hyperlordosis. All of these elements add up

Table 8-3 Health History

Questions for the Client	Importance for the Treatment Plan
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors.
Describe what your symptoms feel like.	Differentiate between the possible origins of symptoms and determine the involvement of muscles, joints, nerves, blood vessels, or viscera. See Chapter 1 for a more detailed description of symptoms and possible origins.
Do any movements make symptoms worse or better?	Locate tension, weakness, or compression in structures producing such movements.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Bone density tests, blood tests, and other tests may indicate contributing factors.
Have you been diagnosed with a condition such as osteoporosis, rheumatoid arthritis, or osteoarthritis?	Systemic conditions may contribute to signs and symptoms, may require adjustments to treatment, and may impact treatment outcomes.
Have you had an injury or surgery, or did your symptoms begin during a pregnancy?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM. Changes in the center of gravity during pregnancy or other rapid weight gain may be a contributing factor.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures that increase flexion of the hips or anterior pelvic tilt may contribute to the client's condition.
Are you taking any prescribed medication or herbal or other supplements?	Medication of all types may contribute to symptoms or involve contraindications or cautions.
Have you had a cortisone shot in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction initiates an inflammatory process and should not be performed if the client has recently taken anti-inflammatory medication.

to many variations in how a client may present to you. For example, a client with increased lumbar curve and anterior pelvic tilt who often stands with more weight on one leg may present with lateral flexion of the thorax, an elevated iliac crest, sacroiliac joint immobility, and rotation in the hips or spine affecting the abdominal obliques, latissimus dorsi, multifidi and rotatores, and ligaments connecting the sacrum, pelvis, and spine. What follows are common presentations for hyperlordosis. However, it is essential to assess every joint to form an accurate picture for each individual client.

Assessment begins at your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself.

Table 8-3 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to enter the room ahead of you while you assess his or her posture and movements before he or she is aware that the assessment has begun. Look for imbalances or patterns of compensation for deviations common with hyperlordosis. Watch the client walk and look

for reduced mobility in the hips or whether the client appears to be favoring one side. Have the client sit to fill out the assessment form, and watch to see if he or she lowers into the chair cautiously or shifts around to find a comfortable position. Watch also as the client stands up to see if he or she is able to extend the hips fully and if standing from a seated position causes him or her to use the arms to lift themselves or to lean on a stable surface. When assessing the standing posture, be sure that the client is standing comfortably. If the client is asked to stand in the anatomic position, you will not get an accurate assessment of his or her posture in daily life. Look for anterior pelvic tilt, increased curve in the lumbar spine, hip flexion, rotation of the hips, hyperextended knees, and pronation or supination of the ankles.

Figure 8-4 compares healthy posture to a posture affected by hyperlordosis.

ROM ASSESSMENT

Test the ROM of the hips and lumbar spine as both agonists and antagonists. If hyperlordosis is structural in nature, do not perform ROM tests that move the affected joints into ranges that are inhibited by the altered joint structure or that may cause further damage. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of an injury to prevent undue pain or re-injury. Box 8-1 presents the average active ROM results for the joints involved in hyperlordosis.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 8-1. Pain and other symptoms may not be reproduced during active ROM assessment, because the client may limit movement to a symptom-free range.

- **Active posterior pelvic tilt,** particularly when the hip flexors are lengthened as when standing, may be restricted and cause pain.
- **Active extension of the hip** may be reduced when muscle tension, adhesions, and trigger points shorten hip flexors or weaken hip extensors. The client may resist full active extension of the hip if this produces symptoms during activities of daily living.
- **Active medial rotation** of the hip may be reduced or cause pain when shortened or hypertonic muscles hold the hip in lateral rotation.

Passive ROM

Compare the client's P ROM on one side to the other when applicable. Note and compare the end feel for each range (see Chapter 1 for an explanation of end feel).

- **Passive extension of the hips** may be restricted when the hip flexors are shortened or hypertonic.
- **Passive medial rotation of the hips** may be restricted when lateral rotators such as the iliopsoas are short and hypertonic, which could occur if lateral rotation of the hips becomes a compensating pattern.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the joints involved. Compare the strength of the affected side to the unaffected side.

- **Resisted extension of the hip** may cause pain in the low back when the hip flexors are short and hypertonic and the hip extensors are weak. The client may rotate the pelvis to compensate.
- **Resisted flexion of the thorax** may be reduced when the abdominals are weak and stretched. This test is best performed with the hips and knees flexed to reduce the contraction of the hip flexors.

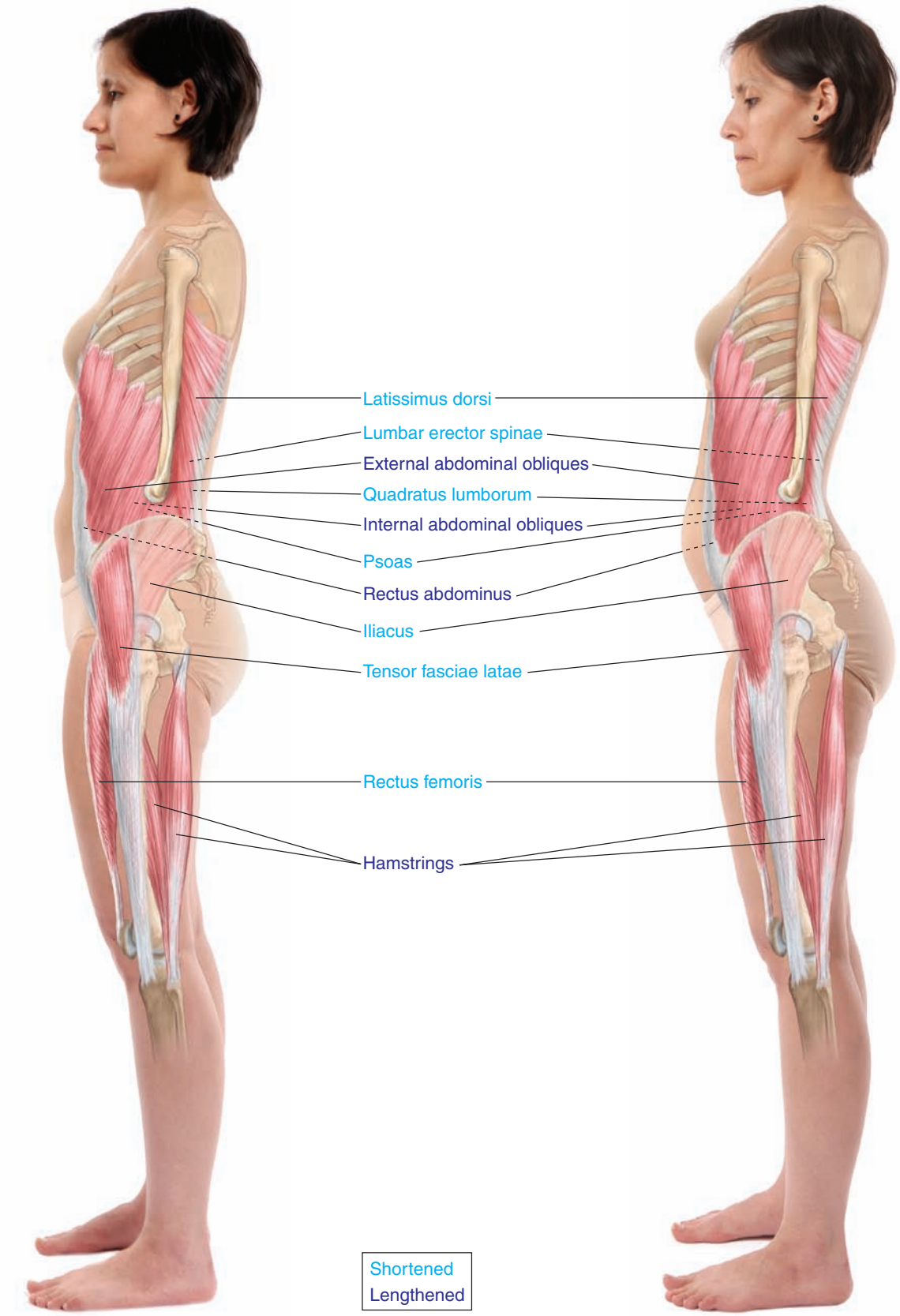


Figure 8-4 **Postural assessment comparison.** Compare the anatomical postures on the left to the hyperlordotic postures on the right. Note how the muscles of the lower cross contribute to the increased lordotic curve and anterior pelvic tilt.

Box 8-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN HYPERLORDOSIS

Trunk (at Lumbar Spine)

Flexion 50–60°
- Rectus abdominis
- External oblique (bilateral)
- Internal oblique (bilateral)

Extension 25°
- Spinalis (bilateral)
- Longissimus (bilateral)
- Iliocostalis (bilateral)
- Multifidi (bilateral)
- Rotatores (bilateral)
- Quadratus lumborum (bilateral)
- Latissimus dorsi (with arm fixed)

Lateral Flexion 25°
- Spinalis (unilateral)
- Longissimus (unilateral)
- Iliocostalis (unilateral)
- External oblique (unilateral)
- Internal oblique (unilateral)
- Quadratus lumborum (unilateral)
- Latissimus dorsi (unilateral)

Ipsilateral Rotation 20°
- Internal oblique (unilateral)

Contralateral Rotation 20°
- External oblique (unilateral)
- Multifidi (unilateral)
- Rotatores (unilateral)

Pelvis

Anterior Tilt (downward rotation) (Angle from PSIS to ASIS) 0–10°
- Rectus femoris
- Iliacus
- Sartorius
- Tensor fasciae latae

Posterior Tilt (upward rotation) (Angle from PSIS to ASIS) 0–10°
- Biceps femoris
- Semitendinosus
- Semimembranosus

Lateral tilt (elevation) 0°
- Latissimus dorsi (unilateral)
- Quadratus lumborum (unilateral)

Hip

Flexion 110–120°
- Rectus femoris
- Tensor fasciae latae
- Sartorius
- Psoas major
- Iliacus
- Gluteus minimus
- Gluteus medius (anterior fibers)
- Adductor magnus (anterior fibers)
- Adductor longus
- Adductor brevis
- Pectineus
- Gracilis

Extension 10–15°
- Gluteus maximus
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gluteus medius (posterior fibers)
- Gluteus minimus (posterior fibers)
- Adductor magnus (posterior fibers)

Lateral Rotation 40–60°
- Gluteus maximus
- Gluteus medius (posterior fibers)
- Gluteus minimus (posterior fibers)
- Piriformis
- Quadratus femoris
- Obturator internus
- Obturator externus
- Gemellus superior
- Gemellus inferior
- Sartorius
- Biceps femoris (long head)
- Psoas major
- Iliacus

Medial Rotation 30–40°
- Gluteus medius (anterior fibers)
- Gluteus minimus (anterior fibers)
- Semitendinosus
- Semimembranosus
- Tensor fasciae latae
- Gracilis

Abduction 30–50°
- Gluteus medius
- Gluteus minimus
- Tensor fasciae latae
- Sartorius
- Gluteus maximus
- Piriformis (with flexed hip)

Adduction 30°
- Adductor magnus
- Adductor longus
- Adductor brevis
- Pectineus
- Gracilis
- Gluteus maximus (low fibers)
- Psoas major
- Iliacus

Knee

Flexion 120–150°
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Gastrocnemius
- Popliteus
- Plantaris

Extension 0–15°
- Rectus femoris
- Vastus lateralis
- Vastus medialis
- Vastus intermedius

Medial Rotation (When Flexed) 20–30°
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Popliteus

Lateral Rotation (When Flexed) 30–40°
- Biceps femoris

SPECIAL TESTS

The following special tests can help you to determine which muscles are contributing to pain and when a client should be evaluated by a medical professional using X-ray or other tools, which may reveal conditions that are contraindications for massage or require special considerations when planning treatment with massage.

The **Valsalva maneuver** may reveal a herniated disc, tumor, or other factor that increases pressure on the spinal cord. This test is used when the client complains of pain in a localized area along the spine, particularly when coughing or sneezing. A herniated disc does not contraindicate massage, but this test is not specific for the cause of increased pressure. For this reason, it is best to refer the client to a health care provider for further testing before performing the massage. To avoid even a temporary reduction in circulation, do not perform this test if the client has tested positive for vertebral artery insufficiency or has a cardiovascular disorder.

1. With the client seated and facing you, ask him or her to take a deep breath and then attempt to forcefully exhale against the closed throat (such as when forcing a bowel movement).
2. The test is positive if the client feels pain in a localized spot along the spine.

Kemp's test may reveal a disc lesion or irritation of the facet joint in the lumbar spine. Neither of these contraindicates massage, but it is best to understand the extent of damage and to be sure that these are not signs of something more serious before performing any deep tissue treatments.

1. With the client standing, ask him or her to slowly extend, laterally flex, and rotate the spine to the affected side as if reaching for the heel (Fig. 8-5). This action increases stress on the nerve root and facet joints.
2. The test is positive for nerve root irritation if the client feels radiating pain or numbness and tingling in the affected leg. Ask the client to describe the area of symptoms to help you determine which nerve root is affected.
3. The test is positive for facet joint irritation if pain is localized along the lumbar vertebrae. Very localized symptoms may help you to determine which vertebrae are affected.

The **Stork test** is intended to assess sacroiliac joint mobility.

1. The client should be standing near a stable surface or wall that he or she can lean on to maintain balance during the test.
2. Begin on the side you suspect is dysfunctional, and then compare the results of both sides.
3. Kneel or sit behind the standing client with one thumb on the posterior superior iliac spine of the affected side and the other thumb on the sacrum at the same level.
4. Instruct the client to flex the hip and knee on the affected side within his or her comfort range. Notice the relative movement of your thumbs while the client flexes the hip (Fig. 8-6).
5. When the sacroiliac joint is normally mobile, the ilium should rotate posteriorly, moving the thumb on the posterior superior iliac spine inferior. The test is positive for decreased sacroiliac joint mobility if the thumb on the posterior superior iliac spine moves superiorly while the client flexes the hip.

The **Thomas test** is intended to assess the client for shortened hip flexors. This test may not be comfortable for clients with severe low back pain.

1. Instruct the client to sit at the edge of the massage table so that the legs can hang freely, then assist the client to lie back.
2. Ask the client to flex one hip by bringing the knee toward the chest (Fig. 8-7). The unflexed hip is the one being tested. If you suspect that one side is primarily responsible for symptoms, instruct the client to flex the unaffected hip first.
3. If the hip flexors are shortened, the straight leg (the affected side) will come off the table, unable to extend fully because the hip flexors are unable to lengthen fully. If the rectus femoris is short and cannot lengthen fully, the knee of the affected leg will be slightly extended. These results indicate a positive test.
4. To assess the degree of the increased lumbar curve and anterior pelvic tilt caused by tight hip flexors, try to slip your hand under the lumbar curve. If your hand moves in easily, this is a sign that the extension of the hips increases the lumbar curve and anterior pelvic tilt because the hip flexors cannot lengthen fully.
5. Repeat the test on the unaffected side for comparison. Although the client may feel symptoms only on one side, these muscles may be short on both.

Figure 8-5 Kemp's test. With the client standing, ask him or her to slowly extend, laterally flex, and rotate the spine to the affected side as if reaching for the heel.

Figure 8-6 Stork test. Assess the mobility of the sacroiliac joint with the Stork test.

Figure 8-7 Thomas test. Assess the involvement of the hip flexors with the Thomas test.

PALPATION ASSESSMENT

Palpate the muscles of the lower cross to assess for hyper- and hypotonicity and myofascial restrictions. You are likely to find myofascial restrictions across the anterior aspect of the hip joint, from the iliac crest down into the quadriceps as well as along the posterior iliac crests and into the thoracolumbar fascia. Shortened, hypertonic muscles that may contain trigger points include the iliacus, psoas major, rectus femoris, sartorius, and tensor fasciae latae anteriorly; posteriorly, these muscles include latissimus dorsi, the lumbar erector spinae and quadratus lumborum. If the client presents with lateral rotation in the hips, assess the lateral rotators of the hips including the piriformis, quadratus femoris, obturator internus and externus, and the gemellus superior and inferior (see chapter 9). While the superficial gluteals may be stretched in clients with hyperlordosis, the deeper gluteal muscles with varied functions may be tight and adhered. If the client presents with an elevated iliac crest or lateral flexion of the thorax or lumbar spine, assess the latissimus dorsi, internal and external obliques, serratus posterior inferior, and the thoracic erector spinae on the affected side. A compromised serratus posterior inferior can also affect respiration. Although the focus here is on the muscles that are directly related to the postural imbalance occurring in hyperlordosis, it is essential to assess the synergists and antagonists in each ROM for these joints. For example, although the rectus femoris is a hip flexor involved in hyperlordosis, it also extends the knee. In this example, you may find adhesions between the rectus femoris, vastus lateralis, and vastus intermedius (see chapter 10). While the internal and external obliques both laterally flex the thorax to the same side, internal obliques rotate the thorax to the same side while external obliques rotate the thorax to the opposite side. When muscles are short or otherwise compromised, any of their actions may be compromised and any of the synergists and antagonists for each of their actions may be affected.

Overstretched muscles that may contain trigger points include the rectus abdominis, gluteus maximus (particularly the lower fibers), and the hamstrings. If lateral rotation of the hip is present, the adductor magnus, longus, and brevis as well as the gracilis, and pectineus may be overstretched and weak. However, if the adductors are regularly recruited to maintain posture or are overworking to antagonize lateral rotation, they may be hypertonic.

Condition-Specific Massage

Because hyperlordosis may have a structural cause, it is essential to understand the client's health history before initiating treatment. If a systemic condition or a degenerative bone or disc disease is present, discuss treatment with the client's health care provider and adjust the treatment accordingly. If hyperkyphosis, piriformis syndrome, patellofemoral syndrome, or plantar fasciitis is present, refer to Chapters 4, 9, 10, and 11, respectively, for special testing and consideration of neuromuscular characteristics.

It is essential for the treatment to be relaxing. You are not likely to eradicate the pain associated with hyperlordosis or any of the associated conditions in one treatment. Do not try to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure you are applying keeps him or her from relaxing fully. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised.

Ask the client to let you know if any part of your treatment reproduces symptoms, and always work within his or her tolerance. When deep palpation of a trigger point reproduces symptoms, explain this to your client and ask him or her to breathe deeply during the technique. As the trigger point is deactivated, the referral pain will also diminish. Common trigger points and their referral points are shown in Figure 8-8.

If any other symptoms are reproduced, adjust the client to a more neutral position, reduce your pressure, or move slightly off the area, and make a note about it because this may help you understand more clearly exactly which neuromuscular condition is contributing to the client's symptoms. Instruct your client to use deep but relaxed breathing to assist in relaxation.

Figure 8-8 **Common trigger points and referral.** Common trigger points associated with hyperlordosis and their referral patterns.

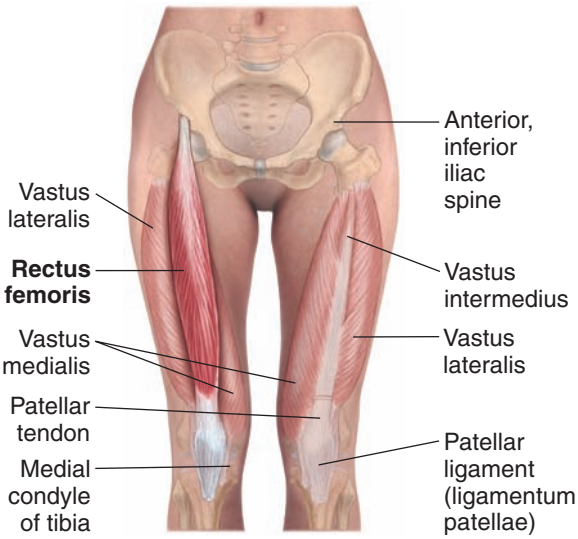
The following suggestions are for treatment that considers several factors involved in hyperlordosis. Because several joints and many muscles are involved in this condition, your treatment will likely fill the entire session.


- Begin in the supine position with the knees bolstered.
- If you have access to moist heat, place it on one rectus femoris. After heating one rectus femoris, move the heat to the other side, and begin treating the heated side. After heating the other rectus femoris, you can move the heat to the abdomen.

- Before applying emollient, assess the tissues of the leg and hip for myofascial restrictions, and release them if indicated. A common area of myofascial restriction with hyperlordosis is found where the hip flexor tendons cross the hip joint. You may also find adhesions along the iliac crests. If the rectus femoris is shortened, you may find adhesions anywhere along its length, and it may be adhered to any of the muscles that surround it.

- Treat the thigh generally to soften tissues and reduce hypertonicity.

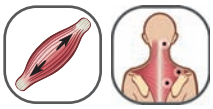
Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area



RECTUS FEMORIS

Origin	*Anterior inferior iliac spine.*
Insertion	*Tibial tuberosity.*
Action	*Flex hip, extend knee, anterior pelvic tilt.*
Nerve	*Femoral.*

Figure 8-9 Rectus femoris. A short, tight rectus femoris contributes to hip flexion and anterior pelvic tilt. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



- Apply lengthening strokes along the rectus femoris and assess for trigger points (Fig. 8-9). Note the varied fiber directions of the rectus femoris. Treat the trigger points if any are found. Common trigger points in the rectus femoris are found near the superior tendon and refer pain along the muscle into the knee.

- Treat the tensor fasciae latae (Fig. 8-10) for hypertonicity and trigger points if found. Because this area may be sensitive or ticklish, begin slowly with firm (not deep) strokes. Trigger points in the tensor fasciae latae refer pain along the iliotibial band.

- If your assessment revealed shortened or hypertonic adductors or iliotibial band, treat these. Assess and treat any trigger points found.

- Passively Stretch any muscles treated for trigger points.

- Before treating the iliopsoas, warm the abdominals to be certain that the superficial tissues are prepared to allow you to access the deeper tissues (Fig. 8-11). When warming the abdomen, it is important to work in a clockwise direction to move the contents of the intestines toward the rectum. Your client may feel the need to pass gas during this treatment. Instruct him or her not to hold this back because that would cause muscle tensing.

- With fingers resting on the medial aspect of the iliac crest, instruct the client to take a deep breath into the abdomen, and as he or she exhales, gently move into the iliac fossa to treat the iliacus (Fig. 8-12). The depth of your access into the iliac fossa will depend on the texture of the tissues surrounding it. If you cannot access the fossa, spend a little more time on softening the superficial tissues and try again. Trigger points in the iliacus refer pain into the quadriceps area and into the low back and gluteal muscles.

- Treating the psoas directly requires proficiency in the anatomy of the abdomen. There are many vessels and viscera that could be damaged when deep pressure is applied to the abdomen, and it is essential to know which structures you may be compressing as you

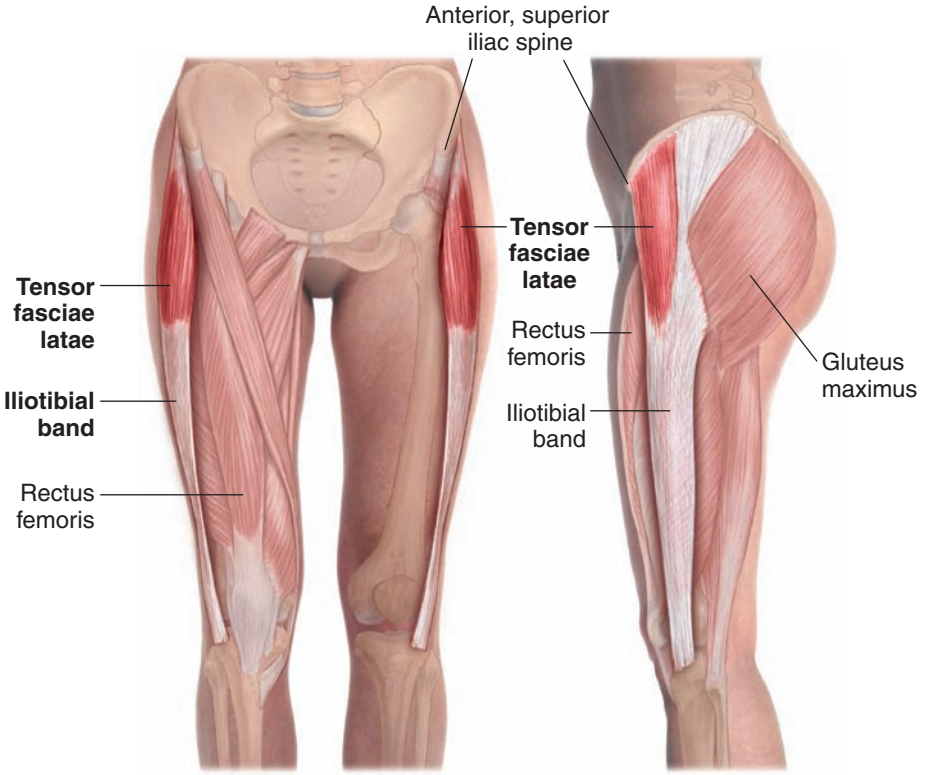


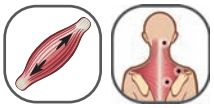
Figure 8-10 Tensor fasciae latae. When the hips are flexed, the tensor fasciae latae and iliotibial band may become shortened and hypertonic. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

TENSOR FASCIAE LATAE

Origin	*Outer surface of anterior superior iliac spine, outer lip of anterior iliac crest.*
Insertion	*Lateral condyle of tibia via the iliotibial band.*
Action	*Flex hip, medially rotate hip, abduct hip, anterior pelvic tilt.*
Nerve	*Superior gluteal.*

approach the psoas. If you have not had detailed instruction on safely accessing the psoas or do not feel familiar enough with abdominal anatomy to avoid vessels and organs, stretch the psoas by extending the hip when the client is prone.

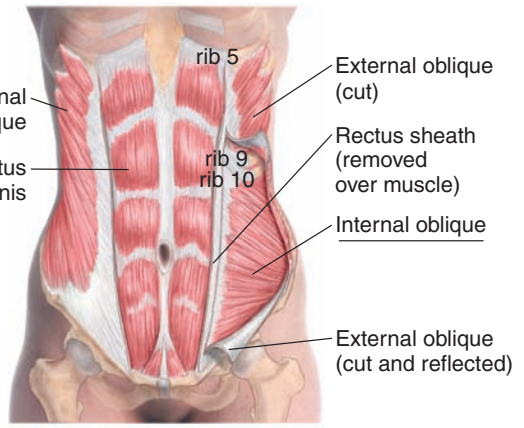
- If you have had training in safely accessing the psoas, assess it, and treat it for hypertonicity and trigger points. One safe way to access the psoas is by placing your fingers at the level of the iliac crests and, very slowly, move medially toward the psoas. When you believe you have reached the psoas, ask the client to flex the hip and feel for a contraction.



- To ensure that the client has control over the amount of movement and pressure applied in the abdomen, ask him or her to slowly flex and extend the hip and feel the psoas move under your fingers. If the client reports nausea, pain, or other sensations that may suggest compression of a vessel or organ, discontinue treatment of the psoas, and give the client a minute to breathe and relax.

- Turn the client prone and bolster the ankles. Stretch the rectus femoris and iliopsoas by performing passive hip extension if this does not reproduce symptoms. If you notice the client's hip rotating or elevating during the stretch, stabilize the sacrum and ilium with the palm of your free hand while extending the hip. If hip extension causes pain beyond the client's tolerance, try to stretch the rectus femoris alone by flexing the knee. Apply postisometric relaxation techniques to the hip within the client's tolerance to encourage the lengthening of the hip flexors.

- Assess and treat any myofascial restrictions found in the thoracolumbar fascia before applying lotions to the back.



RECTUS ABDOMINIS

Origin	*Pubic crest, pubic symphysis.*
Insertion	*Cartilage of ribs 5, 6, and 7, xiphoid process.*
Action	*Flex trunk, posterior pelvic tilt.*
Nerve	*Branches of intercostal nerves.*

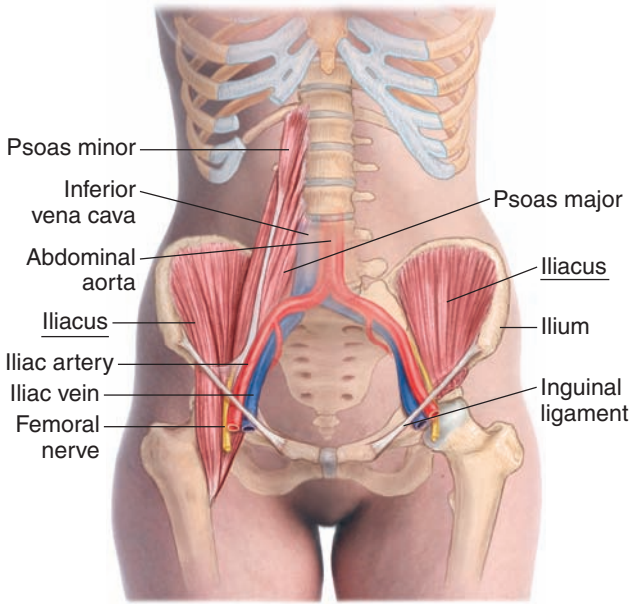
EXTERNAL OBLIQUES

Origin	*Lower 8 ribs.*
Insertion	*Anterior iliac crest, abdominal aponeurosis to linea alba.*
Action	***Unilaterally**: lateral flexion of trunk, contralateral rotation of trunk, ipsilateral rotation of pelvis; **bilaterally**: flex trunk, compress abdominal contents, posterior pelvic tilt.*
Nerve	*Branches of intercostal nerves.*

INTERNAL OBLIQUES

Origin	*Lateral inguinal ligament, iliac crest and thoracolumbar fascia.*
Insertion	*Internal surface of lower three ribs, abdominal aponeurosis to linea alba.*
Action	***Unilaterally**: lateral flexion of trunk, ipsilateral rotation of trunk, contralateral rotation of pelvis; **bilaterally**: flex trunk, compress abdominal contents, posterior pelvic tilt.*
Nerve	*Branches of intercostal nerves.*

Figure 8-11 **Abdominals.** Warm the abdominals and assess for hypotonicity before accessing the psoas. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



ILIACUS

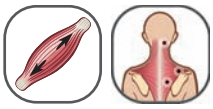
Origin	*Iliac fossa.*
Insertion	*Lesser trochanter of the femur.*
Action	*Flex hip, laterally rotate hip, adduct hip, anterior pelvic tilt.*
Nerve	*Femoral.*

PSOAS MAJOR

Origin	*Body and transverse processes of lumbar vertebrae.*
Insertion	*Lesser trochanter of the femur.*
Action	*Flex hip, laterally rotate hip, adduct hip, flex trunk, anterior pelvic tilt.*
Nerve	*Lumbar plexus.*

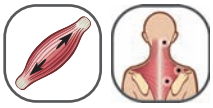
Figure 8-12 **Iliopsoas.** The iliacus and psoas may be short and hypertonic when hip flexion contributes to hyperlordosis. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Once you are ready to apply lotions, warm the full back. If the client has had symptoms in the upper back, treat these as thoroughly as time permits.

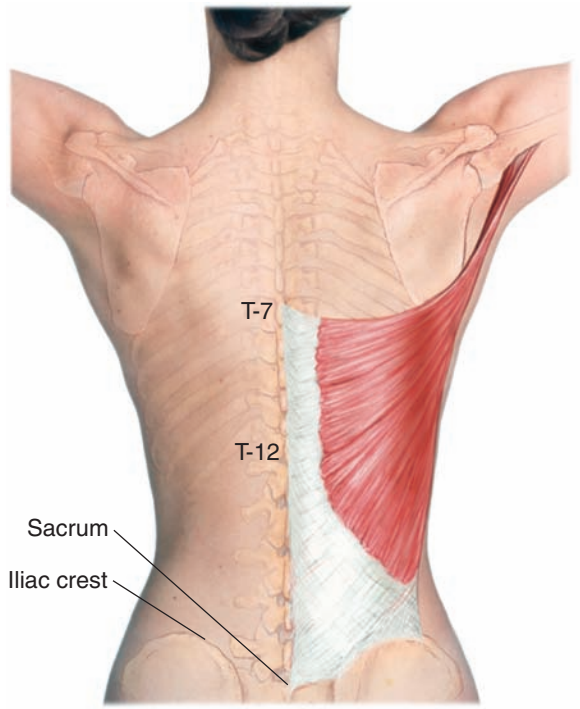


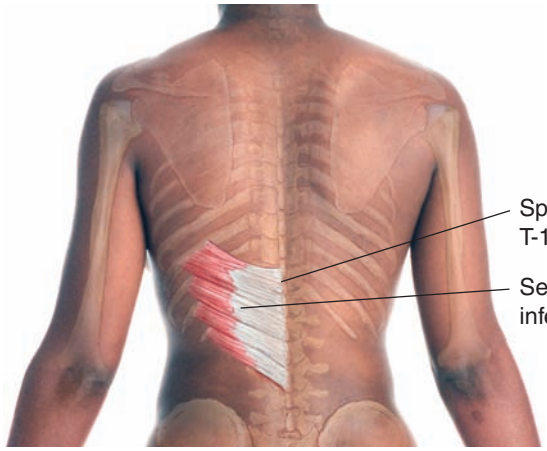
- Treat the latissimus dorsi and serratus posterior inferior for hypertonicity and trigger points (Fig. 8-13).

- Assess and treat the muscles of the lumbar spine. The attachment sites at the iliac crests, transverse and spinous processes, and lower ribs may be tender. Warm and soften the tissues attached to these bones to release tension in these muscles.



- Treat the bellies of the lumbar erector spinae and the deeper quadratus lumborum for adhesions, hypertonicity and trigger points (Fig. 8-14). Apply cross-fiber strokes to separate the fibers and open the area for deeper work. Treat trigger points if any are found. Follow this with lengthening strokes.





LATISSIMUS DORSI

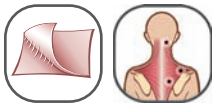
Origin	*SP of T7-12, ribs 8-12, thoracolumbar aponeurosis and posterior iliac crest.*
Insertion	*Crest of lesser tubercle of humerus.*
Action	*Extend, adduct and medially rotate shoulder.*
Nerve	*Thoracodorsal.*

SERRATUS POSTERIOR INFERIOR

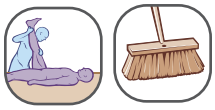
Origin	*Spinous process of T11-L3.*
Insertion	*Ribs 9-12.*
Action	*Depress the ribs during exhalation.*
Nerve	*Spinal nerves 9-12.*

Figure 8-13 **Latissimus dorsi and serratus inferior posterior.** The serratus inferior posterior draws the ribcage down and toward the ribcage, assisting in exhalation. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Once the erector spinae have softened and allow access to deeper tissues, apply lengthening strokes to the quadratus lumborum. Note the variety of fiber directions in the quadratus lumborum. Common trigger points in the quadratus lumborum are found in the angle formed by the twelfth rib and the spine, as well as in the flank midway between the twelfth rib and the ilium. Take care not to apply excessive force to the floating 11th and 12th ribs.



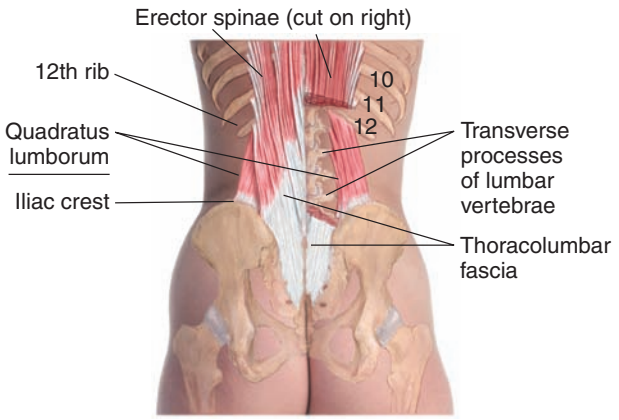
- Assess the hamstrings for adhesions and trigger points and treat if indicated (Fig. 8-15). It is likely that the hamstrings are overstretched and should not be stretched further by using muscle stripping.



- From the prone position, ask the client to use the arms to slowly move the body without stressing the low back, bringing the buttocks toward the ankles, to stretch the quadratus lumborum, erector spinae, and the latissimus dorsi (Fig. 8-16). When the client returns to the prone position, end with clearing strokes to the whole back.

- With the remaining time, consider the other possible conditions that may develop with hyperlordosis and treat these areas. External or internal rotation of the hip suggests treatment to the piriformis and other external rotators or the adductors, respectively. Flat feet suggest treatment to the muscles of the lower leg and feet. If hyperkyphosis is also present, refer to Chapter 4 for additional treatment. You may not have time to treat all of these fully, but you can pay attention to some of them in each session. As the signs and symptoms of hyperlordosis decrease, you can increase the amount of time you spend in other areas.

The treatment overview diagram summarizes the flow of treatment (Fig. 8-17).



QUADRATUS LUMBORUM

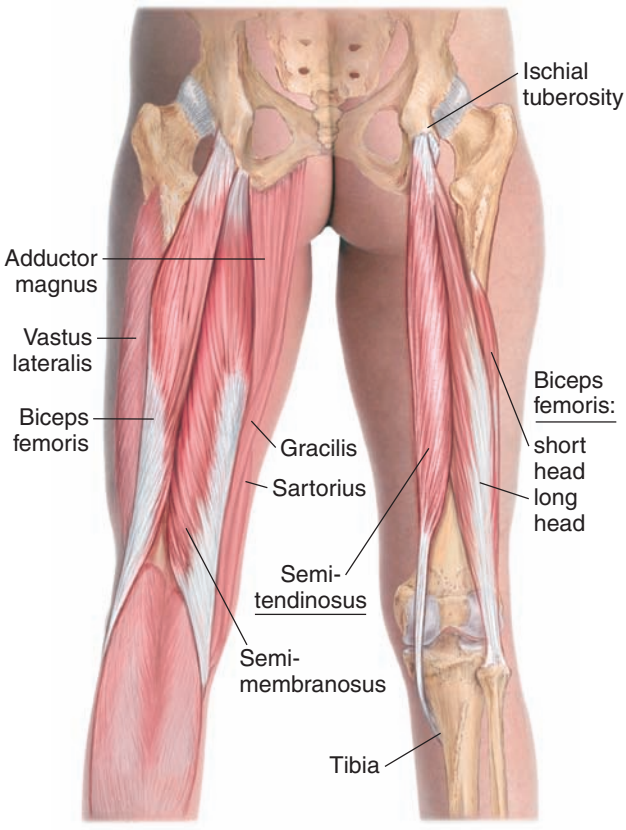
Origin	*Posterior iliac crest.*
Insertion	*Last rib, transverse processes of lumbar vertebrae 1-4.*
Action	***Unilaterally**: laterally tilt pelvis, laterally flex spine; **bilaterally**: extend spine, fix last rib during respiration.*
Nerve	*Branches of first lumbar and 12th thoracic.*

ERECTOR SPINAE

Origin	*Thoracolumbar fascia, posterior surface of sacrum, iliac crest, SPs of lumbar and a few of the inferior thoracic vertebrae.*
Insertion	*Posterior ribs, SPs and TVPs of vertebrae.*
Action	***Unilaterally**: lateral flexion of spine; **bilaterally:** extend spine.*
Nerve	*Dorsal primary divisions of spinal nerves.*

Figure 8-14 Quadratus lumborum and the lumbar erector spinae. Muscles that extend the lumbar spine may become short and hypertonic with hyperlordosis. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

Figure 8-16 Stretch quadratus lumborum and the lumbar erector spinae. Instruct the client to bring the buttocks toward the heels to stretch the quadratus lumborum and the erector spinae.



BICEPS FEMORIS

Origin	***Long head**: ischial tuberosity; **short head**: lateral lip of linea aspera.*
Insertion	*Head of fibula.*
Action	*Flex knee, laterally rotate flexed knee, extend hip, laterally rotate hip, tilt pelvis posteriorly.*
Nerve	*Tibial and peroneal.*

SEMITENDINOSUS

Origin	*Ischial tuberosity.*
Insertion	*Proximal, medial shaft of tibia at pes anserinus tendon.*
Action	*Flex knee, medially rotate flexed knee, extend hip, medially rotate hip, tilt pelvis posteriorly.*
Nerve	*Tibial.*

SEMIMEMBRANOSUS

Origin	*Ischial tuberosity.*
Insertion	*Posterior aspect of medial condyle of tibia.*
Action	*Flex knee, medially rotate flexed knee, extend hip, medially rotate hip, tilt pelvis posteriorly.*
Nerve	*Tibial.*

Figure 8-15 Hamstrings. Weak hamstrings cannot adequately oppose flexion of the hip and should be strengthened.

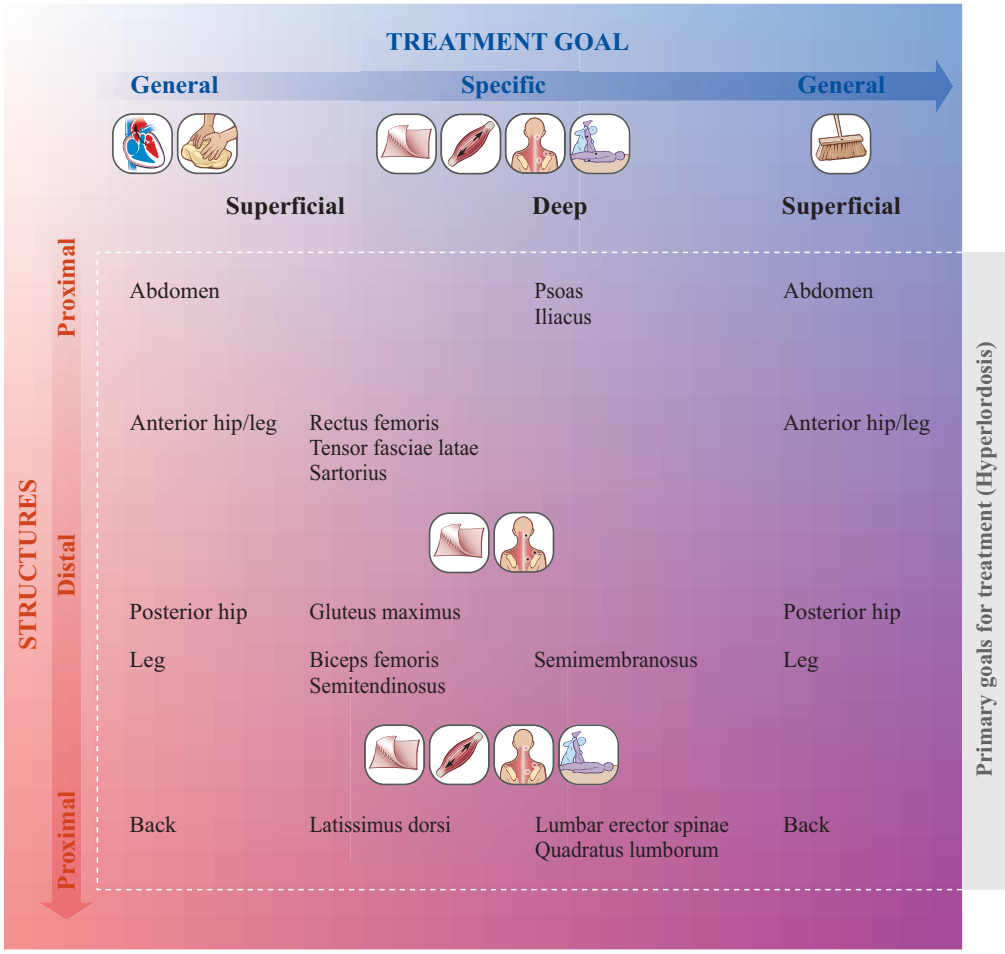


Figure 8-17 **Hyperlordosis treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating hyperlordosis.

CLIENT SELF-CARE

The following are intended as general recommendations for stretching and strengthening muscles involved in the client's condition. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises or do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines.

- Instruct the client to perform self-care throughout the day, such as while taking a phone call, reading e-mail, washing the dishes, or watching television, instead of setting aside extra time. When performing activities while standing, contracting the abdominal muscles or "sucking in the stomach" as well as tilting the pelvis posteriorly by squeezing the gluteal muscles may decrease pain and weakness in addition to toning these weakened muscles. This should be done only if it is comfortable and if it does not cause the client to breathe shallowly.

- Encourage the client to take regular breaks from repetitive actions.
- Demonstrate gentle self-massage to keep adhesions and hypertonicity at bay between treatments.
- Recommend that the client avoid sleeping with the hips flexed.
- Instruct the client on how to maintain proper posture in the standing and seated positions to keep pressure off the weakened joints. Sitting in a chair that supports the back and allows the client to rest the feet flat on the floor with the knees and hips flexed at approximately 90° may reduce muscle strain and stress on the joints.
- Instruct those whose exercise is focused on strengthening the quadriceps to stretch these and to strengthen the hamstrings by performing extensions of the hip, resisted or not, depending on their capability. Walking is a low-impact activity that helps keep the joints mobile.
- Instruct a client who regularly performs heavy lifting to bend the knees, and lift with the legs instead of the spine.
- Demonstrate all strengthening exercises and stretches and have the client perform these in your presence before leaving to ensure that he or she is performing them properly and will not harm himself or herself when practicing alone. Stretches should be held for 15–30 seconds and are performed frequently throughout the day, within the client's limits, during an active flare-up. The client should not force the stretch or bounce. Exercises should be slow, gentle, and steady while the client tries to keep every other muscle as relaxed as possible.

Stretching

Instruct the client to stretch his or her hip flexors by kneeling with one knee on a soft surface such as a pillow on the floor and the other foot on the floor with the hip and knee flexed (Fig. 8-18). The client should then slowly move the pelvis forward with the spine erect, lengthening the quadriceps and iliopsoas on the side of the unflexed hip. Switch legs to stretch the other side.

It is also important to reduce anterior pelvic tilt. While this may occur when lengthening the hip flexors, for some, it will be necessary to add a little push. Instruct the client, particularly when standing, to squeeze the gluteal muscles together toward the midline. This action will tilt the pelvis posteriorly while strengthening the gluteals.

To lengthen the lumbar erectors and quadratus lumborum, simple forward bends performed periodically throughout the day are helpful. To add an additional stretch with the pelvis stabilized and hip flexion minimized, instruct the client to stand approximately 12 inches from a wall with the dorsal surface of the hands along the edges of the sacrum as shown in Figure 8-19. With the hands on the sacrum, instruct the client to lean his or her back against a wall with the knees slightly bent. The hands help stabilize the sacrum and pelvis while the client extends the knees and slowly bends forward at the hips, stretching the low back.

Strengthening

While it may be important to strengthen the abdominal muscles for core strength, it is essential that these exercises do not include resisted flexion of the hips. Crunches are best performed with the knees bent to inhibit the hip flexors. While performing crunches this way, the client need not flex the thorax completely, since this might place strain on the low back. Small crunches held for 3–5 seconds will strengthen the abdominal muscles without undue stress on the lumbar spine.

Extension of the hip strengthens the hamstrings and gluteal muscles. The hamstrings are also strengthened by flexing the knee. These exercises can be performed while standing and leaning against a wall or other stable surface for balance or while positioned on the hands and knees (Fig. 8-20). An elastic band around the ankles can be used to add resistance within the client's tolerance.

Figure 8-18 **Hip flexor stretch.** Instruct the client to stretch the hip flexors by kneeling with one knee on a soft surface such as a pillow, placing the other foot on the floor with the hip and knee flexed; then slowly move the pelvis forward with the spine erect.

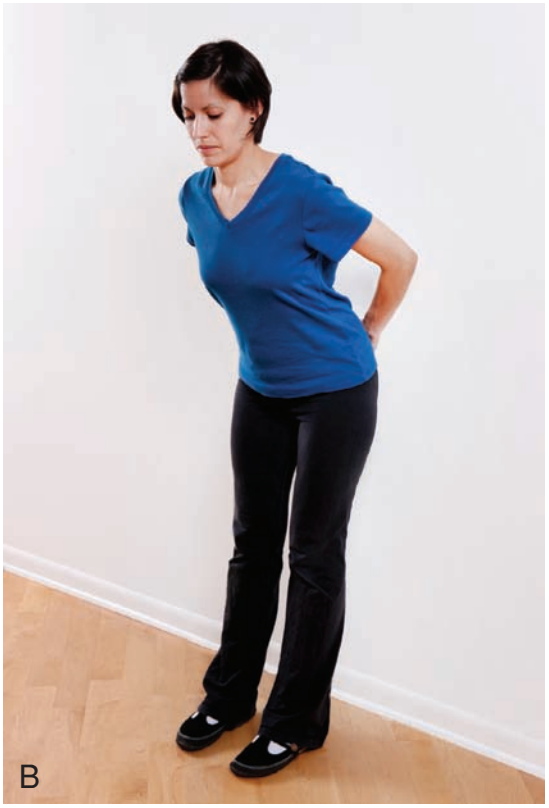


Figure 8-19 **Lumbar stretch.** Stabilize the sacrum while bending forward to stretch the low back muscles.

Figure 8-20 Strengthen hamstrings and gluteal muscles. Instruct the client to strengthen the hamstrings and gluteal muscles by extending the hip. This exercise will also stretch the hip flexors.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client with hyperlordosis will have treatments twice a week until the client can perform activities of daily living with minimal or no pain for at least 4 days. Reduce frequency to once per week until symptoms are absent for at least 7 days. When the client reports that he or she has been pain-free for more than 7 days, treatment can be reduced to twice per month. If the client is pain-free for 2 or more consecutive weeks, he or she can then schedule once per month or as necessary. With structural hyperkyphosis, treatment goals are limited to pain relief and minor increases in ROM, and these may be temporary. With functional hyperlordosis, there should be some improvement in both pain and posture with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting his or her activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest. Explain the importance of the client's participation in the healing process and encourage him or her to follow your recommendations, but be careful not to judge or reprimand a client who does not.
- The condition is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy altogether and hinder healing.
- The hyperlordosis is structural or there is an undiagnosed underlying condition. Discontinue treatment until the client sees a health care provider for a medical assessment, and work with the health care team to plan massage treatments.

If you are not treating the client in a clinical setting or private practice, you may not be able to take this client through the full program of healing. Still, if you can bring some relief in just one treatment, it may encourage the client to discuss this change with his or her health care provider and seek manual therapy rather than more aggressive treatment options. If the client returns for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on a specific area. Likewise, once you have treated the structures specific to hyperlordosis, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Tangelique is a 38-year-old married mother of two children. She cares for her children during the day, which includes home-schooling, and works evenings in a high-end department store, giving perfume samples to customers. In the past year, she has made the consumption of locally grown, whole foods a priority in her home after her husband received a diagnosis of diabetes. Prior to this, processed food and carbonated drinks had been common in their diet. She has had minor low back pain for years, but recently the pain has intensified, and she feels weak when standing for long periods.

Subjective

The client complained of low back pain and weakness when standing for more than 30 minutes. She has had minor back pain since her first pregnancy, and 2 weeks ago, she felt a sharp but diffuse pain across her low back when standing up from sitting. Since then she has had more severe back pain, sometimes causing her to hunch, and she feels weak after standing. She spends 4–6 hours each day home-schooling her children and 4 hours on 3 nights each week in a department store. When home-schooling, Tangelique is often seated for several hours at a time. At the department store, she stands the whole time and is required to wear contemporary fashions with high-heeled shoes.

The client reported no systemic conditions and is taking no medication currently. She reported having no abdominal pain or difficulty urinating or with bowel movements. When asked if she feels any numbness or tingling or has experienced any swelling in her legs, Tangelique stated only that on occasion she feels "electricity" on the front of her right leg. When asked if she wears hip huggers or tight belts low on the waist, she responded "Yes." The client is not currently pregnant, premenstrual, or menstruating.

Objective

Postural assessment revealed a significant increase in the lumbar curve with anterior pelvic tilt. She displayed a minor lateral rotation of hips bilaterally. Valsalva and Kemp's tests were negative for space-occupying lesions and disc involvement. The Stork test was negative for sacroiliac joint dysfunction. The Thomas test was positive for short hip flexors. Tinel's sign was positive for irritation of the femoral nerve. This may be due to compression by tight clothing around the hips.

Palpation revealed fascial restrictions across the hip joint bilaterally and into the quadriceps area on the right thigh. The thoracolumbar fascia is thickened and adhered. The rectus femoris is dense and adhered bilaterally, but particularly on the right. The right tensor fasciae latae and iliotibial band are tender and adhered. The client was ticklish near the iliac fossa initially but was able to relax enough to reveal hypertonicity in the iliacus. Moderate pressure to the psoas caused pain in the low back. The latissimus dorsi contained adhesions at the lateral ribcage bilaterally. The quadratus lumborum and the lumbar erector spinae are tender, hypertonic, and adhered.

Action

I began in the supine position with a bolster under the knees. I applied myofascial release to tissues across the anterior hip joint and leg, taking care not to compress the femoral nerve. I applied general effleurage and petrissage to the anterior leg followed by muscle stripping to the rectus femoris, vastus lateralis, tensor fasciae latae, and the iliotibial band. There was a trigger point in the superior aspect of rectus femoris that referred down into the anterior leg. The client stated that this referral was similar to the area where she occasionally felt "electricity." Muscle stripping did not reduce the referred pain. I followed two rounds of compression with effleurage, which reduced the referred pain from level 6 to 2. I then applied clearing strokes to the legs and the hips.

I applied slow but firm petrissage around the anterior iliac crest to reduce tickling followed by deep petrissage in the iliac fossa. The area was very tender to the client at first, but the tenderness reduced quickly as each

layer of tissue was released. No trigger points were found in the iliacus, and there was no reproduction of symptoms. I applied superficial, clockwise effleurage to the abdomen to warm the tissues. The psoas was hypertonic bilaterally, particularly on the right. I applied muscle stripping to the psoas in 1-inch increments. A trigger point was found in the mid belly of the right psoas, which referred into the back. Compression reduced the referred pain from level 8 to 6. I cleared the area, and then instructed the client to turn to the prone position, using the arms as much as possible to reduce the possibility of straining the low back.

I applied a passive stretch to the hip flexors bilaterally. I used myofascial release including skin rolling across the thoracolumbar fascia. I applied petrissage to the muscle attachment sites along the iliac crests, sacrum, and lower ribs. I also applied petrissage and firm effleurage to the latissimus dorsi bilaterally. No trigger points were found here. I used deep effleurage followed by muscle stripping to the lumbar erector spinae and quadratus lumborum. A trigger point was found in the mid muscle belly of the lateral portion of the right quadratus lumborum. Compression followed by muscle stripping reduced the referred pain from level 8 to 4. I cleared the area. I followed deep petrissage to the lateral rotators of the hip with a passive stretch.

Following treatment, the client reported feeling "looser" but stated that getting off the table did cause some discomfort in her low back.

Plan

I explained that the shortened hip flexors pull on the spine and pelvis when she stands because they are unable to lengthen fully. I demonstrated the stretches for the hip flexors and the lumbar spine. I demonstrated strengthening for hamstrings and abdominals but encouraged her to wait for 24–48 hours to see how she responded to treatment before stressing the low back with abdominal strengthening exercises. I advised her to proceed cautiously, with the hips and knees flexed, if she chose to do the strengthening exercises.

I explained that tight clothing around her ilia may be compressing the femoral artery, causing the "electricity" she feels. I suggested that she wear looser clothing or bands and belts that do not rest on the pelvis. I also explained that high heels may be contributing to the postural imbalance, although I understand that this is part of her uniform, and she may not be able to stop wearing them. I recommended wearing lower heels as much as possible and to practice posterior pelvic tilt and calf stretches after wearing high heels.

The client is unable to schedule treatments biweekly, but she scheduled one appointment for next week and stated that frequency will depend on financial restrictions. A sliding scale was offered if she felt she needed more frequent treatments, and I encouraged her to call if she had questions about more intensive self-care if she is unable to return regularly for treatment.

CRITICAL THINKING EXERCISES

1. Develop a 10-minute stretching and strengthening routine for a client that covers all of the muscles involved in hyperlordosis. Use Table 8-1, Box 8-1, and Figure 8-4 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles. Describe each step of the routine in enough detail that the client can refer to these descriptions in your absence and perform them without harm.
2. A client calls to schedule a massage for low back pain. She explains that she had a caesarian section 7 years ago that left a scar above her pelvis. Discuss the role her surgery may have had in the development of her chronic pain, the essential questions to ask her and her health care provider before initiating treatment, and the cautions and considerations to take when planning treatment.
3. In the assessment of a client with chronic low back pain, he tests negative for short hip flexors and has no anterior pelvic tilt. The client has a right rotation of the pelvis, his left hip is elevated, his thorax is flexed to the left, his right hip is laterally rotated, and his left ankle is everted. His left hamstrings are hypertonic compared to his right. Use Table 8-1 to determine

which muscles are short and which may be lengthened. Put yourself in this posture to figure out how this client's activities or posture may be contributing to his pain. Design a treatment plan describing massage therapy as well as self-care.

4. Conduct a short literature review to learn how the following conditions may put a client at greater risk for developing hyperlordosis:
   - Nerve root compression
   - Obesity
   - Rheumatoid arthritis
   - Vitamin D deficiency
   - Spondylolisthesis

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CHAPTER 9

Piriformis Syndrome

UNDERSTANDING PIRIFORMIS SYNDROME

Piriformis syndrome is a complex condition characterized primarily by myofascial pain with trigger points, which may involve nerve and vascular compression or sacroiliac joint dysfunction. Often, piriformis syndrome is reported as "sciatica," a general term referring to pain along the sciatic nerve, which can result from a variety of causes other than piriformis syndrome including a herniated disc, impingement of the nerve between bones, degenerative disc disease, spinal stenosis, tumors compressing the nerve, and trauma.

Because the piriformis muscle fits precisely in the greater sciatic foramen, increased tone and trigger points that shorten and increase the width of the muscle decreases the space available for the nerves that also pass through the foramen to function optimally. Normally, the sciatic nerve emerges from the sacrum and passes deep to the piriformis muscle. In a small percentage of the population, the sciatic nerve travels through the piriformis or the piriformis muscle is split into two bellies with the sciatic nerve running between them. Although the sciatic nerve is most often affected by piriformis syndrome, the gluteal and pudendal nerves may also become irritated. Compression can also affect the vasculature, reducing circulation and affecting the health of the structures supplied by those vessels.

The sciatic nerve exits the spine as five separate roots between L4 and S3. They converge into one large sciatic nerve at the greater sciatic foramen under the piriformis muscle. From here, the nerve curves toward the hip and passes between the greater trochanter and the ischial tuberosity, then down the middle of the thigh along the length of the femur (Fig. 9-1). The sciatic nerve innervates the skin of the leg and foot, as well as the hamstrings. Just above the knee, the nerve divides into the common peroneal and tibial branches. Generally, these branches innervate the muscles of the anterior and lateral leg and the top of the foot and the posterior leg and the bottom of the foot, respectively.

Muscles innervated by the sciatic nerve and its branches include the following:

- Adductor magnus, posterior head (sciatic nerve)
- Semitendinosus (sciatic nerve)
- Semimembranosus (sciatic nerve)
- Biceps femoris (sciatic nerve)
- Plantaris (tibial nerve)
- Gastrocnemius (tibial nerve)
- Soleus (tibial nerve)
- Tibialis posterior (tibial nerve)
- Flexor digitorum longus (tibial nerve)
- Flexor hallucis longus (tibial nerve)
- Peroneus longus (superficial peroneal nerve)
- Peroneus brevis (superficial peroneal nerve)
- Tibialis anterior (deep peroneal nerve)

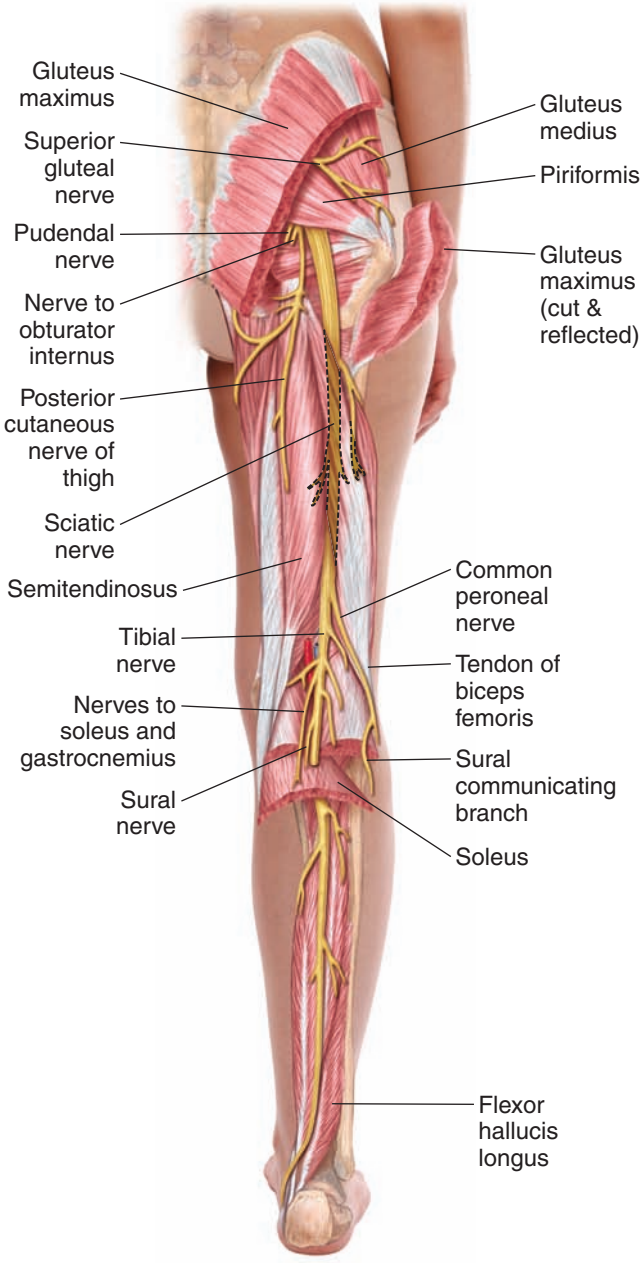


Figure 9-1 The sciatic nerve and its branches. The sciatic nerve passes under the piriformis muscle.

- Extensor digitorum longus (deep peroneal nerve)
- Extensor hallucis longus (deep peroneal nerve)
- Extensor digitorum brevis (deep peroneal nerve)
- Intrinsic muscles of the foot (medial and lateral plantar nerves)

Common Signs and Symptoms

The symptoms of piriformis syndrome usually begin gradually with pain in the low back, hip, or gluteal area. When the sciatic nerve is involved, radiating pain, numbness, or tingling is felt along the posterior thigh, calf, and foot. Active lateral rotation of the hip, which contracts the

piriformis, and active or passive medial rotation of the hip, which stretches the shortened piriformis, may compress the sciatic nerve and intensify symptoms. An absence of numbness and tingling may suggest that the nerves are not involved; this is referred to as non-neurogenic piriformis syndrome. In these cases, referred pain from trigger points as well as weakness due to compensation may present similarly, and the condition can progress to involve the nerves and vessels if the syndrome is not treated.

Trigger points in the piriformis refer pain into the low back, buttocks, hip, and superior posterior thigh. When one piriformis is short, the sacrum may shift laterally toward the affected side and rotate anteriorly, causing sacroiliac joint dysfunction and pain in the low back. In this case, the ilium may be elevated on the opposite side. Sciatic nerve compression may cause pain in the posterior thigh with pain, numbness, and tingling radiating into the leg and foot and impaired proprioception causing an irregular gait and balance. Gluteal nerve irritation may cause pain in the buttocks and atrophy of the gluteal muscles. Pudendal nerve irritation can cause groin and perineal pain, bowel or bladder dysfunction, sexual dysfunction, and impotence. Irritation to the pudendal nerve has also been associated with prostatitis in men.

Sitting, walking, and climbing stairs often worsens the pain. Sitting, particularly with the affected hip flexed and adducted, such as with the legs crossed, often increases pain. Any posture or activity that opposes abduction or lateral rotation, the actions of the piriformis, stretches the muscle and may increase symptoms. If the condition has become chronic or is combined with hyperlordosis, it may be difficult for the person to find a comfortable position when sitting or lying down. Lateral rotation of the hip may relieve symptoms, but maintaining this posture encourages the deviation by keeping the piriformis short and weakening the medial rotators of the hip, decreasing their ability to oppose lateral rotation. Anomalies in posture associated with changes in the piriformis muscle may also decrease mobility in the sacroiliac joint and lead to changes in the muscles that attach to the sacrum and ilium, namely the latissimus dorsi, the lumbar erector spinae, and quadratus lumborum.

The further the syndrome progresses, the greater is the chance that the nerves will become damaged, causing changes in the tone and strength of the muscles innervated by them. In chronic cases, the client may develop an unsteady gait and postural instability due to impaired proprioception and weakening of the muscles from the gluteal region down to the foot. One presentation of this impairment is drop foot or difficulty in dorsiflexing the ankle, which causes the foot to drag or strike hard onto the ground when walking. Chronic compression may also contribute to edema in the lower leg and pallor, cooling, or dryness in the skin of the buttocks and leg. Therefore, it is important for a person suffering from even mild symptoms of piriformis syndrome to be treated as soon as possible.

Possible Causes and Contributing Factors

The piriformis muscle is the biggest of the six lateral rotators of the hip. It originates on the anterior surface of the sacrum and inserts on the superior aspect of the greater trochanter. The piriformis laterally rotates the hip and abducts the flexed hip. The sciatic nerve becomes compressed when the piriformis is shortened; it can also become hypertonic and develop trigger points. The other lateral rotators, namely the quadratus femoris, obturator internus and externus, and the gemellus superior and inferior, are likely involved in the postural deviation and should also be treated.

Standing with one hip laterally rotated with the weight on one leg or squatting with the knees separated also shortens the lateral rotators (Fig. 9-2). Sitting with the knees widely separated—a common posture for pregnant women or clients with a large abdomen—abducts and laterally rotates the hip, and passively shortens the muscles that perform this action. Adding weight or resistance to any of these activities increases the risk of spasm and trigger points in the piriformis.

The piriformis is overactive when the client's posture involves medial rotation of the hips, valgus of the knees, and eversion of the ankle, a posture often referred to as "knock-kneed" (Fig. 9-3). In this posture, the lateral rotators are overstretched and overworked as antagonists to the medial rotation of the hips, particularly when walking, running, or climbing stairs. When hyperlordosis coexists with piriformis syndrome, muscles attached to the ilium, sacrum, and

Figure 9-2 Postural imbalance. Standing with one or both hips laterally rotated, particularly when the weight is shifted to one side, can contribute to shortening, trigger points, and spasm in the piriformis.

Figure 9-3 Knee valgus. With valgus of the knees and medial rotation of the hips, the piriformis may become overactive as an antagonist, resulting in taut bands and trigger points that can irritate the sciatic nerve.

femur work harder to stabilize the joints, which may increase tension. Any increase in the tone of the gluteal muscles may increase the possibility of the sciatic nerve becoming compressed between the piriformis and the pelvis. Postural deviations and the signs and symptoms of plantar fasciitis may also be found in clients with symptoms of piriformis syndrome when these deviations involve rotation of the hips. With each of the postural deviations and activities described above, adhesions and trigger points may develop, reducing the ROM of the hip and sacroiliac joints.

Try these positions yourself. Begin by standing in the anatomic position. Now, laterally rotate one or both hips. Notice changes in the pressure on your pelvis, hips, knees, and ankles. Walk forward, and notice which muscles are compensating. When you stop walking, with the hips still laterally rotated, stand with your weight on one leg and notice how your pelvis, sacrum, and hips feel. With the hips still laterally rotated, sit down. Notice how your spine and pelvis compensate for this posture. If you draw your knees closer together, can you feel a stretch in the piriformis?

Now, stand and medially rotate your hips. Notice the change in distance between your knees, the angle of your femur, and the eversion in your ankle. Did you increase flexion in your knees to keep from straining the joint? While maintaining these deviations, walk forward. Feel the stress on your gluteal muscles and lateral rotators, the relative restriction in the ROM in your hips, and the stress on your knee as you try to move fluidly.

Carrying bulky objects, such as a wallet in a back pocket, can also compress the piriformis and the sciatic nerve, causing irritation, inflammation, spasm, and trigger points. Wearing tight pants low on the hips can put pressure on the sacrum, compressing the sciatic nerve as well as

putting pressure on the lateral femoral cutaneous nerve at the anterior superior iliac spine, which may cause numbness and tingling in the anterior and lateral leg. Wearing high heels can contribute to atypical postures that contribute to hyperlordosis and piriformis syndrome. Dancers are often trained to adjust their posture to accentuate lateral rotation in the hips and plantar flexion of the ankle. A dancer who is still performing is unlikely to agree to therapy that restores a more balanced posture. The structures causing pain or other symptoms can be treated, although it may be necessary to omit any techniques intended to adjust posture, such as releasing deep fascial restrictions or fully lengthening the lateral rotators. In this case, the client is at risk for recurring symptoms.

Trauma, such as a fall or car accident, can cause inflammation of the piriformis, irritation to the nerves and vessels, and scar tissue formation. Trauma may also cause myositis ossificans—a calcification in the muscle that can induce symptoms of piriformis syndrome. Consult your pathology book for massage cautions and contraindications for clients with myositis ossificans. Other contributing factors include hip replacement, an aneurysm of the gluteal artery, degenerative disc disease, facet irritation, or bursitis at the greater trochanter. Consult the client's health care provider to determine the best treatment plan in these cases.

Other factors associated with nerve impairment include obesity, hypothyroid condition, arthritis, diabetes, gout, hormonal changes, lymphedema, rheumatoid arthritis, lupus, and Lyme disease. In these cases, the symptoms may quickly resolve once the associated condition is controlled. During pregnancy, body fluids and abdominal size increase while the center of gravity changes, which may contribute to compression that is likely to resolve after childbirth. Smoking cigarettes—although it is not a cause of piriformis syndrome—exacerbates the inflammatory process and thus can intensify the symptoms. Alcoholism, poor nutrition, vitamin B deficiency, and general stress may also contribute to nerve impairment.

Because so many potential factors contribute to peripheral neuropathies, it is essential to understand the client's health history before proceeding with treatment. Many of the conditions listed above involve contraindications for massage therapy or require adjustments to treatment. Moreover, when a systemic condition is a contributing factor for a peripheral neuropathy, particularly if that systemic condition is not being monitored by a health care provider, massage therapy alone may bring only temporary relief of symptoms. Refer the client to his or her health care provider for medical assessment if you suspect a systemic condition, and discuss massage treatment plans with the health care provider if such a condition is diagnosed.

Table 9-1 lists conditions commonly confused with or contributing to piriformis syndrome.

Contraindications and Special Considerations

First, it is essential to understand the cause of sciatic nerve symptoms. If a systemic condition is present, work with the client's physician, and consult a pathology text for massage therapists before proceeding. Following are a few general cautions:

- **Underlying pathologies.** Systemic conditions including diabetes, rheumatoid arthritis, and hypothyroidism may contribute to peripheral neuropathies. Spondylolisthesis or degenerative disc disease may be present. If you suspect an underlying condition (consult Table 9-1 and your pathology book for signs and symptoms), refer the client to his or her health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not contraindicated for massage, work with the health care provider to develop a treatment plan that is appropriate for that individual.
- **Endangerment sites.** Be cautious near endangerment sites in the popliteal and femoral areas.
- **Reproducing symptoms.** Symptoms may occur during treatment if you manually compress the sciatic nerve or if the client's posture causes anatomic structures to compress them. If treatment produces symptoms, first adjust the client to a more neutral posture. If this does not relieve the symptoms, reduce your pressure or move away from the area. You may be able to treat around the site that reproduced the symptoms, but proceed with caution.

Table 9-1 Differentiating Conditions Commonly Confused with or Contributing to Piriformis Syndrome

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Sacroiliac joint dysfunction	Pain in the low back, hip, or pelvis Postural deviations Atypical gait	Physical exam Stork (Gillet's) test Gaenslen's test Yeoman's test X-ray	Massage therapy is indicated when the cause is neuromuscular. Consult with the health care provider if an underlying cause is suspected.
Bursitis at greater trochanter	Aching in hip Pain worsens with movement or when lying on the affected side Feeling of swelling or fullness in the hip Skin is warm to the touch	Physical exam X-ray MRI	Massage therapy is systemically contraindicated if bursitis is due to infection. Massage is locally contraindicated in the acute stage to avoid increased swelling. In the subacute stage, massage to structures surrounding the joint is indicated.
Herniated lumbar disc	Muscle spasm Weakness or atrophy Low back pain Pain in buttocks, legs, and feet worsen when coughing, laughing, or straining Numbness and tingling in legs and feet	Physical exam including muscle reflexes and strength Straight leg raise test X-ray, CT, MRI, Electromyography (EMG) Myelogram	Massage therapy is indicated with caution and proper training. Work with the health care team.
Nerve root compression (radiculopathy)	Muscle spasm, weakness, or atrophy Pain radiates to the extremities	Kemp's test Valsalva's test Neurological exam to test reflexes, sensation, and strength	Massage therapy is indicated if the cause and location of the compression are understood. Take care not to increase the compression or reproduce symptoms.
Diabetes	Frequent urination, frequent thirst, increased appetite, fatigue, nausea	Physical exam Fasting blood sugar test	Massage therapy is indicated when tissues and circulation are not compromised.
Myositis ossificans	Local mass that is hard and tender Limited ROM in joint involved	Physical exam X-ray	Massage therapy is locally contraindicated to avoid increased bleeding. Working around the edges of the injury may stimulate reabsorption.
Lumbar spinal stenosis	Pain and cramping in the legs Radiating back or hip pain Numbness, tingling, or weakness in the leg or foot Balance disturbance Loss of bowel or bladder function	Physical exam Spinal X-ray MRI CT scan or myelogram Bone scan	Massage therapy is indicated with caution. Work with the health care provider. Client may receive corticosteroid injections or may be using anti-inflammatory medication.
Spondylolisthesis (begins in the lumbar region and proceeds to the thoracic spine)	Lumbar hyperlordosis Pain in low back, buttocks, and thighs Stiff back	X-ray Straight leg raise test	Massage is indicated. Stretching and strengthening are encouraged.

Table 9-1 Differentiating Conditions Commonly Confused with or Contributing to Piriformis Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Spinal or sciatic tumors	Pain in the back, hips, legs, and feet Loss of sensation or weakness in legs Difficulty walking Decreased sensitivity Loss of bowel or bladder function Varying degrees of paralysis Scoliosis or spinal deformity	MRI CT scan PET scan CBC Myelogram Biopsy	Refer to the health care provider if you suspect a tumor. Work with the health care provider if a tumor is diagnosed. Recommendations for massage depend on the type and location of the tumor.
Pudendal nerve irritation	Pain in the groin, genitals, and rectum Constipation Pain and straining during bowel movements Straining or burning when urinating Painful intercourse Sexual dysfunction	Pudendal nerve motor latency test (PNMLT) Electromyography (EMG) Diagnostic nerve blocks Magnetic resonance neurography (MRN)	Often the muscles of the pelvic floor are involved. Massage is indicated when treatment of these muscles is within the scope of practice for massage therapists. Work with the health care provider.

- **Treatment duration and pressure.** If the client is elderly, has degenerative disease, or has been diagnosed with a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better.
- **Positioning.** Use bolsters to position a client for comfort as well as to reduce postures that reproduce symptoms. In the supine position, reducing lateral rotation of the hips by placing bolsters at the lateral knee helps to keep the muscle closer to anatomic length and may facilitate access to the piriformis. If hyperlordosis is present, see Chapter 8 for guidelines.
- **Friction.** Do not use deep frictions if the client has an inflammatory condition such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised, or if the client is taking anti-inflammatory medication. Friction creates an inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours prior to treatment if the health care provider agrees.
- **Injections.** If the client has had a steroid, Botox, or analgesic injection within 2 weeks of treatment, avoid that area. These injections reduce sensation and alter the physiology of the muscle, which may prevent the client from assessing your pressure adequately.
- **Tissue length.** It is important when treating myofascial tissues that you do not further lengthen those that are already stretched. Assess for myofascial restrictions first and treat only those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. If you treat trigger points in overstretched tissue, use heat or a localized pin and stretch technique instead of full ROM stretches.
- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Massage Therapy Research

A thorough literature review identified no peer-reviewed studies specifically on the benefits of massage therapy for piriformis syndrome. Much of the literature on the use of manual therapy to treat piriformis syndrome is found in textbooks and originates in other disciplines such as physical medicine, physical therapy, and chiropractic care. A closer examination is needed of the benefits of massage therapy applied to lengthen the tissues that are shortened and hypertonic along with self-care intended to strengthen the muscles that are lengthened and weak.

Several literature reviews explore the use of physical or manual therapy for relieving piriformis syndrome symptoms, although none of these offer specific treatment plans, and most cases involved surgery, Botox or other injections, and other interventions that include manual therapy only in an adjunctive role. The work of Travell and Simons (1999) explaining the role of trigger points in developing piriformis syndrome is sometimes mentioned, but the usual therapeutic intervention described to relieve trigger points is vapocoolant spray. "Massage Therapy and Restless Legs Syndrome" by Meg Russell (2007) mentions a relationship between piriformis syndrome and restless leg syndrome, but that study does not focus on symptoms specific to piriformis syndrome. In 2006, Peggi Honig received the Runner-Up Award from the Massage Therapy Foundation's Student Case Report Contest for her study, "A Case Report of the Treatment of Piriformis Syndrome: Applying Modalities of Therapeutic Bodywork." That study describes the case of a 43-year-old female with a history of chronic pain for a few years prior to this case study, whose symptoms of piriformis syndrome were reduced following massage therapy. Although the case study is unpublished, and a more comprehensive design may result in more conclusive findings, its outcome is encouraging.

WORKING WITH THE CLIENT

Client Assessment

The symptoms of piriformis syndrome can be confused with more serious conditions, and a wide variety of possible factors can contribute to its development. All of these elements add up to many variations in how a client may present. For example, a client with lateral rotation of the hip who tends to stand with more weight on one leg may present with lateral flexion of the thorax, an elevated iliac crest, sacroiliac joint immobility, and rotation in the hips or spine affecting the latissimus dorsi, abdominal obliques, multifidi and rotatores, and the ligaments connecting the sacrum, pelvis, and spine. Hyperlordosis may also be present (see Chapter 8). What follows are common presentations for piriformis syndrome. However, it is essential to assess every involved joint to put together an accurate picture for each individual client.

Assessment begins with your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself.

Table 9-2 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to walk and enter the room ahead of you while you assess his or her posture and movements. Look for imbalances or patterns of compensation for deviations common with piriformis syndrome. Watch as the client climbs steps, looking for reduced mobility in the hips or whether the client favors one side. Assess for joint instability, limping, drop foot, lateral rotation of the hip, or hyperlordosis. Have the client sit to fill out the assessment form and watch to see if

Table 9-2 Health History

Questions for the Client	Importance to the Treatment Plan
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors. Radiating pain or numbness and tingling in the extremities indicate nerve involvement.
Describe what your symptoms feel like.	Differentiate between possible origins of symptoms, and determine the involvement of nerves or blood vessels.
Do any movements make it worse or better?	Locate tension, weakness, or compression in structures producing such movements.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Medical tests may reveal contributing factors as well as contraindications. If no tests were performed by the health care provider making a diagnosis, use the tests described later in this chapter for your assessment. If your assessment is inconsistent with the diagnosis, ask the client to discuss your findings with the health care provider or for permission to contact the provider directly.
Have you been diagnosed with a condition such as diabetes, osteoporosis, rheumatoid arthritis, or hypothyroid?	Systemic conditions may contribute to signs and symptoms, may require adjustments to treatment, and may impact treatment outcomes.
Have you had an injury or surgery or did your symptoms begin during a pregnancy?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM. Changes in posture during pregnancy may be a contributing factor.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions and static postures that increase lateral rotation or abduction of the hip may contribute to the client's condition.
Are you taking any prescribed medications or herbal or other supplements?	Medication of all types may contribute to symptoms or involve contraindications or cautions.
Have you had a corticosteroid, Botox, or analgesic injection in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours? medication.	Deep friction initiates an inflammatory response and should not be performed if the client has recently taken anti-inflammatory

he or she lowers into the chair cautiously or shifts around to find a comfortable position. Watch also as the client stands up to see if he or she is able to stand without assistance or if he or she lifts out of the chair using the arms or by leaning on a stable surface.

When assessing the standing posture, be sure that the client is standing comfortably and naturally. If he or she deliberately tries to stand in the anatomic position, you will not get an accurate assessment of his or her posture in daily life. In a postural assessment, you may notice a lateral rotation of the hips if the piriformis is short and hypertonic. Lateral rotation of one hip is often accompanied by rotation of the pelvis and slight flexion of that hip. The client may stand with the affected leg anterior to the unaffected leg so that one foot is in front of the other. Compensating patterns may include hyperextension in the knee of the unaffected leg, because the client shifts weight to that leg while favoring the affected hip. The client may also present with hyperlordosis; see Chapter 8 for postural assessment with hyperlordosis. If the client has sacroiliac joint dysfunction, he or she may have an elevated hip, rotation in the pelvis, or lateral flexion of the thoracic and lumbar spine. If the client's symptoms are due to overuse of the piriformis as an antagonist, you may observe medially rotated hips, knee valgus, and eversion of the ankle.

Figure 9-4 compares a healthy posture to a posture affected by piriformis syndrome due to short lateral rotators of the hip.

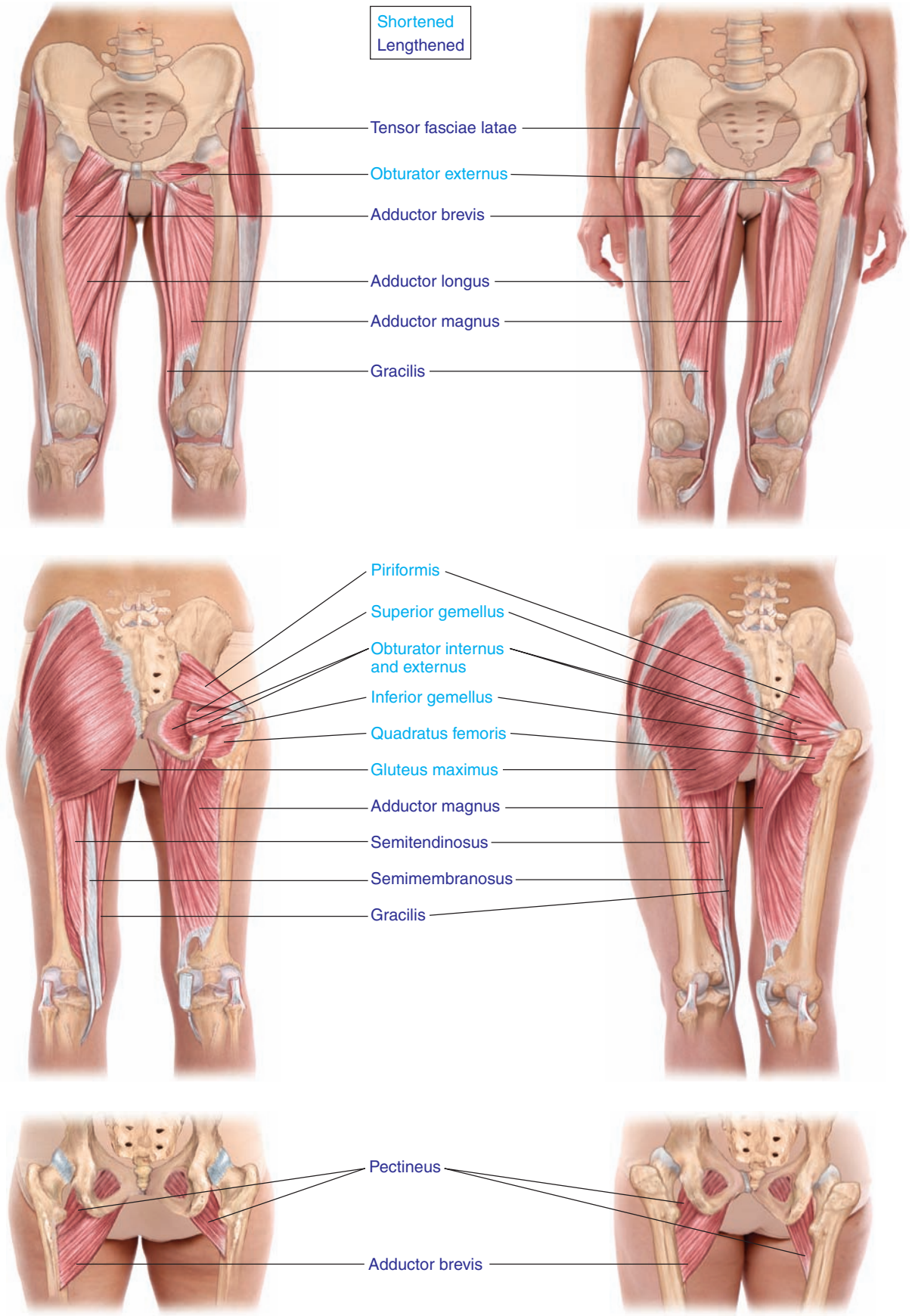


Figure 9-4 **Postural assessment comparison.** Compare the postures in these images. In the image on the right, note the lateral rotation in the right hip, tilting and rotation of the pelvis, and right lateral flexion of the thorax.

ROM ASSESSMENT

Test the ranges of hip motion that recruit the piriformis as either agonist or antagonist. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or re-injury. Box 9-1 presents the average active ROM results for the joints involved in piriformis syndrome.

Box 9-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN PIRIFORMIS SYNDROME

Hip

Flexion 110–120°
- Rectus femoris
- Gluteus medius (anterior fibers)
- Tensor fasciae latae
- Sartorius
- Psoas major
- Iliacus
- Gluteus minimus
- Adductor magnus
- Adductor longus
- Adductor brevis

Extension 10–15°
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gluteus maximus
- Gluteus medius (posterior fibers)
- Adductor magnus (posterior fibers)

Lateral Rotation 40–60°
- Biceps femoris
- Gluteus maximus
- Gluteus medius (posterior fibers)
- Sartorius
- Piriformis
- Quadratus femoris
- Obturator internus
- Obturator externus
- Gemellus superior
- Gemellus inferior
- Psoas major
- Iliacus

Medial Rotation 30–40°
- Semitendinosus
- Semimembranosus
- Gluteus medius (anterior fibers)
- Gluteus minimus
- Adductor magnus
- Adductor longus
- Adductor brevis
- Gracilis
- Pectineus
- Tensor fasciae latae

Abduction 30–50°
- Gluteus maximus
- Gluteus medius
- Gluteus minimus
- Tensor fasciae latae
- Sartorius
- Piriformis (with flexed hip)

Adduction 30°
- Adductor magnus
- Adductor longus
- Adductor brevis
- Pectineus
- Gracilis
- Psoas Major
- Iliacus
- Gluteus maximus (low fibers)

Trunk (at lumbar spine)

Flexion 50–60°
- Rectus abdominis
- External oblique (bilateral)
- Internal oblique (bilateral)

Extension 25°
- Spinalis (bilateral
- Longissimus (bilateral)
- Iliocostalis (bilateral)
- Multifidi (bilateral)
- Rotatores (bilateral)
- Quadratus lumborum (bilateral)
- Latissimus dorsi (with arm fixed)

Lateral Flexion 25°
- Spinalis (unilateral)
- Longissimus (unilateral)
- Iliocostalis (unilateral)
- External oblique (unilateral)
- Internal oblique (unilateral)
- Quadratus lumborum (unilateral)
- Latissimus dorsi (unilateral)

Ipsilateral Rotation 20°
- Internal oblique (unilateral)

Contralateral Rotation 20°
- Multifidi (unilateral)
- Rotatores (unilateral)
- External oblique(unilateral)

Knee

Flexion 120–150°
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Gastrocnemius
- Popliteus
- Plantaris

Extension 0–15°
- Rectus femoris
- Vastus lateralis
- Vastus medialis
- Vastus intermedius

Medial Rotation (when flexed) 20–30°
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Popliteus

Lateral Rotation (when flexed) 30–40°
- Biceps femoris

Ankle

Dorsiflexion 20°
- Tibialis anterior
- Extensor digitorum longus
- Extensor hallucis longus

Plantar flexion 50°
- Gastrocnemius
- Soleus
- Tibialis posterior
- Peroneus longus
- Peroneus brevis
- Flexor digitorum longus
- Flexor hallucis longus
- Plantaris

Inversion 45–60°
- Tibialis anterior
- Tibialis posterior
- Flexor digitorum longus
- Flexor hallucis longus
- Extensor hallucis longus

Eversion 15–30°
- Peroneus longus
- Peroneus brevis
- Extensor digitorum longus

Active ROM

Compare your assessment of the client's active ROM to the values in Box 9-1. Pain and other symptoms may not be reproduced during an active ROM assessment because the client may limit movement to a symptom-free range.

- **Active medial rotation of the hip** may be restricted and cause pain, numbness, and tingling when the piriformis is shortened.
- **Active lateral rotation of the hip** may reduce pain caused by medial rotation when the piriformis is short and tight. Although less common, active lateral rotation of the hip may be restricted or cause pain when the piriformis is overactive as an antagonist to the short and tight medial rotators of the hip or when it is recruited to stabilize the hip joint.
- **Active abduction of the hip.** If the piriformis is short and tight, active abduction of the hip may be weak, and the hip may laterally rotate during the movement. This test is best performed in the side-lying position.

Passive ROM

Compare the client's P ROM on one side to the other. Note and compare the end feel for each range (see Chapter 1 for an explanation of end feel).

- **Passive medial rotation of the hips** may be restricted and cause pain for a client whose posture or activities of daily living favor lateral rotation of the hips.
- **Passive lateral rotation of the hip** may reduce pain caused by medial rotation when the piriformis is short.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the hip joint. Compare the strength of the affected side to the unaffected side.

- **Resisted lateral rotation and abduction of the hip** may cause pain in the low back, buttocks, and hip and numbness and tingling in the leg and may reveal weakness in the piriformis. The client may rotate the pelvis to compensate.

SPECIAL TESTS

The following special tests help to determine which muscles are contributing to pain and whether the client should be evaluated by a medical professional using X-ray or other tools, which may reveal conditions that are contraindicated or require special considerations when planning treatment with massage.

The **Valsalva maneuver** may reveal a herniated disc, tumor, or other factor that increases pressure on the spinal cord and is used when the client complains of pain in a localized area along the spine, particularly when coughing or sneezing. A herniated disc does not contraindicate massage, but this test is not specific for the cause of increased pressure. For this reason, if Valsalva maneuver is positive it is best to refer the client to a health care provider for further testing before performing the massage.

1. To avoid even a temporary reduction in circulation, do not perform this test if the client has tested positive for vertebral artery insufficiency (see vertebral artery test in Chapter 4) or has cardiovascular disorders.
2. With the client seated facing you, ask them to take a deep breath and then attempt to forcefully exhale against the closed throat (such as when forcing a bowel movement).
3. The test is positive if the client feels pain in a localized spot along the spine. The client should be evaluated by a medical professional prior to receiving the massage.

The **piriformis length test** assesses the length of the piriformis.

1. The client should lie prone with the knees and feet together and the knees flexed to 90°.
2. Instruct the client to keep the knees together while allowing the feet to fall naturally, unforced, to either side, which will medially rotate the hips and lengthen the piriformis (Fig. 9-5).

Figure 9-5 Piriformis length test. The piriformis is short on the left side, as noted by restricted medial rotation.

Figure 9-6 Pace test. Ask the client to abduct the hips against your resistance to test the strength of the piriformis.

3. Compare the distance that each leg has moved from the midline. Notice whether one has moved further than the other.
4. The test is positive for a shortened piriformis on the side with less movement from the midline.

The **Pace test** is intended to assess the strength of the piriformis.

1. The client should be supine or seated with the knees placed together.
2. Place your hands on the sides of both knees, and ask the client to push the knees apart (abduct) against your resistance (Fig. 9-6).
3. Note weakness on either side. If the syndrome is unilateral, abduction on the affected side will be weaker than on the unaffected side.

The **stork test** is intended to assess sacroiliac joint mobility.

1. The client should stand near a stable surface or wall against which he or she can lean to maintain balance during the test.
2. Begin on the side you suspect is dysfunctional, but it is best to compare the results of both sides.
3. Kneel or sit behind the standing client with one thumb on the posterior superior iliac spine of the affected side and the other thumb on the sacrum at the same level.
4. Instruct the client to flex the hip and knee on the affected side to 90° or within his or her comfort range (Fig. 9-7). Notice the relative movement of your thumbs as the client flexes the hip.
5. When the sacroiliac joint is normally mobile, the ilium should rotate posteriorly, moving the thumb on the posterior superior iliac spine inferiorly. The test is positive for decreased sacroiliac joint mobility if the thumb on the posterior superior iliac spine moves superiorly as the client flexes the hip.

PALPATION ASSESSMENT

Assess the low back, gluteal area, and affected leg for atypical temperature, color, and texture. Compression of the sciatic nerve or the vessels feeding the soft tissues may cause cool skin, swelling, boggy texture, and even reduced hair growth. You may find adhesions around the attachment sites of the gluteal muscles and the lateral rotators of the hips. If bursitis is a contributing factor, the area around the greater trochanter may be hot and tender.

Palpate the gluteal muscles and the lateral rotators of the hip for tenderness, tone, and trigger points. Trigger points in the piriformis refer into the gluteal area and down the posterior thigh. If hyperlordosis is also present, see Chapter 8 for palpation guidelines.

If the client presents with an elevated iliac crest, sacroiliac joint dysfunction, or lateral flexion of the thorax or lumbar spine, assess the latissimus dorsi, quadratus lumborum, internal and external

Figure 9-7 Stork test. Assess the mobility of the sacroiliac joint with the stork test.

obliques, and thoracic and lumbar erector spinae. Although the focus here is on the muscles that are directly related to the postural imbalance seen in piriformis syndrome, it is essential to assess the synergists and antagonists in each ROM for these joints. For example, although the piriformis is a lateral rotator of the hip, it also abducts the hip. When it is short or otherwise compromised, any of its actions may be compromised, and any of the synergists and antagonists for each of its actions may be affected. In this example, you may find adhesions in the gluteal muscles and the lateral rotators. The biceps femoris, sartorius, and iliopsoas, which laterally rotate the hip, may also be short, adhered, or hypertonic. The medial rotators of the hip may be stretched due to the postural imbalance favoring lateral rotation and taut as a result of overwork as antagonists to lateral rotation. Overstretched muscles that may be adhered and contain trigger points include the semimembranosus, semitendinosus, adductor magnus, adductor longus, adductor brevis, gracilis, and pectineus.

Condition-Specific Massage

Since the causes of pain, numbness, and tingling in the low back and leg vary widely, the exact cause can be difficult to pinpoint and more than one condition may coexist. Systemic conditions such as diabetes may be a contributing factor to neuropathies and involve cautions or contraindications for massage therapy. If you feel uncertain whether the client's symptoms are caused by piriformis dysfunction, refer the client to his or her health care provider for medical assessment.

It is essential for the treatment to be relaxing. You are not likely to eliminate the symptoms associated with piriformis syndrome or any of the coexisting conditions in a single treatment. Do not attempt to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure you are applying keeps them from fully relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised. Ask the client to let you know if any part of your treatment reproduces symptoms, and always work within his or her tolerance. Deep palpation of a trigger point may cause pain at the upper end of the client's tolerance. Explain this to

Figure 9-8 **Common trigger points associated with piriformis syndrome and their referral patterns.**

your client, describe a pain scale, and suggest the level of pain that should not be exceeded; ask them to breathe deeply during the application of the technique. As the trigger point is deactivated, the referred pain will also diminish. Common trigger points and their referral patterns are shown in Figure 9-8.

If symptoms such as numbness and tingling are reproduced, you may be compressing the sciatic nerve. Adjust the client to a more neutral position, reduce your pressure, or move slightly off the area, and make a note about it, because this may help you understand more clearly exactly which neuromuscular condition is contributing to the client's symptoms.

The following are treatment suggestions for the more common presentation of piriformis syndrome caused primarily by the short, tight piriformis irritating the sciatic nerve. If the client has an acute injury, PRICE (protection, rest, ice, compression, and elevation) is the protocol. You may work conservatively proximal or distal to the site, but avoid the area of injury until the subacute or chronic stage.

- Begin with the client in a prone position with the ankles bolstered. If one or both heels of the feet fall closer to the midline than the toes, suggesting that the hip is laterally rotated, try to straighten the leg and minimize rotation by placing bolsters on the outside of the thigh just above the knee.

- Apply moist heat to the gluteal area of the affected side if indicated. If both sides are affected, move the heat to the gluteal area on the other side after heating the first.

- Use your initial warming strokes to superficially assess the tissues from the trunk down to the feet. You should be able to minimally assess the tissues of the mid and low back, gluteal area, thigh, leg, and feet, which may help you to determine where to focus the time remaining after treating the lateral rotators of the hip.

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

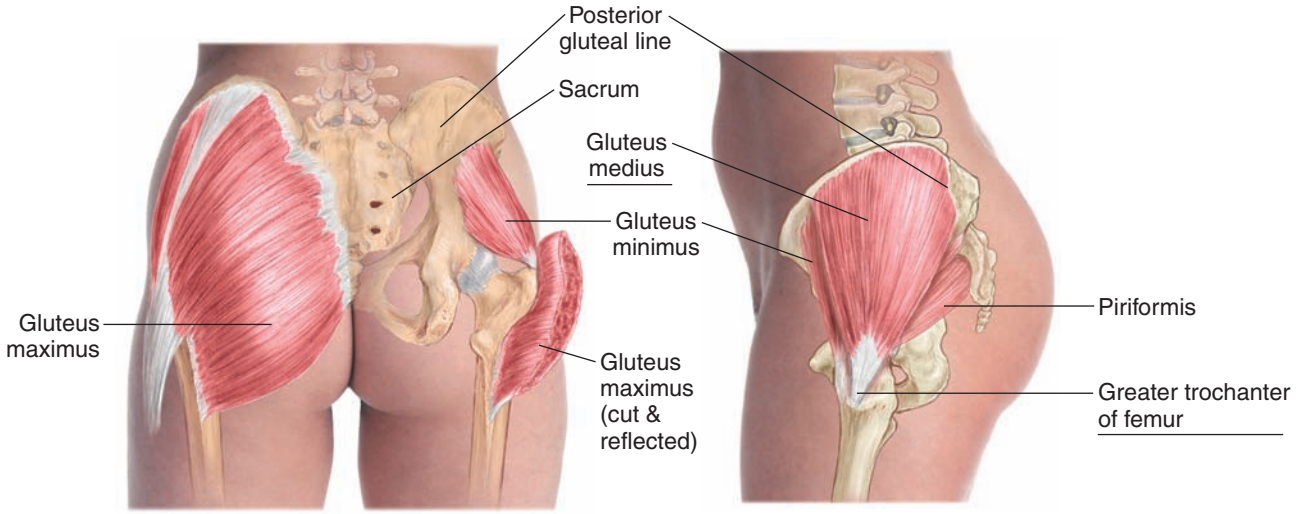
- If you notice swelling around the low back or gluteal area, apply superficial draining strokes toward the nearest lymph nodes.

- Before applying emollient, assess for and treat myofascial restrictions across the thoracolumbar aponeurosis.

- Assess and treat hypertonicity and trigger points in the latissimus dorsi, lumbar erector spinae, and quadratus lumborum, particularly if hyperlordosis is also present. Assess and treat these briefly for the moment. You can return to treat the area again if time permits.

- Remove moist heat, and assess the tissues around the sacrum and greater trochanter for myofascial restrictions and release them. It may be difficult to assess the gluteal area for superficial myofascial restrictions because of the presence of adipose tissue. Superficial restrictions around the attachment sites may be addressed more readily.

- Treat the gluteal muscles for hypertonicity and trigger points (Fig. 9-9). Knead the tissues along the full length of the iliac crest and sacrum and around the greater trochanter to treat the attachments of the gluteal muscles and lateral rotators. To release adhesions in the deeper gluteal muscles, use cross-fiber friction beginning at the sacrum and move toward the greater trochanter. Lengthen tissues in each of the fiber directions of all three gluteal muscles to assess and treat hypertonicity and trigger points.



GLUTEUS MAXIMUS

Origin	*Coccyx, lateral sacrum, posterior iliac crest, sacrotuberous and sacroiliac ligaments.*
Insertion	***Upper fibers**: iliotibial band; **lower fibers**: gluteal tuberosity.*
Action	***All fibers**: extend hip, laterally rotate hip, posterior pelvic tilt; **upper fibers**: abduct hip; **lower fibers**: adduct hip.*
Nerve	*Inferior gluteal.*

GLUTEUS MEDIUS

Origin	*Surface of ilium between iliac crest gluteal lines.*
Insertion	*Greater trochanter of the femur.*
Action	***All fibers**: Abduct hip; **anterior fibers**: flex hip, medially rotate hip; **posterior fibers**: extend hip, laterally rotate hip, posterior pelvic tilt.*
Nerve	*Superior gluteal.*

GLUTEUS MINIMUS

Origin	*Ilium between gluteal lines.*
Insertion	*Anterior aspect of greater trochanter.*
Action	*Abduct hip, medially rotate hip, flex hip.*
Nerve	*Superior gluteal.*

Figure 9-9 The gluteal muscles. Warm and treat the gluteal muscles before working on the deeper piriformis. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

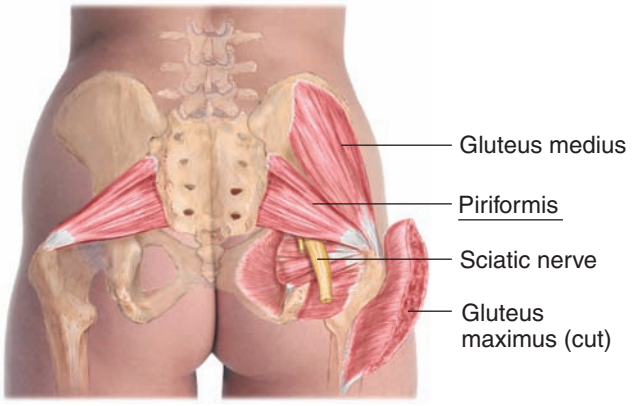
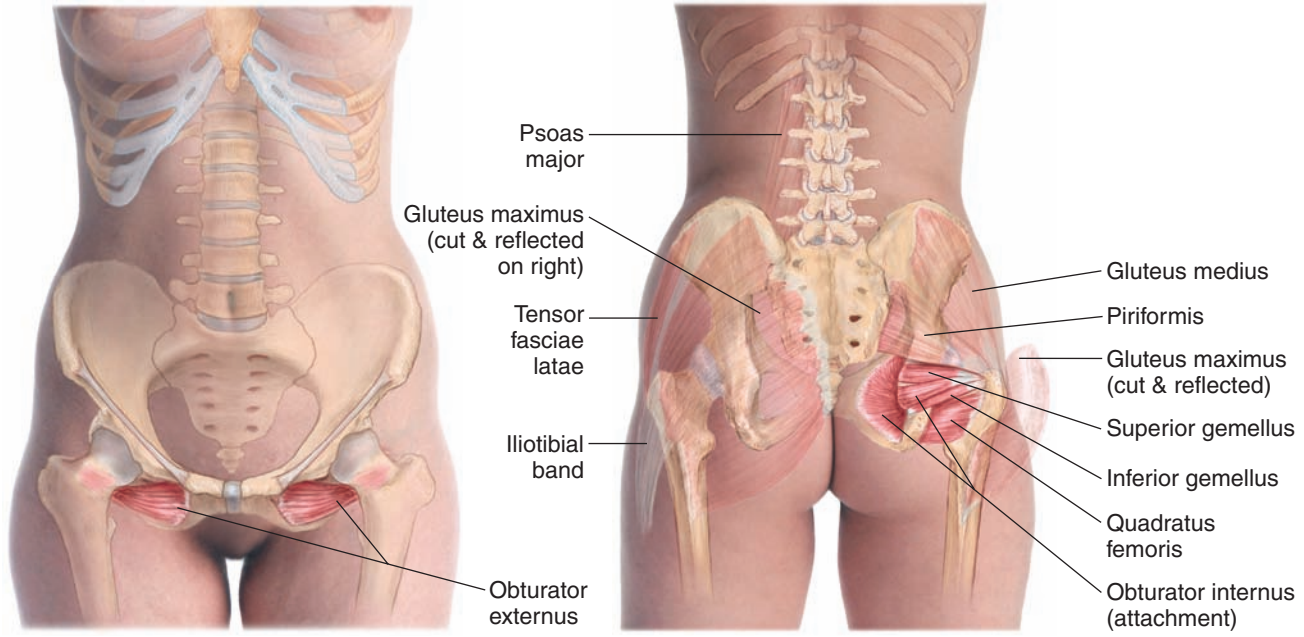


Figure 9-10 **Piriformis.** Find and then treat the piriformis for hypertonicity and trigger points. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

PIRIFORMIS

Origin	*Anterior surface of sacrum.*
Insertion	*Greater trochanter of the femur.*
Action	*Laterally rotate hip, abduct the flexed hip.*
Nerve	*L5-S2 nerve roots of sacral plexus.*



QUADRATUS FEMORIS

Origin	*Lateral ischial tuberosity.*
Insertion	*Crest between greater and lesser trochanter of the femur.*
Action	*Laterally rotate hip.*
Nerve	*L4-S1 nerve roots of sacral plexus.*

OBTURATOR INTERNUS

Origin	*Inferior surface of obturator foramen.*
Insertion	*Medial surface of greater trochanter of the femur.*
Action	*Laterally rotate hip.*
Nerve	*L5-S2 nerve roots of sacral plexus.*

OBTURATOR EXTERNUS

Origin	*Rami of pubis.*
Insertion	*Trochanteric fossa.*
Action	*Laterally rotate hip.*
Nerve	*Obturator.*

SUPERIOR GEMELLUS

Origin	*Ischial spine.*
Insertion	*Upper border of greater trochanter of the femur.*
Action	*Laterally rotate hip.*
Nerve	*L5-S1 nerve roots of sacral plexus.*

INFERIOR GEMELLUS

Origin	*Ischial tuberosity.*
Insertion	*Upper border of greater trochanter of the femur.*
Action	*Laterally rotate hip.*
Nerve	*L5-S1 nerve roots of sacral plexus.*

Figure 9-11 **Other lateral rotators of the hip.** Assess and treat the deep lateral rotators for hypertonicity and trigger points. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment*, 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

- Once the gluteal muscles are treated sufficiently to access the deeper piriformis, begin your specific work (Fig. 9-10). To find the piriformis, place your fingers midway between the middle of the sacrum and the greater trochanter. Flex the client's knee to 90°, and ask the client to pull the foot away from you against your resistance. This lateral rotation will cause the piriformis to contract under your finger.

- Once you have found the muscle, slowly lengthen it from origin to insertion. Assess for trigger points as you slowly stroke along the length of the piriformis.

- Treat trigger points if any are found. Trigger points in the piriformis are frequently found near the greater trochanter and near the sacrum. If your treatment reproduces symptoms, adjust the client's posture, lighten your pressure, or move slightly off the area. As you proceed with the treatment, symptoms may lessen allowing you to treat more directly.

- Assess the quadratus femoris, obturator internus and externus, and the gemellus superior and inferior for hypertonicity and trigger points (Fig. 9-11). These are small, deep muscles that may be difficult to distinguish. Familiarize yourself with their fiber directions and work generally to increase their length if you are unable to access each one individually. Lengthen these muscles manually, and treat any trigger points found.

- Stretch the lateral rotators by stabilizing the sacrum with one hand while bending the client's knee to 90° and gently pulling the leg toward you with the other hand (medial rotation) (Fig. 9-12).

- If the lateral rotators seem resistant to stretch, use postisometric relaxation to encourage lengthening. Bend the knee 90° and minimally rotate the hip medially by bringing the leg closer to you to lengthen the lateral rotators. Instruct the client to laterally rotate the hip by pulling the leg away from you against your resistance and hold for 10 seconds, or less if you feel a tremor or other sign that the muscles are fatiguing. Hold the leg steady while the client releases the contraction; then slowly rotate the hip medially by drawing the leg closer to you as fully as you can within the client's tolerance.

Figure 9-12 Passively stretch piriformis. Stabilize the sacrum, bend the knee to 90°, and draw the client's foot toward you to passively stretch the piriformis.

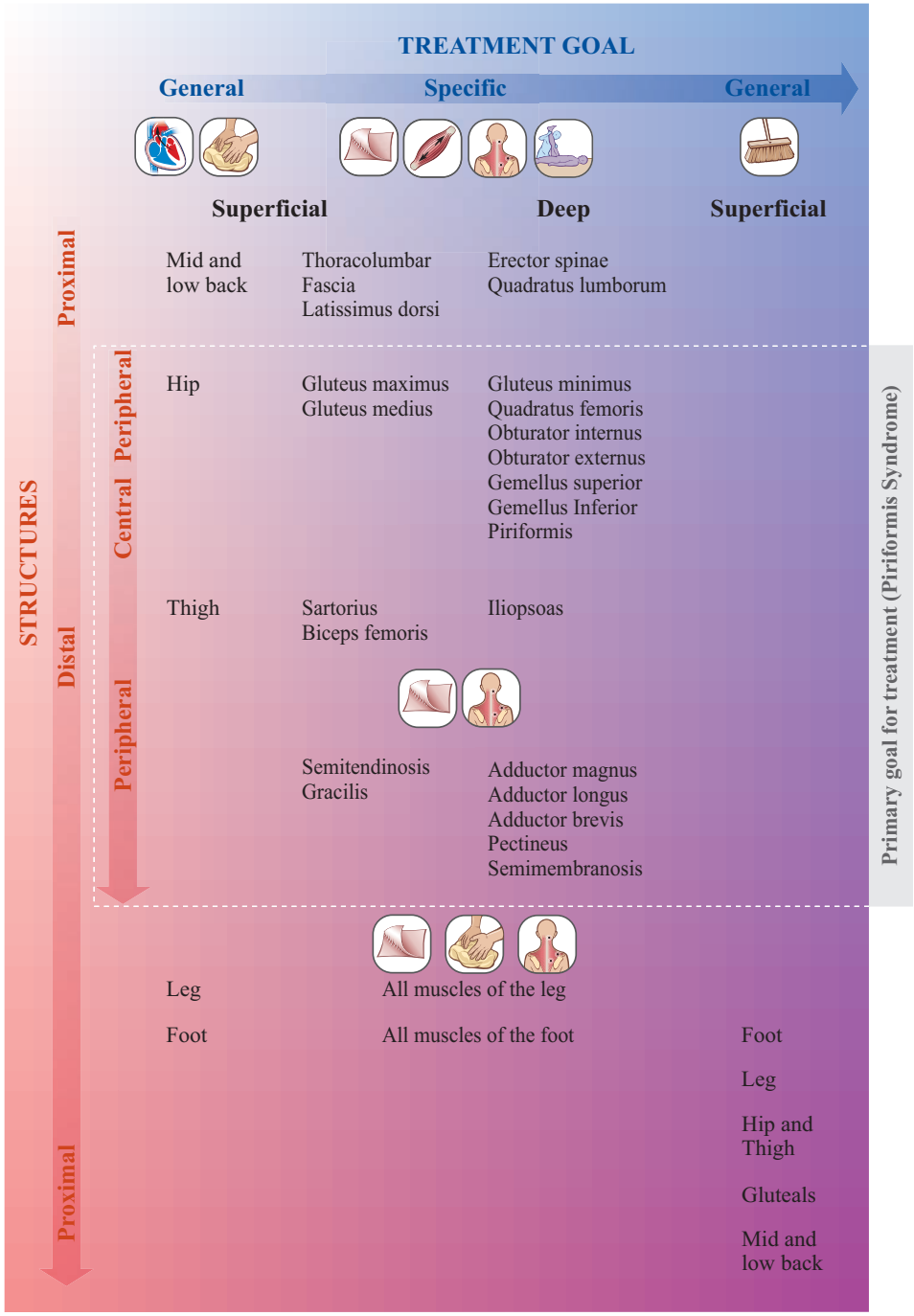
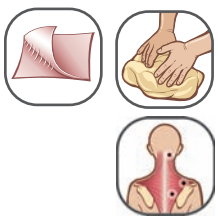


Figure 9-13 **Piriformis syndrome treatment overview table.** Follow the general principles from left to right or top to bottom when treating piriformis syndrome.



- Treat the thigh and leg for hypertonicity and trigger points and to restore neuromuscular function. Irritation of the sciatic nerve and its branches can cause changes in the tone and strength of any of the muscles innervated by it. Assess for adhesions, hyper- or hypotonicity, and weakness, and treat accordingly. If the tone is diminished, use stimulating strokes to encourage an increase in tone.

- Apply superficial gliding to the leg, thigh, and buttocks to clear the areas and encourage venous return.

- With the remaining time, consider the other possible conditions that may develop with piriformis syndrome and treat these. Hyperlordosis suggests treatment to the hip flexors and lumbar spine extensors. Eversion or inversion of the ankle suggests treatment to the muscles of the lower leg and feet. You may not have time to treat all of these fully, but you can pay attention to some of them in each session, and as the signs and symptoms of piriformis syndrome decrease, you can increase the amount of time you spend in these other areas.

The treatment overview diagram summarizes the flow of treatment (Fig. 9-13).

CLIENT SELF-CARE

The following are intended as general recommendations for stretching and strengthening muscles involved in the client's condition. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines:

- Instruct the client to perform self-care throughout the day, such as while taking a phone call, reading e-mail, washing the dishes, or watching television instead of setting aside extra time. When performing activities while standing, ask the client to notice if he or she is shifting weight to one leg and whether the feet point outward (laterally rotated hips). If so, instruct the client to focus on distributing weight evenly to both legs and on keeping the toes pointed forward within his or her comfort level.
- Instruct the client on proper seated posture to keep pressure off the weakened joints. Sitting in a chair that supports the back and allows the client to rest the feet flat on the floor with the knees and hips flexed approximately 90° may reduce muscle strain and stress on the joints. To reduce lateral rotation in the hips while sitting for long periods of time, the client can place a band around the knees to keep them from separating.
- Encourage the client to remove any bulky objects from the back pockets of his or her pants, particularly when sitting.
- Encourage the client to take regular breaks from repetitive actions.
- Demonstrate gentle self-massage of the hip to keep adhesions and hypertonicity at bay between treatments.
- Demonstrate all strengthening exercises and stretches, and have the client perform these in your presence before leaving to ensure that he or she is performing them properly and will not be harmed when practicing alone. Stretches should be held for 15-30 seconds and performed frequently throughout the day, within the client's limits, during an active flare-up. The client should not force the stretch or bounce. It should be slow, gentle, and steady, trying to keep every other muscle as relaxed as possible.

Stretching

To stretch the lateral rotators of the hip, instruct the client to sit at the edge of the chair with the hips medially rotated by bringing the knees together and the feet resting away from the midline, and then have him or her lean forward (Fig. 9-14). Hold the stretch for 15–30 seconds, and then stand and take a few steps to mobilize the hip.

Alternatively, instruct the client to lie supine with the hip and knee of the affected side flexed and the hand of the opposite side rested on the flexed knee. Pull the knee of the affected side medially into a twist until a stretch is felt (Fig. 9-15). Hold the stretch for 15–30 seconds, and then stand and take a few steps to mobilize the hip.

Figure 9-14 **Piriformis seated stretch.** Sit with the knees together and the hips medially rotated while leaning forward to stretch the piriformis.

Figure 9-15 **Piriformis stretch.** Draw the flexed knee of the affected side toward the opposite shoulder to stretch the piriformis.

Figure 9-16 **Strengthen adductors.** Instruct the client to squeeze the knees together against the resistance of a ball or other object to strengthen the adductors.

Strengthening

The choice of strengthening exercises depends on which structures are lengthened or have lost tone. Compensating patterns may differ depending on the client's contributing factors and posture. Nearly all of the muscles of the posterior thigh, leg, or foot can lose tone and strength when innervation by the sciatic nerve is reduced. Assess the client thoroughly to determine which structures are affected before assigning strengthening exercises.

Because lateral rotation is the most common postural deviation, you may find the medial hamstrings and adductors lengthened, taut, and weak. To strengthen these, instruct the client to lie supine with his or her feet on the floor, knees bent, and a ball or other object adding resistance between the knees (Fig. 9-16). Instruct the client to adduct and medially rotate the hip by squeezing the knees together against the resistance of the ball and hold for 10 seconds, or less if he or she feels fatigue. The contraction can be repeated 5–10 times.

If the Pace test is positive for weak abduction, recommend strengthening the abductors. Instruct the client to stand with the support of a wall or chair while lifting the affected leg away from the midline (Fig. 9-17). It is important not to laterally rotate the hip when performing this exercise to keep the piriformis from shortening.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client with piriformis syndrome will have treatments twice a week until the client can perform activities of daily living with minimal or no pain for at least 4 days. When this occurs, reduce frequency to once per week until symptoms are absent for at least 7 days. When the client

Figure 9-17 Strengthen abductors. Instruct the client to stabilize themselves against a wall or chair, and lift the leg to strengthen the abductors.

reports that he or she has been pain free longer than 7 days, treatment can be reduced to twice per month. If the client is pain-free for 3 or more consecutive weeks, he or she can then schedule once per month or as necessary. In the treatment of piriformis syndrome that is neuromuscular in nature, there should be some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest. Explain the importance of his or her participation in the healing process, and encourage the client to follow your recommendations, but be careful not to judge or reprimand a client who does not.
- The condition is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical or medical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy altogether and hinder healing.
- The client has an undiagnosed, underlying condition. Discontinue treatment until the client sees a health care provider for a medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be able to take him or her through the full program of healing. Still, if you can bring some relief in just one treatment, it may encourage the client to discuss this change with a physician and seek manual therapy rather than more aggressive treatment options. If the client returns for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on a specific area. Likewise, once you have treated the structures

specific to piriformis syndrome, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Vittorio is a 35-year-old, single male. He is currently the marketing director for a nonprofit arts organization. Vittorio trained and performed as a professional ballet dancer until his retirement from dance 4 years ago. Within a year of retiring, he began feeling general aches in his hips, knees, and ankles. The symptoms have gotten worse, and he now feels numbness in his left leg and foot.

Subjective

The client complained of pain in his hips, particularly in the left hip, with occasional general aching in his knees and occasional instability in his ankles. Approximately 6 months ago, he began to feel tingling down the back of his left leg and in the left foot after sitting at his desk for an extended period or driving long distances. Within the past 6 weeks, he has felt numbness in the leg and feels like the step of his left foot is heavier than the right. He has lost his balance more than once while taking the first few steps after having been seated for a while. In his job as a marketing director, he spends many consecutive hours seated. He commutes by car for an average of 1 hour in each direction and frequently drives to meetings. On the weekends, he is much more active, rarely uses his car, and has noticed that he has fewer symptoms. He has purchased a new chair with lumbar support and adjustable height to try to relieve symptoms. The use of this chair reduced the pain he had felt in his low back but had no effect on the pain, numbness, or tingling in his leg.

Vittorio visited his health care provider for a general checkup and to discuss the symptoms in his leg. He was concerned that changes in his diet, which now includes more packaged and take-out food, may be affecting his nervous system. A physical exam and blood tests revealed no underlying pathologies. He is considered to be in "excellent health." His health care provider explained that while his current food choices may contribute to his symptoms and may make healing less efficient, they are not the cause of his pain. The health care provider prescribed physical therapy, which largely focused on strengthening exercises and reduced the pain in his knees and ankles, but Vittorio noticed that the numbness and tingling was often worse after sessions. His former dance instructor referred him to this clinic. When asked about changes in bladder or bowel movements, he replied that nothing had changed. He has no pain in the groin area. He has noticed no swelling, and does not feel unusual heat, cold, or fullness in the extremities.

Objective

The client very clearly protects his left leg. He climbed the stairs using the rail on the left side, lifting his weight with the right leg for each step. When seated, his knees are widely separated. A bulge in the left pocket of his jeans suggests a large wallet or other object. A faded area of fabric around the edges of this bulge suggests that he carries this object in the same pocket regularly. Vittorio had no trouble sitting in the chair. He stood without assistance, but paused for a second, seemingly to check his balance, before walking again. Other than the widely separated knees, his seated posture is well balanced and erect.

Postural assessment revealed a significant lateral rotation of the hips bilaterally. When this was pointed out to Vittorio, he stated that he had trained for years to establish that posture, which is essential for a ballet dancer. I have worked with several dancers who specifically requested that the lateral rotation of the hips not be realigned, but Vittorio responded, "I don't need it anymore," with no apparent regret. He has minor hypolordosis and valgus of the knees. The ankles are everted bilaterally, and the lateral two or three toes are slightly extended (i.e., not fully rested on the floor). The posture of the upper body is normal.

His Valsalva test was negative for space-occupying lesions. The Pace test revealed significant weakness with abduction of the left hip. When asked to try to increase the strength of the contraction in the left hip, Vittorio rotated his trunk to compensate. Although his right hip is stronger, this result is relative. The stork test was negative for sacroiliac joint dysfunction. Active medial rotation of the hips reproduced no symptoms at first, but tingling began at 24 seconds.

Palpation revealed fascial restrictions across the hip joint bilaterally and at the thoracolumbar fascia. No swelling or temperature difference was apparent between the hips. The lateral rotators of both hips have increased tone. Only the lateral rotators of the left hip were tender to the touch. With deep palpation, pain reached a level 8 out of 10. Trigger points near both attachments referred pain within the gluteal area. Pain with compression to a trigger point near the trochanter reduced from level 8 to 5. Pain with compression to a trigger point near the sacrum reduced from level 7 to 3. The iliotibial bands are dense and adhered bilaterally, particularly on the superior aspect of the left. The left vastus lateralis is also dense with superficial adhesions. The adductors and medial hamstrings are tender to the touch (level 4 of 10) with taut bands. There is point tenderness near the adductor tubercle and medial condyle of the femur and the medial tibial plateau (level 6 of 10). The peroneus longus and brevis and extensor digitorum longus are hypertonic bilaterally. Distal tendons of the extensor digitorum longus are thick and short. Biceps femoris and ankle dorsiflexors are slightly hypotonic, and sensation is reduced compared to the right side.

The assessment suggests possible piriformis syndrome—neurogenic in the left hip and non-neurogenic in the right hip. The client was encouraged to discuss this assessment with his health care provider for a specific diagnosis.

Action

Treatment focused on reducing hypertonicity and restoring the proper length of the lateral rotators of the hip bilaterally with the additional goal of reducing irritation to the left sciatic nerve. I performed myofascial release to the thoracolumbar fascia and around the greater trochanters. I used cross-fiber friction on the iliotibial bands and vastus lateralis bilaterally. I softened the superficial tissues moderately, but the fibers were still obscured by adhesions. I applied general warming to the gluteal area followed by muscle stripping and trigger point therapy on the lateral rotators of the hips bilaterally. P ROM in the right hip increased by approximately 15° with no pain upon medial rotation. P ROM in the left hip increased by less than 10° with pain at a level 5 out of 10 upon medial rotation and with tingling in the thigh after 15 seconds in the initial attempt. PIR increased P ROM by only a few degrees, and all successive passive medial rotation of the left hip was confined to 10 seconds. No trigger points were found in the taut bands of the adductors semimembranosus and semitendinosus. Adhesions and warmth at the medial knee suggest strain on the pes anserinus tendon due to excessive lateral rotation and attempts by the medial rotators to oppose the action. The client felt no tenderness in the anterior leg, but the density of the peroneals and extensor digitorum and the minimal change in tissues following the application of superficial techniques limited the depth and pressure attempted in this session. The client felt an intense stretch with a passive inversion of the ankle. I applied stimulating strokes to the left biceps femoris and ankle dorsiflexors.

Following treatment, the client stated that he felt greater mobility in the hips and legs but did not feel confident enough to stop favoring the left leg. I explained that rushing into false confidence in his strength and stability could have negative consequences and that he should trust his instinct and sense of balance when standing or walking but do his best not to favor one side if it is not necessary.

Plan

I demonstrated a stretch for the lateral rotators of the hips while seated. I recommended wrapping a band around the knees while he is seated for long periods to reduce the lateral rotation of the hips. I emphasized the importance of limiting the duration of stretches and removing the band around his knees if numbness, tingling, or pain beyond his tolerance occurs. Results during treatment suggested that stretches should be limited to 10-15 seconds to minimize the reproduction of symptoms. If, at any time, symptoms occur within 5 or fewer seconds, the client was advised to discontinue performing this stretch. We will reevaluate this recommendation in the next session.

I demonstrated stretches to the ankle evertors, emphasizing that these should be performed only if the client feels stable while standing and only with the assistance of a wall or other surface to lean on. If

continued treatment reduces symptoms during activities of daily living, and as stability and balance are restored, strengthening exercises for the biceps femoris and the dorsiflexors of the ankle will be introduced.

The client's primary goal is to stop the loss of control he feels in his left leg. His secondary goal is to restore strength. His long-term goals are to realign the hips, knees, and ankles, although this is not a priority. He has agreed to treatments twice a week until symptoms are absent for at least 4 consecutive days, with reassessment at that time. Massage therapy prescribed by a health care provider is covered under his insurance. He will discuss this with his health care provider and request a referral to this clinic.

CRITICAL THINKING EXERCISES

1. Design an assessment and treatment plan that considers the contributing factors for a client with symptoms of piriformis syndrome due to overuse of the piriformis as an antagonist. This client will likely present with medial rotation of the hips, valgus of the knees, and eversion of the ankle. The assessment plan should consider ROMs that may be restricted, testing for muscle weakness, and palpation findings. Treatment goals should include lengthening shortened tissues, strengthening weak muscles, and restoring proper neuromuscular function.
2. A client presents with numbness and tingling in the legs and pain in the hip, low back, and groin. The client also reports having recently developed urinary difficulty. Symptoms suggest both sciatic and pudendal nerve irritation. Conduct a short literature review of manual therapy for restoring the function of the pudendal nerve. Develop a treatment plan for this client with special attention to aspects of treatment both within and outside the massage scope of practice. Include possible referrals to practitioners licensed to treat elements of this condition that are outside the scope of practice for massage therapists.
3. Develop a 10-minute stretching and strengthening routine for a client that covers all of the muscles involved in piriformis syndrome. Use Box 9-1 and Figure 9-4 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles. Describe each step of the routine in enough detail that the client can refer to these descriptions in your absence and perform them without harm.
4. A client calls to schedule a massage for hip pain with tingling down the back of the leg. She explains that she had a hip replacement following an accident 5 years ago when she was 22 years old. Her physician has cleared her for massage therapy. Discuss the possible relationship between the hip replacement and piriformis syndrome. What questions would you ask this client and her health care provider? What special considerations would you need to make in your treatment plan both for contributing factors and for contraindications? Would a hip replacement affect proprioception at that joint?
5. Conduct a short literature review to explore the relationship between symptoms suggesting compression of one or more nerves in the gluteal area and the following:
   - Facet joint irritation
   - Diabetes
   - Prostatitis
   - Myositis ossificans
   - Rheumatoid arthritis

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CHAPTER 10

Patellofemoral Syndrome

UNDERSTANDING PATELLOFEMORAL SYNDROME

Patellofemoral syndrome refers generally to anterior knee pain primarily due to improper tracking of the patella over the femur. Many factors can affect the tracking of the patella, and the degree of discomfort, pain, or restricted mobility varies widely. To recognize these potential contributing factors, it is important to understand the relationships among the femur, tibia, patella, and the soft tissues responsible for their movement and stability.

The knee joint includes two articulations (Fig. 10-1). The concave plateaus of the tibia and the convex condyles of the femur articulate to form a modified hinge joint (tibiofemoral). The posterior aspect of the patella also has concave surfaces—called the medial and lateral facets—that articulate with the medial and lateral condyles of the femur (patellofemoral). The ridge that separates the medial and lateral facets of the patella glides in the groove between the medial and lateral condyles of the femur. Articular cartilage that covers the condyles of the femur and the tibial plateau, and the menisci that sit between them provide cushioned, friction-free movement of the joint.

Flexion and extension of the knee, which involve both of these articulations, are not simple transverse movements. Some rotation and translation of the bones occurs during flexion and extension of the healthy knee. The angle of the joint and the strength of its surrounding structures influence the amount of rotation and translation. Noncontractile soft tissues including the medial and lateral collateral ligaments and the anterior and posterior cruciate ligaments protect the knee from excessive rotation and translation during movement. Other noncontractile tissues that protect the knee include the joint capsule, menisci, bursae, and fat pads (Fig. 10-2). Contractile soft tissues that both move and stabilize the knee include the quadriceps, hamstrings, gracilis, sartorius, and gastrocnemius. A healthy knee depends on all of these structures working together to create smooth movement.

The lateral condyle of the femur is more prominent anteriorly than the medial condyle, which provides a buffer for excessive lateral movement of the patella. The medial condyle of the femur extends more distally than the lateral condyle, but both lie in the same plane as they articulate with the tibia. This puts the femur at an angle from the inferior medial location of the knee to the superior lateral location of the hip. The angle at the intersection of those differently oriented bones—called the Q angle—partly determines how the quadriceps pull on the tibia in knee extension and how they contract eccentrically in knee flexion. To measure this angle, draw one line diagonally from the middle of the patella to the anterior superior iliac spine (ASIS), and another from the middle of the patella through the middle of the tibial tubercle (Fig. 10-3). The average Q angle is approximately 15°; it is often greater in females than in males, because women generally have a wider pelvis. Because the Q angle affects the line of pull of the quadriceps, significant deviations can have a great impact on how the bones of the knee joint articulate and how the soft

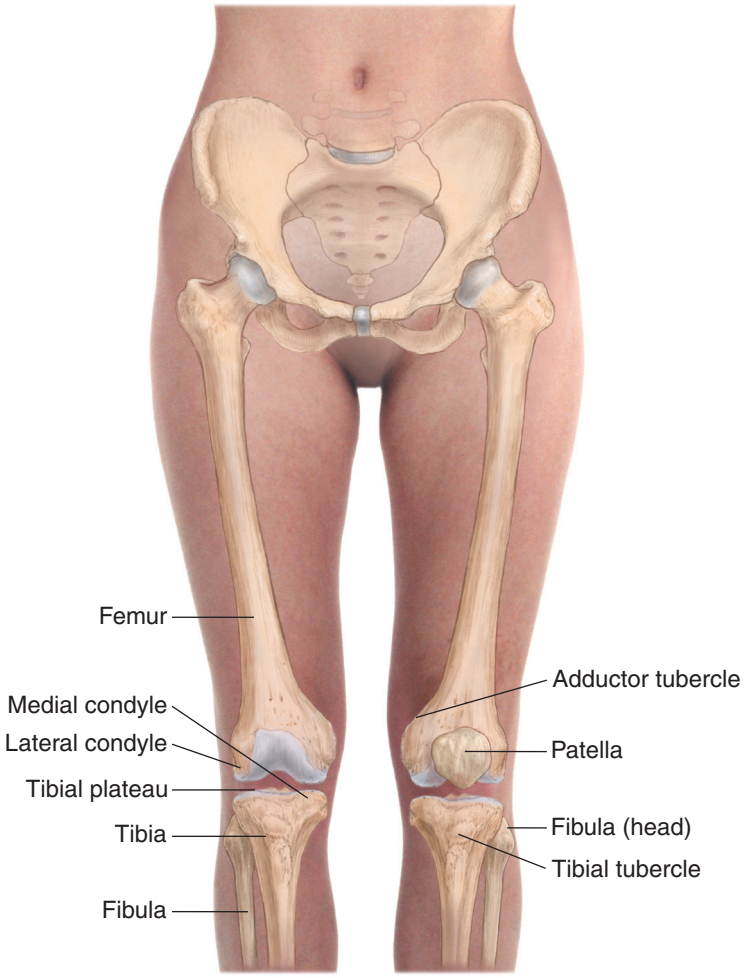


Figure 10-1 **Articulations of the knee joint.** The tibia articulates with the femur to form the tibiofemoral joint, and the patella articulates with the femur to form the patellofemoral joint. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

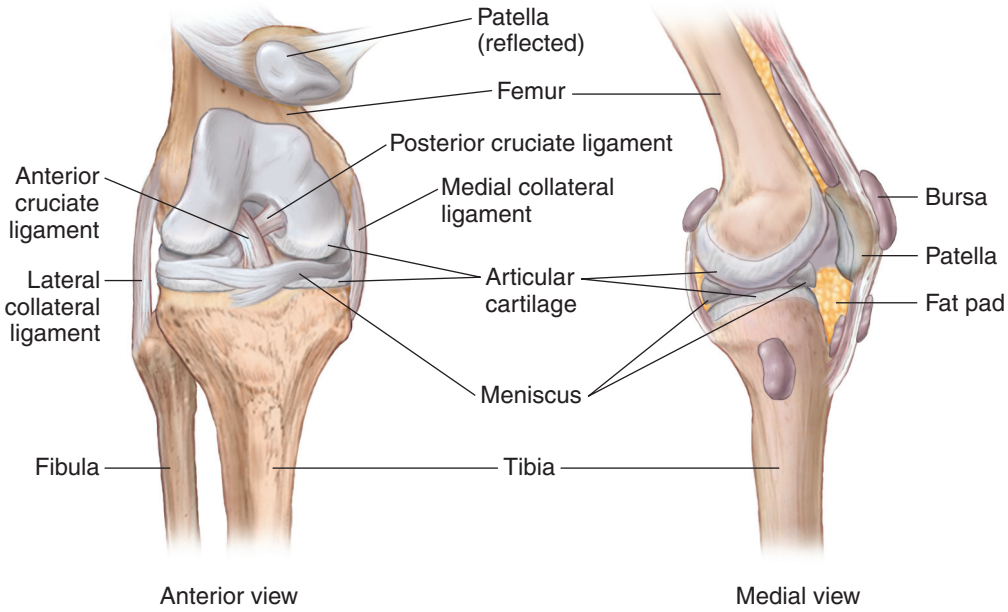


Figure 10-2 **Supporting structures of the knee.** Ligaments, cartilage, menisci, bursae, and fat pads stabilize and cushion the knee joints.

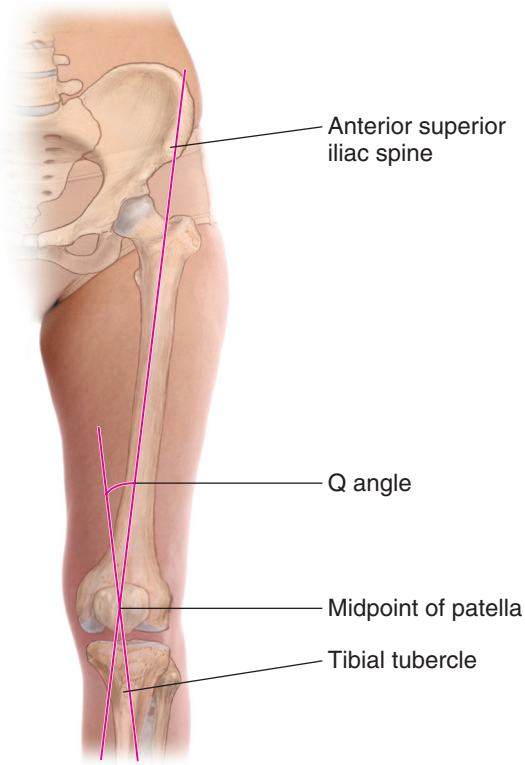


Figure 10-3 **Q angle.** The Q angle is formed by the lines that run from the patella to the anterior superior iliac spine and from the patella to the tibial tubercle.

tissues respond. In the case of patellofemoral syndrome, an increased Q angle—sometimes resulting from an injury, activities of daily living, or postural deviations anywhere from the hips to the feet—may contribute to excessive lateral tracking of the patella.

The quadriceps are also angled, following the line of the femur. The patella is rooted in the quadriceps tendon, is stabilized inferiorly by the patellar tendon, and is further stabilized by the medial and lateral retinacula. In extension and flexion of the knee, the patella moves superiorly and inferiorly over the condyles of the femur. The main function of the patella is to help guide the movement of this joint with differently angled bones by realigning the quadriceps' pull on the tibia. Without the patella, the quadriceps would draw the tibia diagonally, along their line of pull. Instead, the quadriceps move the patella slightly laterally along the line of the femur, while the patellar tendon redirects the line of pull on the tibia, moving it more perpendicularly and minimizing rotation. If the patella is not tracking normally, stress to the joint and the muscles that move it increases.

Because the quadriceps' line of pull is lateral compared to the orientation of the patellar tendon, several other structures are vital for proper tracking of the patella. The distal fibers of the vastus medialis run obliquely, offering ideal resistance to a lateral pull on the patella. The medial patellar retinaculum resists lateral pull while the lateral patellar retinaculum resists medial pull. The medial and lateral collateral ligaments assist in normalizing a valgus or varus position of the knee, which may help to prevent improper tracking of the patella.

Common Signs and Symptoms

The most common symptom of patellofemoral syndrome is pain at the anterior knee, often just above or just below the patella. Pain usually has a gradual onset. Pain may also be felt at the medial or lateral side of the knee depending on which structures are primarily involved. Pain is usually most intense with a weight-bearing extension of the knee. Symptoms are felt when walking, running, squatting and rising from a squat, and when ascending and descending stairs. While sitting

for long periods, the knee is flexed, elongating the quadriceps, and pain may be felt upon standing when the lengthened quadriceps need to contract concentrically. The knee may also give way during weight-bearing activities. While instability of the joint may be a complicating factor in patellofemoral syndrome, the knee giving way may also be the result of a neuromuscular reflex inhibition of the quadriceps in response to pain. This inhibition may lead to atrophy of the quadriceps.

Hyper- or hypomobility of the patella in a lateral or medial direction may be present. When structures are pulling the patella laterally, medial mobility may be reduced. When structures are pulling the patella medially, lateral mobility may be reduced. You may notice swelling at the knee when misalignment of the patella and factors contributing to patellofemoral syndrome increase friction and lead to increased inflammation and arthritis. Snapping or grinding may be felt or heard by the client when flexing and extending the knee, particularly during weight-bearing activity.

Patellofemoral syndrome was once called (and is still often confused with) chondromalacia of the patella, which involves degeneration of cartilage. The signs and symptoms listed above are often present without any changes to the cartilage of the patella. However, left untreated, patellofemoral syndrome may lead to degeneration of the patellar cartilage.

Possible Causes and Contributing Factors

There is no single, clearly understood cause of patellofemoral syndrome. Improper tracking of the patella and increased pressure within the patellofemoral joint may involve a variety of coexisting contributing factors. Lateral misalignment of the patella is reported more often than medial misalignment. This is thought to be due to lateral pull by the quadriceps. An increased Q angle may contribute to excessive lateral pull by the quadriceps and rotation of the femur or tibia and may affect proper tracking of the patella. A tight vastus lateralis or iliotibial band, which have distal tissues that blend into the lateral patellar retinaculum, also increase lateral pull on the patella. The distal fibers of the vastus medialis, referred to as vastus medialis obliquus, run at an oblique angle, making them favorable for opposing lateral pull on the patella by the quadriceps and iliotibial band. A weak vastus medialis obliquus may not be optimally effective for this function. In all of these cases, weight-bearing or repetitive activities increase the demand on the knee and the risk of injury to its stabilizing soft tissues.

Try this yourself. Stand on one leg, leaning against a wall or chair for balance. Extend and flex the knee of the opposite leg. If there is no tissue damage, the movement of your knee will be smooth, and you probably will not feel any discomfort. Now, adduct your hip, crossing your free leg over the leg you are standing on, and extend and flex your knee 10 times so that movement of the tibia is straight and directly in front of you. This may not be the exact mechanism of an increased Q angle, but it approximates the rotation of the femur and the increased angle of pull on the quadriceps. Moving the tibia straight and directly in front of you approximates walking. After 10 repetitions of this action, do you feel stress in the medial knee or hip? Now imagine the additional impact on the joint if you added the full weight of your body. Next, without causing discomfort beyond your tolerance, walk around with one ankle everted or inverted. Pay attention to what you feel in that knee and hip compared to the leg with a normally oriented ankle and foot.

Sitting or squatting for long periods lengthens the quadriceps, particularly the distal tendons, which may weaken knee extension causing pain when the individual needs to recruit these muscles to stand. Lengthening may be associated with neuromuscular dysfunction, affecting the tone and strength of the quadriceps, which can cause the knee to give way. It is unclear whether the neuromuscular dysfunction is a cause or result of changes to the quadriceps' muscle tone. Along the same lines, the knee is usually flexed when sitting, which shortens and possibly increases the resting tone of the hamstrings. This may increase the risk of strain during eccentric contractions of the hamstrings such as when extending the knee to stand. Furthermore, if the quadriceps have weakened, they may be less able to oppose the hamstrings that flex the knee.

Although less common, medial misalignment does occur and should be assessed. In fact, any anomaly in the structures of the knee can affect patellar tracking in the femoral groove. Patella alta—a patella that is abnormally high in relation to the femur—is positioned in the more shallow aspect of the femoral groove and may be associated with lateral displacement. Patella baja—a

patella that is abnormally low in relation to the femur—increases contact with the tibia and is associated with chondromalacia. Patella alta and patella baja are often associated with an injury to the quadriceps and patellar tendons. A lateral femoral condyle that is smaller than average or that does not protrude sufficiently anteriorly cannot provide an adequate buffer for the patella and may also contribute to excessive lateral tracking.

Pes planus or pes cavus, inversion or eversion of the ankle, and rotation of the femur or tibia may all play a role in improper biomechanics that contribute to patellofemoral syndrome. Injuries, particularly to the ligaments that stabilize the knee, and more so if they are repeated or untreated, may affect the articulation of bones in the joints of the knee and encourage compensating patterns in the soft tissues surrounding the knee. Surgery, including arthroscopic procedures, may damage soft tissues, cartilage, and proprioceptors, resulting in scar tissue and compromised function. Overuse and weight-bearing impact, such as when running and ascending or descending stairs or hills, may contribute to inflammation and degeneration of structures. Weight gain may also be a predisposing factor.

Table 10-1 lists conditions commonly confused with or contributing to patellofemoral syndrome.

Contraindications and Special Considerations

First, it is essential to understand the cause of the client's knee pain. If the client has a history of arthritis, cartilage degeneration, or previously unresolved injuries, or if you suspect the client has a fractured bone or a torn ligament, work with the client's health care provider and consult a pathology text for massage therapists before proceeding. These are a few general cautions:

- **Underlying pathologies.** Arthritis or conditions affecting the cartilage may be contributing factors. If you suspect an underlying condition (consult Table 10-1 and your pathology book for signs and symptoms), refer the client to his or her health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not a contraindication for massage, work with the health care team to develop a treatment plan that is appropriate for that individual.
- **Endangerment sites.** Be cautious near endangerment sites in the popliteal area.
- **Producing symptoms.** Symptoms may occur during treatment. If treatment reproduces symptoms, first adjust the client to a more neutral posture. If this does not relieve the symptoms, reduce your pressure or move away from the area. You may be able to treat around the site that reproduced the symptoms, but proceed with caution.
- **Treatment duration and pressure.** If the client is elderly, has degenerative disease, or has been diagnosed with a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better.
- **Positioning.** Use bolsters to position the client for comfort as well as to reduce postures that contribute to patellofemoral syndrome or coexisting conditions. Adjusting the alignment of the hips, knees, and ankles helps to keep muscles closer to their anatomic length and may facilitate access.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition such as rheumatoid arthritis or osteoarthritis, if the health of the underlying tissues is compromised, or if the client is taking anti-inflammatory medication. Friction creates an inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that your client refrain from taking such medication for several hours prior to treatment if the health care provider agrees.
- **Injections.** If the client has had a steroid or analgesic injection within 2 weeks of treatment, avoid the area. These injections reduce sensation, which may prevent the client from assessing your pressure adequately. These injections may also alter the physiology of the soft tissues, increasing the risk of injury from manual pressure.
- **Tissue length.** It is important when treating myofascial tissues that you do not lengthen those that are already stretched. Assess for myofascial restrictions first and treat only those

Table 10-1 Differentiating Conditions Commonly Confused with or Contributing to Patellofemoral Syndrome

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Baker's cyst	May be asymptomatic Pain and swelling behind the knee If cyst ruptures, pain, swelling, and bruising at posterior knee and calf	Physical exam Transillumination X-ray MRI	Baker's cyst can be confused with deep vein thrombosis and should be assessed by a medical professional prior to treatment. Massage is locally contraindicated in the popliteal area. Massage elsewhere is indicated.
Bone spur	Pain in knee, particularly on flexion and extension and when kneeling Reduced ROM	X-ray MRI CT scan	Massage will not reduce symptoms of a bone spur. ROM testing or exercises are locally contraindicated. Be cautious with compressions.
Bursitis (pes anserine, infrapatellar, prepatellar)	Heat, redness, and swelling Pain at rest Aching or stiffness with use Significant pain when kneeling and ascending or descending stairs Fever, pain, and swelling if infection occurs	Physical exam ROM tests X-ray MRI	Massage is systemically contraindicated if bursitis is due to infection. Massage is locally contraindicated in the acute stage to avoid increased swelling. In the subacute stage, massage to structures surrounding the joint is indicated.
Chondromalacia	Dull pain and tenderness at the anterior knee Worsens with kneeling, squatting, prolonged sitting, standing from sitting, and ascending or descending stairs Crepitus	Physical exam X-ray MRI	Massage is indicated to reduce stress on the joint by altering soft tissues but will not affect cartilage. Avoid compression to the patella and repeated ROM exercises of the knee.
Gout	Redness, heat, and swelling Sudden, intense pain, often at night, that diminishes gradually over a couple of weeks	Physical exam Blood and urine uric acid concentration tests Synovial fluid test	Massage is contraindicated during acute attacks. Gout may indicate other systemic conditions. Work with health care team.
Iliotibial band syndrome	Sharp or burning pain in lateral knee, particularly following activity Pain resolves with rest in early stages As syndrome progresses, pain with simple activities like walking and ascending or descending stairs	Physical exam ROM tests	Massage is indicated

Table 10-1 Differentiating Conditions Commonly Confused with or Contributing to Patellofemoral Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Ligament injury/ sprain	Snapping sound or sensation at time of injury Acute pain that worsens with movement Rapid swelling, heat, and redness Unable to bear weight on the injured leg Knee gives way In the subacute stage, joint may regain function	Physical exam MRI	Massage is indicated and best used following acute stage. See Chapter 13.
Meniscus injury	Pain and stiffness Popping sensation Slowly progressive swelling Reduced ROM Pain with activity Knee may lock in place	Physical exam McMurray's test X-ray MRI Arthroscopy	Massage is indicated to reduce stress on the joint by altering soft tissues but will not affect meniscus. Avoid compression to the injured meniscus and the patella and minimize repeated ROM exercises of the knee.
Osgood-Schlatter disease (primarily affects teenagers)	Pain that worsens with activity Swelling Tenderness at tibial tuberosity Symptoms often resolve when bones stop growing	Physical exam ROM tests X-ray	Techniques that increase circulation are locally contraindicated in the acute stage to avoid increased inflammation. Massage is indicated in chronic stage.
Osteoarthritis	Pain on standing and walking Swelling Tenderness with pressure on joint Stiffness, particularly after rest or inactivity Inflexibility in the knee Grating sensation or sound	Physical exam X-rays Blood tests Synovial fluid tests Arthroscopy	Massage is contraindicated during an acute flare-up. Massage is indicated in the subacute stage.
Plica syndrome	Intermittent anteromedial knee pain Inflammation Edema Thickening of plica Decreased elasticity of plica Snapping sound when dense plica rolls over femoral condyle Knee may lock or give way	TARP sign (Taut Articular band Reproduces Pain) Arthroscopy	Massage is indicated to reduce inflammation or adhesions, restore mobility, and effect a change in the tone of muscles that cross the knee. There is no research to indicate the benefit of massage to the plica itself.

(*continued*)

Table 10-1 Differentiating Conditions Commonly Confused with or Contributing to Patellofemoral Syndrome (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Rheumatoid arthritis	Chondromalacia Periods of flare-ups and remission Pain, swelling Aching and stiffness, particularly after rest or inactivity Reduced ROM Distortion of knee joint Rheumatic nodules Occasional low-grade fever and malaise	Physical exam Blood tests Synovial fluid tests X-ray	Massage is indicated in nonacute stages. Work with the health care team.
Septic arthritis	Pain, swelling, redness, and heat around the knee Fever, chills Symptoms may occur without prior injury	Synovial fluid test Blood test X-ray MRI	Massage is systemically contraindicated. Refer to a medical professional.
Tendon injuries	Pain in the knee Swelling Pain worsens with intense weight-bearing activity such as jumping, squatting, or climbing stairs Reduced ROM	Physical exam ROM tests	Massage is indicated. See Chapter 14.

that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. If you treat trigger points in overstretched tissue, use heat or a localized pin and stretch technique instead of full ROM stretches.

- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy, or a systemic condition.

Massage Therapy Research

In 2006, Paul van den Dolder and David Roberts published a study titled "Six Sessions of Manual Therapy Increase Knee Flexion and Improve Activity in People with Anterior Knee Pain: A Randomised Controlled Trial." The participants were 38 individuals between the ages of 18 and 80 with anterior knee pain, who were assigned to either an experimental group that received manual therapy or to a control group whose subjects were placed on a waiting list. Participants were excluded if knee pain was caused by recent trauma, infection, tumor, or acute inflammation or if the participant had knee surgery within 6 weeks of the study. Participants were also excluded if pain was reproduced with extension, flexion, or lateral flexion of the lumbar spine or overpressure to the hip or if there was no tenderness on palpation of the lateral knee. Manual therapy consisted of six 15- to 20-minute treatments over the course of approximately 2 weeks. Therapy focused on transverse frictions to the lateral retinaculum of the knee in the fully extended and fully flexed positions, tilt patellofemoral stretches, and sustained medial glide during extension and flexion. Participants were given no self-care instructions or other healing advice. Pain was

measured using Laprade and Culham's patellofemoral pain severity questionnaire. ROM and activity were also assessed. The experimental group reported less average daily pain, less pain, increased speed while ascending or descending stairs, and increased knee flexion compared to the control group. There was no change in knee extension for either group.

In 2009, Pedrelli et al. published a study titled "Treating Patellar Tendinopathy with Fascial Manipulation." All 18 subjects, who were between the ages of 17 and 42 with unilateral, subacute, or chronic patellar tendon pain, received a single treatment using the fascial manipulation technique. Subjects with acute inflammation, meniscus damage, or advanced osteoarthritis were excluded. Prior to treatment, subjects completed the VAS pain questionnaire, describing pain experienced while descending steps and while jumping on flat feet. Subjects were asked to refrain from sports for 4 days following treatment. The same evaluation was repeated after one treatment and again one month after treatment. All treatments were performed by the same therapist and included fascial techniques over the muscular fascia between the vastus lateralis and the rectus femoris with pressure applied toward the vastus intermedius. Client feedback was used to accurately locate the point that produced local pain and referral. All patients reported decreased pain or weakness or increased mobility. All subjects reported a significant decrease in pain immediately following treatment, and progress was maintained or even improved at follow-up by all but three participants. These three subjects had a recurrence of pain, albeit less severe than at pre-treatment levels. It is also noted that these three subjects had more complicated clinical cases compared to other participants.

In 2008, Jennifer Zalta published "Massage Therapy Protocol for Post-Anterior Cruciate Ligament Reconstruction Patellofemoral Pain Syndrome: A Case Report." The study involved a 29-year-old female athlete with a history of injury to her anterior cruciate ligament, medial collateral ligament, and medial meniscus and had surgical repair of all but the medial ligament. After several months following surgery, the subject began experiencing grinding and clicking in the knee. She was later diagnosed as having patellofemoral pain syndrome. She scheduled arthroscopic surgery to remove the damaged cartilage and to reduce crepitus and agreed to participate in the case study beginning 4 days after her arthroscopy. Treatments were performed once a week over the course of 10 weeks, lasting between 60 and 90 minutes to accommodate a wide variety of contributing factors. Subjective pain and function levels were recorded before and after each treatment and daily during the treatment period. Goals included reducing postsurgical inflammation (lymphatic drainage); reducing hypertonicity and lengthening the tensor fasciae latae, iliotibial band, and hamstrings (muscle energy technique); deactivating trigger points in the tensor fasciae latae, vastus lateralis, and biceps femoris (neuromuscular therapy); increasing ROM (PIR and contract relax techniques); and reducing fibrotic tissue around the patella (myofascial release and cross-fiber friction). Strengthening of the vastus medialis oblique and the hip adductors were assigned as self-care. Following the treatment program, the client reported full, pain-free ROM in the affected knee. Pain was reported as 0 on a 0-10 scale by the sixth session. Lateral pull on the patella was reduced, and results of orthopedic tests showed improvement in the Q angle, tensor fasciae latae and iliotibial band contracture, patellar grind, and contracture in the knee flexors. Two weeks before the 1-year follow-up, the subject injured her medial meniscus, but reported that, prior to this most recent injury, she had experienced no pain and had returned to presurgery activity.

WORKING WITH THE CLIENT

Client Assessment

The signs and symptoms of patellofemoral syndrome can present in many different ways. Dysfunction that causes the patella to track laterally is most often reported, but any abnormal tracking that results in pain or dysfunction of the patellofemoral joint may be present. In addition, various repetitive actions, postures, or injuries may be contributing factors; each client will

present differently. For example, an increased Q angle may affect the length and strength of the hip adductors and abductors as well as inversion or eversion of the ankles. A tight semitendinosus may contribute to injury of the pes anserine tendon, which in turn may affect the health of the sartorius or gracilis. Tight hamstrings or quadriceps may also affect pelvic tilt and lumbar lordosis. In general, lateral tracking of the patella suggests shortening of the soft tissues of the lateral thigh and weakening of the medial structures that stabilize the knee while medial tracking of the patella suggests shortening of the soft tissues of the medial thigh and weakening of the lateral structures that stabilize the knee. What follows are common presentations for patellofemoral syndrome. However, it is essential to assess every joint involved to put together an accurate picture for each individual client.

Assessment begins during your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself.

Table 10-2 lists questions to ask the client when taking a health history.

Table 10-2 Health History

Questions for the Client	Importance to the Treatment Plan
Was there a precipitating event, or can you remember a specific moment when the pain began?	The details of the activity or posture that initiated the pain may help you to determine contributing factors. A new regimen of running, new activity that requires weight-bearing movement or squatting, or newly developed sedentary postures may contribute to symptoms of patellofemoral syndrome.
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors. Patellofemoral syndrome generally causes pain in the anterior knee. Although pain elsewhere does not exclude the possibility of patellofemoral syndrome, it may suggest a coexisting condition.
Describe what your symptoms feel like.	Differentiate between possible origins of symptoms, and determine the involvement of bones and soft tissues. See Chapter 1 for descriptions of pain sensations and possible contributing factors.
Do any movements make it worse or better?	Locate tension, weakness, or compression in structures producing such movements. Extension of the knee, ascending and descending stairs, and weight-bearing activity often exacerbate symptoms.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Medical tests may reveal contributing factors as well as contraindications. If no tests were performed in making a diagnosis, use the tests described in this chapter for your assessment. If your assessment is inconsistent with the diagnosis, ask the client to discuss your findings with his or her health care provider or for permission to contact the provider directly.
Have you been diagnosed with a condition such as arthritis?	Arthritis may contribute to signs and symptoms, may require adjustments to treatment and may impact treatment outcomes.
Have you had a previous injury or surgery?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM.
What type of work, hobbies, or other regular activities do you do?	Repetitive motions that stress the knee and static postures that increase flexion of the knee may contribute to the client's condition.
Are you taking any prescribed medications or herbal or other supplements?	Medication of all types may contribute to symptoms or have contraindications or cautions.
Have you had a corticosteroid or analgesic injection in the past 2 weeks? Where?	Local massage is contraindicated.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction may initiate an inflammatory process and should not be performed if the client has recently taken anti-inflammatory medication.

POSTURAL ASSESSMENT

Allow the client to walk and enter the room ahead of you while you assess his or her posture and movements. Look for imbalances or patterns of compensation for deviations common with patellofemoral syndrome. Watch as the client climbs steps, and look for reduced mobility in the knee or whether the client is favoring one side. Assess for joint instability, limping, rotation of the femur or tibia, or hyper- or hypolordosis. Have the client sit to fill out the assessment form and watch to see if he or she lowers into the chair cautiously or shifts around to find a comfortable position for the knee. Watch also as the client stands up to see if he or she can stand without assistance or whether he or she lifts out of the chair using the arms or by leaning on a stable surface.

When assessing the standing posture, be sure that the client stands comfortably. If he or she tries to stand in the anatomic position, you will not get an accurate assessment of his or her posture in daily life. If the patella is tracking laterally, you may notice adduction of the hips, valgus of the knee, increased Q angle, or eversion of the ankle. If the patella is tracking medially, you may notice rotation of the femur and tibia, which appears as lateral rotation of the feet. Other anomalies may include patella alta or patella baja, hyper- or hypoextension of the knees, swelling around the patella, and pes planus or pes cavus.

Figure 10-4 compares a healthy posture to a posture affected by patellofemoral syndrome due to lateral tracking of the patella.

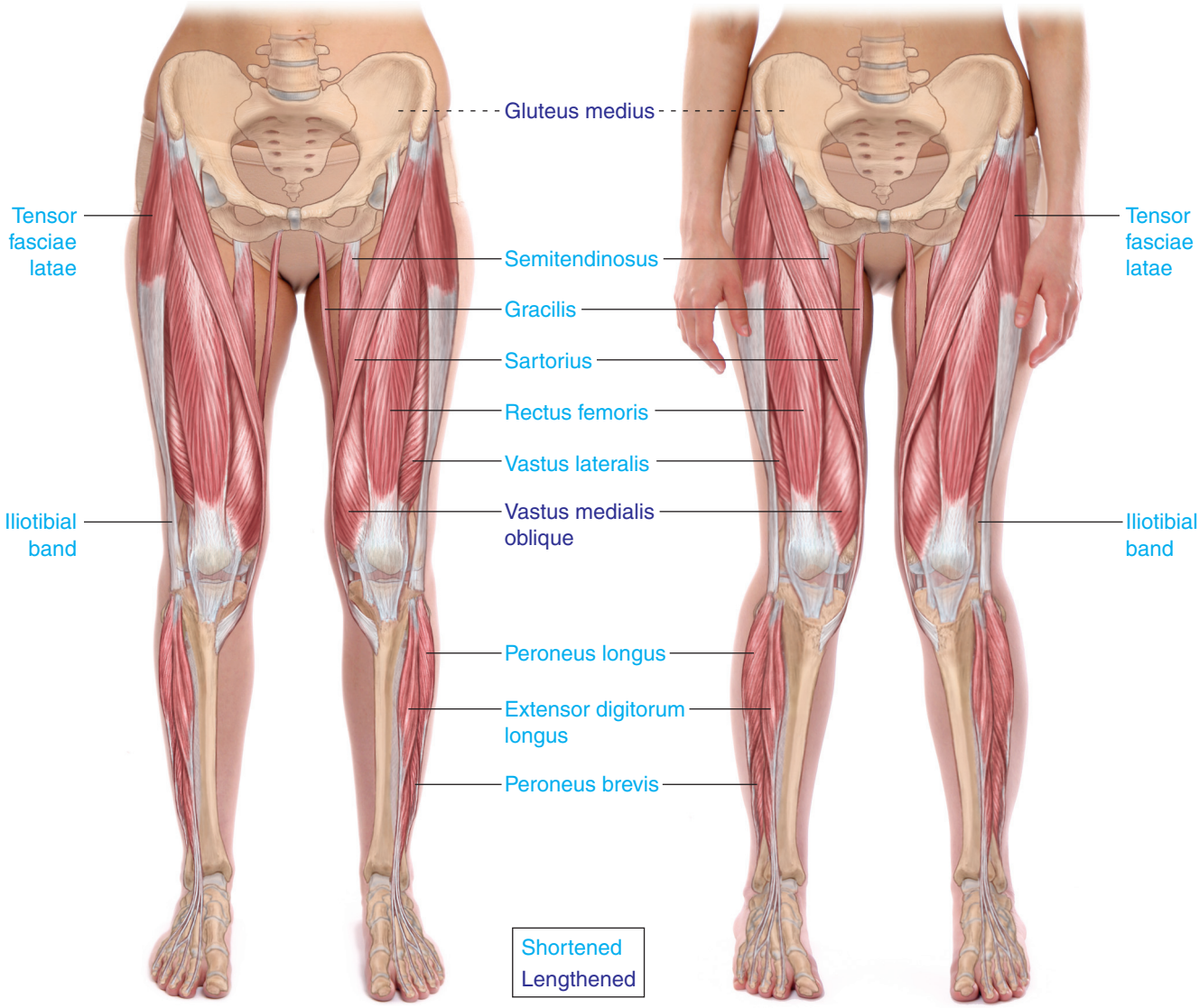


Figure 10-4 Postural assessment comparison. Compare the postures in these images. In the figure on the right, note the angle and rotation of the femur and tibia and the orientation of the ankle and the foot.

ROM ASSESSMENT

Test the ROMs of the knee involving muscles as both agonists and antagonists. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or re-injury. Box 10-1 presents the average active ROM results for the joints involved in patellofemoral syndrome.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 10-1. Pain and other symptoms may not be reproduced during active ROM assessment because the client may limit movement to a symptom-free range.

- **Active extension of the knee** may be restricted and cause pain when weak quadriceps and shortened hamstrings limit movement and when improper patellar tracking increases bone

Box 10-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN PATELLOFEMORAL SYNDROME

Hip

Flexion 110–120°
- Rectus femoris
- Gluteus medius (anterior fibers)
- Tensor fasciae latae
- Sartorius
- Psoas major
- Iliacus
- Gluteus minimus
- Adductor magnus
- Adductor longus
- Adductor brevis

Extension 10–15°
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gluteus maximus
- Gluteus medius (posterior fibers)
- Adductor magnus (posterior fibers)

Lateral Rotation 40–60°
- Biceps femoris
- Gluteus maximus
- Gluteus medius (posterior fibers)
- Sartorius
- Piriformis
- Quadratus femoris
- Obturator internus
- Obturator externus
- Gemellus superior
- Gemellus inferior
- Psoas major
- Iliacus

Medial Rotation 30–40°
- Semitendinosus
- Semimembranosus
- Gluteus medius (anterior fibers)
- Adductor magnus
- Adductor longus
- Adductor brevis
- Gracilis
- Pectineus
- Tensor fasciae latae

Abduction 30–50°
- Gluteus maximus
- Gluteus medius
- Gluteus minimus
- Tensor fasciae latae
- Sartorius
- Piriformis (with flexed hip)

Adduction 30°
- Adductor magnus
- Adductor longus
- Adductor brevis
- Pectineus
- Gracilis
- Psoas major
- Iliacus
- Gluteus maximus (low fibers)

Knee

Flexion 120–150°
- Biceps femoris
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Gastrocnemius
- Popliteus
- Plantaris

Extension 0–15°
- Rectus femoris
- Vastus lateralis
- Vastus medialis
- Vastus intermedius

Medial Rotation (when flexed) 20–30°
- Semitendinosus
- Semimembranosus
- Gracilis
- Sartorius
- Popliteus

Lateral Rotation (when flexed) 30–40°
- Biceps femoris

Ankle

Dorsiflexion 20°
- Tibialis anterior
- Extensor digitorum longus
- Extensor hallucis longus

Plantar Flexion 50°
- Gastrocnemius
- Soleus
- Tibialis posterior
- Peroneus longus
- Peroneus brevis
- Flexor digitorum longus
- Flexor hallucis longus
- Plantaris

Inversion 45–60°
- Tibialis anterior
- Tibialis posterior
- Flexor digitorum longus
- Flexor hallucis longus
- Extensor hallucis longus

Eversion 15–30°
- Peroneus longus
- Peroneus brevis
- Extensor digitorum longus

to bone contact. Grinding or clicking may be heard or felt by the client. Active extension of the knee may also reveal lateral tracking of the patella when the rectus femoris and vastus lateralis contract with greater force than the vastus medialis.

- **Active abduction of the hip** may be restricted if medial rotation of the femur and knee valgus are present.
- **Active dorsiflexion of the ankle** may be restricted if the plantar flexors of the ankle are short and tight.

Passive ROM

Compare the client's P ROM on one side to the other when applicable. Note and compare the end feel for each range (see Chapter 1 for an explanation of end feel).

- **Passive flexion and extension of the knee** may reveal crepitus.
- **Passive extension of the knee** may reveal lateral tracking of the patella when the lateral retinaculum is tight or medial tracking if the medial retinaculum is tight.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the knee. Compare the strength of the affected side to the unaffected side.

- **Resisted extension of the knee** may reveal weakness in the quadriceps and cause pain in the anterior knee.
- **Resisted flexion of the knee** may cause pain in the anterior knee.
- **Resisted abduction of the hip** may reveal weakness in the gluteal muscles.

SPECIAL TESTS

The following special tests can help you to determine which structures are contributing to pain and when a client should be evaluated by a medical professional using X-ray or other tools, which may reveal conditions that are contraindications or require special considerations when planning treatment with massage.

The patellar glide test is used to assess the medial and lateral mobility of the patella (Fig. 10-5). This test may also reveal crepitus.

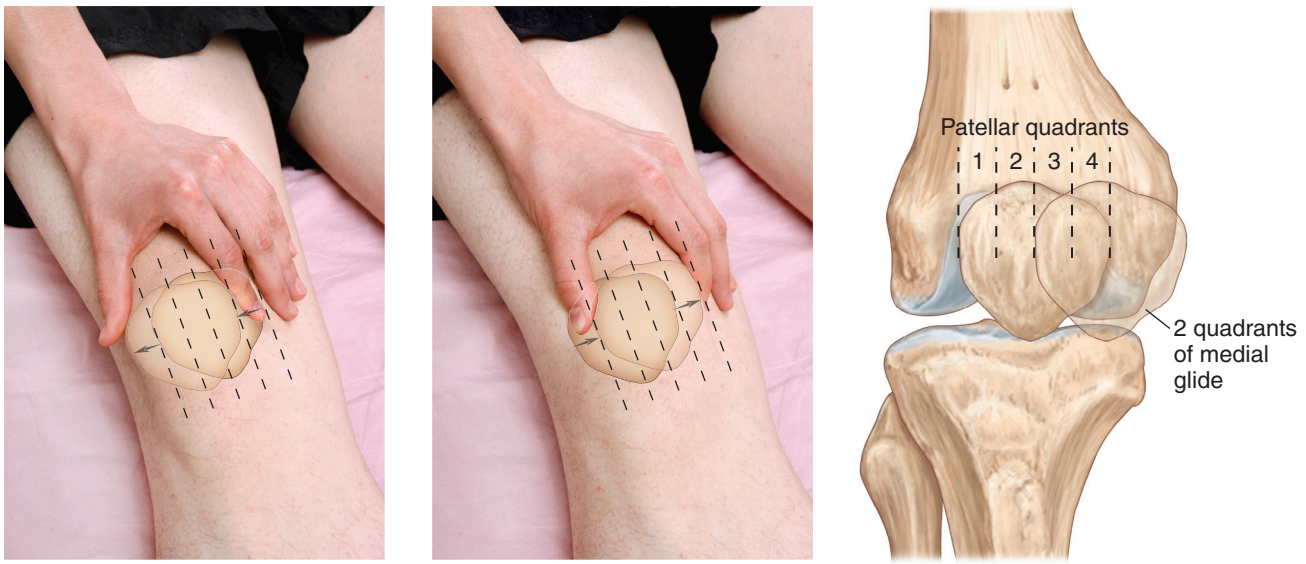


Figure 10-5 **Patellar glide test.** Slowly and gently, glide the patella laterally and medially to assess its mobility.

Figure 10-6 Vastus medialis coordination test. Test the functioning of the vastus medialis with resisted extension.

1. The client should be supine with a bolster under the knees and the quadriceps relaxed.
2. Place your thumb on one side of the patella and one or two fingers on the other side.
3. Slowly and gently glide the patella laterally and medially to assess its mobility. Ideally, the patella should move a distance equal to approximately half of its width in either direction.
4. Limited medial glide suggests that lateral structures are restricting movement. Limited lateral glide suggests that medial structures are restricting movement.

The vastus medialis coordination test is intended to isolate and assess the function of vastus medialis during extension of the knee (Fig. 10-6).

1. The client is supine with the knees extended and the quadriceps relaxed.
2. Place your fist under the distal thigh, superior to the affected knee.
3. Ask the client to slowly extend the knee without moving other joints while you assess the coordination of that action.
4. If you feel the client pushing the thigh into your fist or pulling away from your fist or if he or she flexes the hip to raise the leg, ask him or her to perform the action again by extending only the knee. You may also be able to see the orientation of the teardrop-shaped vastus medialis.
5. The test is considered positive for vastus medialis oblique dysfunction if the client has difficulty extending the knee or if he or she recruits muscles other than the quadriceps to perform this action.

PALPATION ASSESSMENT

Dysfunction in any joint from the sacroiliac to the metatarsals may cause or result from patellofemoral dysfunction. Because contributing factors may vary widely, it is essential to assess the tissues of each individual client from the ilium to the toes. It should not be surprising to find minor or even major differences in the way the tissues respond to this dysfunction.

Assess the knee for atypical temperature, color, and texture. You may find inflammation, adhesions, and tenderness around the patella. If the patella is tracking laterally, you may find the lateral retinaculum, iliotibial band, vastus lateralis, rectus femoris, and tensor fasciae latae tight and adhered; they may contain trigger points. The vastus medialis oblique may be hypotonic, and the semitendinosus, gracilis, and sartorius—muscles that blend into the pes anserinus tendon—may be dense and adhered with trigger points. Crepitus, fibrotic tissue, or a plica cord may be palpated at the medial knee. The hamstrings may feel tight and dense due to flexion contracture. Depending on the biomechanical factors involved, the adductors may be dense and adhered and the abductors taut or weak.

The gastrocnemius may also be tight due to flexion contracture at the knee. If eversion of the ankles is a factor, the peroneus longus and brevis and the extensor digitorum longus may be short and tight. These two factors may also play a role in developing plantar fasciitis, in which case the plantar flexors may be short and tight, and the tissues of the plantar surface of the foot may be thick, dense, and tender. Chapter 11 covers plantar fasciitis in more detail. If the client has a long history of knee pain or injury or has had surgery, you may find scar tissue and adhesions in the affected areas.

Trigger points that refer pain into the anterior knee may be found in the sartorius, rectus femoris, vastus medialis, vastus lateralis, adductor brevis, and adductor longus. See Figure 10-7 for common trigger points with referrals into the anterior knee.

Condition-Specific Massage

Because the causes of knee pain vary widely, the exact cause can be difficult to pinpoint, and more than one of these conditions may coexist. Systemic conditions that involve cautions or contraindications for massage may be the underlying cause of knee pain. If you feel uncertain that symptoms are caused by improper tracking of the patella or any of the soft tissue dysfunctions listed above, refer the client for medical assessment by a health care provider prior to treatment with massage.

It is essential for the treatment to be relaxing. You are not likely to eliminate the symptoms associated with patellofemoral syndrome or any of the coexisting conditions in a single treatment. Do not attempt to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure you are applying keeps him or her from fully relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised. Ask the client to let you know if any part of your treatment reproduces symptoms, and always work within his or her tolerance. Deep palpation of a trigger point may cause pain at the upper end of the client's tolerance. Explain this to your client, describe a pain scale with a level of pain that should not be exceeded, and ask him or her to breathe deeply during the application of the technique. As the trigger point is deactivated, the referral pain will also diminish. Common trigger points and their referral patterns are shown in Figure 10-7.

The following suggestions are for treating the more common presentation of patellofemoral syndrome, caused primarily by improper lateral tracking of the patella. If the client has an acute injury, the protocol is PRICE (protection, rest, ice, compression, and elevation). You may work conservatively proximal or distal to the site, but avoid the area of injury until the subacute or chronic stage.

- Begin in the supine position with the knees bolstered.

- If you notice swelling, apply superficial draining strokes toward the nearest lymph nodes.

- If swelling is minor or absent, apply moist heat to the anterolateral thigh above the knee on the affected side. Do not use heat if swelling is significant.


- Use your initial warming strokes to increase superficial circulation, soften tissues, and to assess the tissues from the ASIS down to the feet. You should be able to minimally assess tissues of the thigh, leg, and foot, which may help you to determine where to focus the time remaining after treating the knee.

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

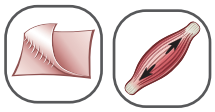
Figure 10-7 **Common trigger points and referral.** Common trigger points associated with patellofemoral syndrome and their referral patterns.

- Before applying emollient, assess for and treat myofascial restrictions in the thigh. You may find restrictions along the length of the iliotibial band, in the lateral quadriceps, and at the medial thigh and knee.

- Treat the tissues of the thigh generally to reduce tension and to continue reducing adhesions.

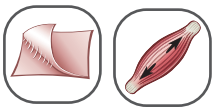
- Once the superficial tissues are pliable enough to allow for deeper work, lengthen tissues that are short and tight, and reduce tension in tissues that are taut. These may include the rectus femoris, vastus lateralis, tensor fasciae latae, iliotibial band, gracilis, sartorius, semitendinosus, and the adductors (Fig. 10-8).

- Treat any trigger points that are found.



- Assess the tissue surrounding the patella and knee joint for crepitus, adhesions, and fibrous tissues. Tissues affected may include the medial and lateral retinacula of the knee, the pes anserine tendon, the quadriceps tendon, the patellar tendon, and the iliotibial band (Fig. 10-9). Use small, focused strokes to release these tissues. If the structures are short and tight, follow this by long strokes in the direction of each muscle's fibers to restore length and tone. Take your time with this step, and treat the area thoroughly within the client's tolerance.

- If you found the adductors and medial hamstrings to be short and tight, stretch them by passively abducting the hip. Perform PIR, if necessary, to relax and lengthen these muscles if a passive stretch is insufficient.



- If eversion is a contributing factor, assess and treat the peroneal muscles and extensor digitorum longus for adhesions, increased tone, and trigger points (Fig. 10-10, p. 252).

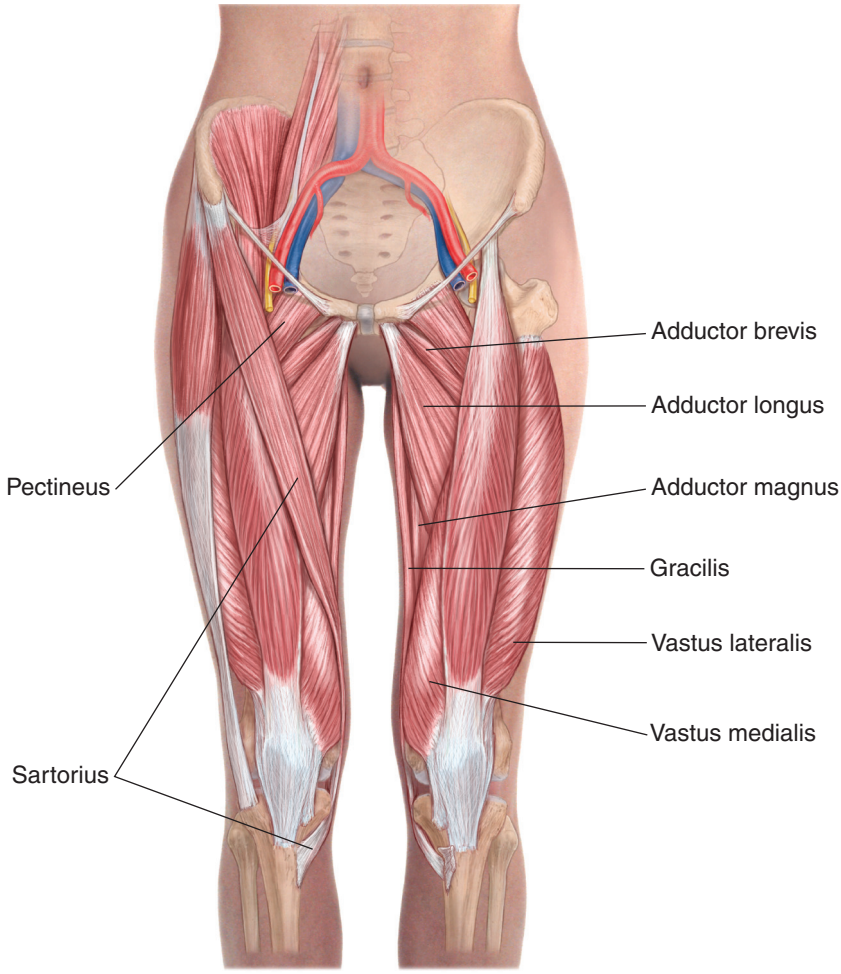
- Use clearing strokes to the entire lower extremity to increase venous return.

- Turn the client prone with a bolster under the ankles. Stretch the lateral quadriceps by bringing the heel toward the buttocks and gently pulling the leg toward you. Use PIR to encourage lengthening if you note resistance.

- If time permits, assess and treat the gluteal muscles, hamstrings, and plantar flexors for adhesions, hypertonicity, and trigger points if found.

- Use clearing strokes to the entire lower extremity to increase venous return.

The treatment overview diagram summarizes the flow of treatment (Fig. 10-11, p. 253).



VASTUS LATERALIS

Origin	*Lateral linea aspera, gluteal tuberosity.*
Insertion	*Tibial tuberosity.*
Action	*Extend knee.*
Nerve	*Femoral.*

GRACILIS

Origin	*Inferior ramus of pubis, ramus of ischium.*
Insertion	*Proximal, medial tibia at pes anserine.*
Action	*Adduct hip, medially rotate hip, flex knee, medially rotate flexed knee.*
Nerve	*Obturator.*

ADDUCTOR MAGNUS

Origin	*Inferior ramus of pubis, ramus of ischium, ischial tuberosity.*
Insertion	*Medial linea aspera, adductor tubercle.*
Action	*Adduct hip, medially rotate hip, assist to flex hip, posterior fibers extend hip.*
Nerve	*Obturator and tibial.*

ADDUCTOR BREVIS

Origin	*Inferior ramus of pubis.*
Insertion	*Pectineal line and medial linea aspera.*
Action	*Adduct hip, medially rotate hip, assist to flex hip.*
Nerve	*Obturator.*

VASTUS MEDIALIS

Origin	*Medial linea aspera.*
Insertion	*Tibial tuberosity.*
Action	*Extend knee.*
Nerve	*Femoral.*

SARTORIUS

Origin	*Anterior superior iliac crest.*
Insertion	*Proximal, medial tibia at pes anserine.*
Action	*Flex hip, laterally rotate hip, abduct hip, flex knee, medially rotate flexed knee.*
Nerve	*Femoral.*

ADDUCTOR LONGUS

Origin	*Pubic tubercle.*
Insertion	*Medial linea aspera.*
Action	*Adduct hip, medially rotate hip, assist to flex hip.*
Nerve	*Obturator.*

PECTINEUS

Origin	*Superior ramus of pubis.*
Insertion	*Pectineal line of femur.*
Action	*Adduct hip, medially rotate hip, assist to flex hip.*
Nerve	*Femoral and obturator.*

Figure 10-8 **Muscles of the anterior thigh.** Assess and treat the thigh for myofascial restrictions, hypertonicity, and trigger points. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

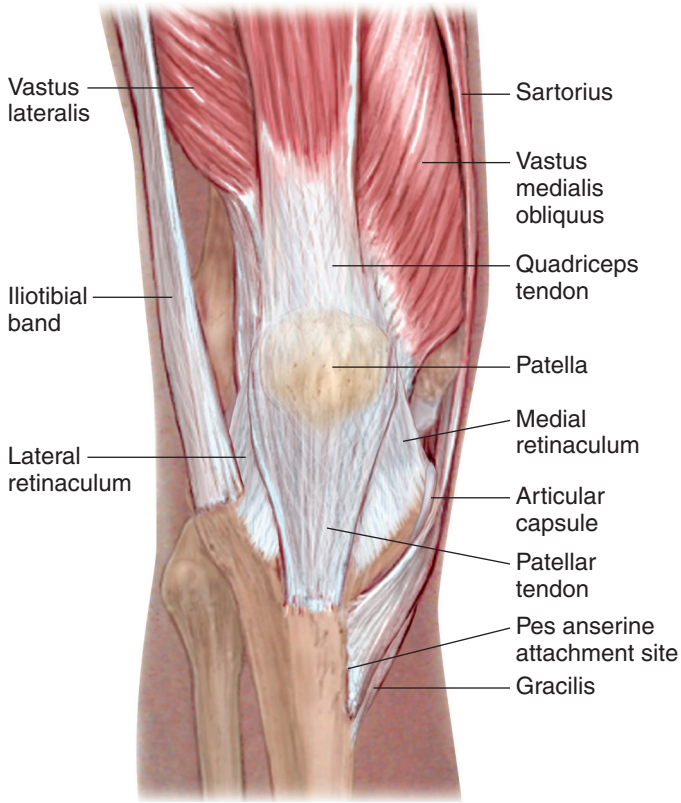


Figure 10-9 Soft tissues surrounding the knee. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

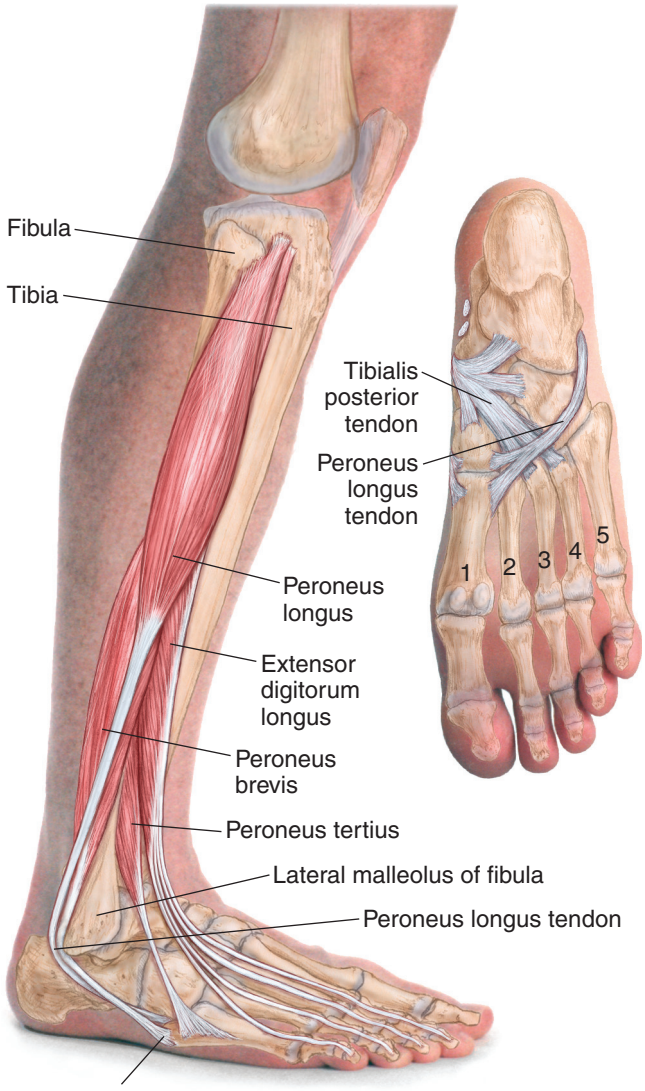
CLIENT SELF-CARE

A client with patellofemoral pain may benefit from wearing a knee brace during activity, in particular if his or her activities include sports, repetitive actions, or weight-bearing motions of the knee such as squatting and lifting heavy objects. If the client wears a brace, recommend that he or she remove the brace during periods of inactivity to avoid reduced circulation to the area if the health care provider agrees. Clients with pes planus or eversion of the ankle may benefit from corrective arch support. Refer the client to a podiatrist for an assessment and fitting for corrective arch support.

The following are intended as general recommendations for stretching and strengthening muscles involved in the client's condition. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care because their daily lives are busy. Encourage them to follow these guidelines:

- Instruct the client to perform self-care throughout the day, such as while taking a phone call, reading e-mail, washing the dishes, or watching television instead of setting aside extra time. When performing self-care while standing, ask the client to notice if he or she is shifting weight to one leg, if the knees are close together, and if the femur is medially rotated. If so, instruct the client to focus on distributing weight evenly to both legs and to keep the toes pointed forward within his or her comfort level.
- Encourage your client to take regular breaks from stationary postures or repetitive actions. If the client's daily activities include hours of sitting, suggest moving for at least a few minutes every hour. If the client's daily activities require repetitive actions affecting the knee, suggest resting for at least a few minutes every hour.



PERONEUS LONGUS

Origin	*Proximal, lateral fibula.*
Insertion	*Base of 1st metatarsal and medial cuneiform.*
Action	*Evert foot, assist in plantar flexion of ankle.*
Nerve	*Superior peroneal.*

PERONEUS BREVIS

Origin	*Distal lateral fibula.*
Insertion	*Tuberosity of 5th metatarsal.*
Action	*Evert foot, assist in plantar flexion of ankle.*
Nerve	*Superior peroneal.*

EXTENSOR DIGITORUM LONGUS

Origin	*Proximal anterior fibula, interosseus membrane.*
Insertion	*Middle and distal phalanges of toes 2–5.*
Action	*Extend toes 2–5, dorsiflex ankle, evert foot.*
Nerve	*Deep peroneal.*

Figure 10-10 Muscles that evert the ankle. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

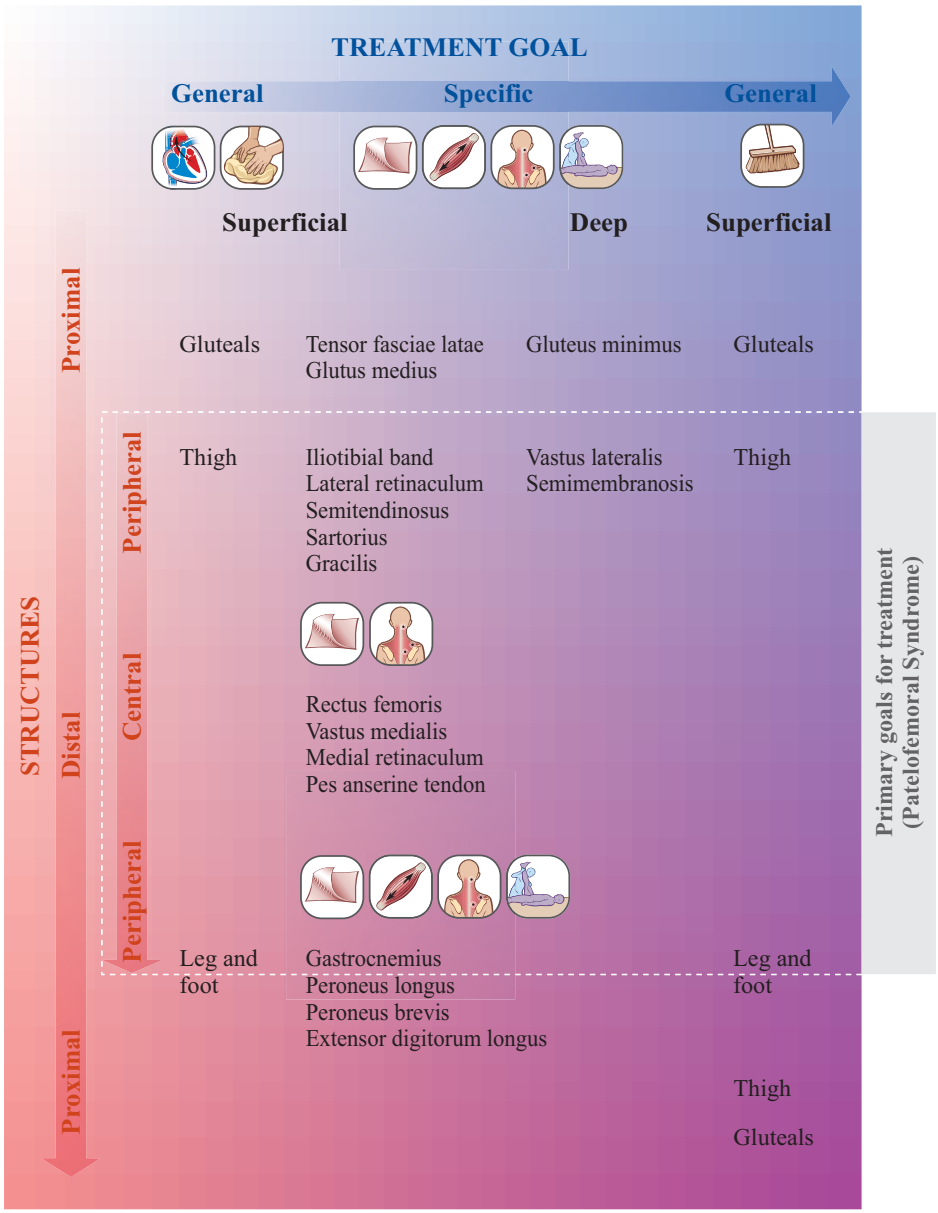


Figure 10-11 **Patellofemoral syndrome treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating patellofemoral syndrome.

- Demonstrate gentle self-massage of the tissues surrounding the knee to keep adhesions and hypertonicity at bay between treatments.
- Demonstrate all strengthening exercises and stretches to your client and have him or her perform these in your presence before leaving to ensure that he or she is performing them properly and will not cause harm when practicing alone. Stretches should be held for 15–30 seconds and performed frequently throughout the day within the client's limits. The client should not force the stretch or bounce. Stretching should be slow, gentle, and steady, trying to keep every other joint as relaxed as possible.
- Stretching and strengthening exercises should be recommended according to your findings in ROM testing and palpation. Because patellofemoral syndrome may present differently with each client, self-care should be tailored to specific needs.

Stretching

To stretch the lateral structures that may contribute to drawing the patella laterally, instruct the client to stand at an arm's length from a wall with the affected side toward the wall. Rest one hand

Figure 10-12 Stretch the lateral structures of the leg.

Figure 10-13 Stretch the hamstrings and plantar flexors while strengthening the quadriceps. Sit comfortably with the back supported, and then extend the knee and dorsiflex the ankle.

on the wall for support, and with the feet together, laterally flex the trunk away from the wall and hold for 15–30 seconds (Fig. 10-12). Do not perform this stretch if it increases pressure on the medial knee. If you found the gluteus medius weak or stretched, instruct the client to adjust their posture in this stretch until it is felt primarily in the lateral leg instead of in the gluteal muscles.

To stretch the hamstrings and plantar flexors while seated, instruct the client to sit comfortably with the back supported, and then extend the knees and dorsiflex the ankles and hold for 15–30 seconds or as long as is comfortable (Fig. 10-13). This action also helps to strengthen the quadriceps. Repeat this action a few times, and then get up and walk around to mobilize the knee.

If eversion contributes, instruct the client to simultaneously stretch the evertors and strengthen the invertors by actively inverting the ankle fully and holding for as long as is comfortable. Repeat this action a few times, and then get up and walk around to mobilize the ankle.

Strengthening

While it is difficult to isolate the vastus medialis oblique from the other quadriceps, it is important to restore its strength and tone so that it can antagonize lateral tracking of the patella. The seated hamstring stretch described above also strengthens the quadriceps. Repeating the steps of the vastus medialis coordination test (Fig 10-6) with a rolled towel or other bolster under the thigh just above the knee will also strengthen the vastus medialis.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client with patellofemoral syndrome will have treatments twice a week until the client can perform activities of daily living with minimal or no pain for at least 4 days. Once this is achieved, reduce frequency to once per week until symptoms are absent for at least 7 days. When the client reports that he or she has been pain-free for more than 7 days, treatment can be reduced to twice

per month. If the client is pain-free for 3 or more consecutive weeks, he or she can then schedule once per month or as necessary. If the client's symptoms are localized and other postural deviations are minimal, half-hour treatments may be sufficient to effect a change in patellofemoral function. In the treatment of patellofemoral syndrome that is muscular in nature, there should be some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give the newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest. Explain the importance of the client's participation in the healing process, and encourage the client to follow your recommendations, but be careful not to judge or reprimand a client who does not.
- The condition is advanced or involves other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy altogether and hinder healing.
- The client has an undiagnosed, underlying condition. Discontinue treatment until the client sees a health care provider for a medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be able to take this client through the full program of healing. Still, if you can bring some relief in just one treatment, it may encourage the client to discuss this change with his or her health care provider and seek manual therapy rather than more aggressive treatment options. If the client agrees to return for regular treatments, his or her symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on deeper tissues in a specific area. Likewise, once you have treated the structures specific to patellofemoral syndrome, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Ronja is a 64-year-old, married female. She is a retired accountant. Ronja and her husband moved from suburban Chicago to San Francisco following their retirement last year. Over the past 2 months she has had knee pain, which is becoming worse. Currently, the pain makes it difficult for her to walk the hills of San Francisco to run her errands.

Subjective

Ronja complained of knee pain that began approximately 2 months ago and has been increasing gradually. She feels aches, sometimes throughout the day, in both knees and feels pain around her right kneecap and on the inside of her knee when she walks. The pain keeps her from performing some activities on some days. She moved from a suburban setting where she worked sitting at a desk all day and had to drive everywhere, because everything was far from her home. She and her husband made a complete lifestyle change that included moving to a more natural environment where locally grown foods are readily available, and they could walk or ride a bike instead of driving. It was difficult at first for her to adjust to the increased activity, but she did not have any pain until recently. Her physician diagnosed chondromalacia and said that she would eventually need knee replacement surgery. He said that while nothing showed up on an MRI, it is probably in the early stages and will show up later. He gave her a prescription for physical

therapy. She was referred by a friend who was treated at this clinic and experienced a full recovery from similar symptoms.

Objective

Ronja appears very healthy and vibrant and looks many years younger than her age. She climbed the stairs very slowly, mainly relying on the left leg to lift her weight. She also stood up from a seated position very cautiously but without leaning on the table or chair for support.

Postural assessment revealed increased lordotic curve with anterior pelvic tilt, slight lateral rotation of the hips bilaterally, flexion of the knees bilaterally, and ankle eversion bilaterally. The four lateral toes of the right foot are hyperextended. The Q angle appears within normal range. Medial patellar glide is reduced. ROM testing resulted in reduced active extension of the knees bilaterally, which is possibly a protective measure. The client felt pain in the medial knee with resisted extension of the knee and resisted adduction of the hip. During passive extension of the right knee, Ronja tensed up at the end range. Crepitus was noted during extension and flexion of the right knee. There was weak abduction of the right hip and minimal active inversion of the ankles. There was only slightly greater range with passive inversion.

Palpation revealed tension in rectus femoris which is adhered to a hypertonic vastus lateralis and a dense, fibrous iliotibial band on the right. Fascial restrictions along the lateral right thigh from ASIS to tibiofibular joint. The medial aspect of the patellofemoral joint was tender to the touch with considerable crepitus and possible plica cord. The vastus medialis feels fibrous and hypotonic. The semitendinosus, sartorius, and gracilis, along with the pes anserine tendons, are taut and tender with adhesions at the distal fibers. The hamstrings feel dense and adhered only at the distal, medial fibers. The peroneals and extensor digitorum longus are short, tight, and adhered. The ankle invertors are taut and weak.

Signs and symptoms suggest patellofemoral syndrome with mild hyperlordosis.

Action

Treatment today focused on reducing knee pain. If the client agrees, future treatment will include restoring proper knee function, pelvic tilt, orientation of the femur and the tibia, and ankle function.

On the right thigh, I performed myofascial release from the ASIS to the tibiofibular joint. I used cross-fiber friction on the iliotibial band. I then used petrissage followed by muscle stripping to the rectus femoris, vastus intermedius and vastus lateralis, and IT band. A trigger point was found at the superior fibers of the rectus femoris that referred into the anterior knee. Two rounds of compressions reduced referral pain from level 7 to 2. I applied cross-fiber strokes to the medial knee to release metabolites and reduce crepitus followed by clearing strokes toward the inguinal lymph nodes. I applied general kneading to the medial thigh. I used cross-fiber strokes from the pes anserine along the path of the sartorius and again along the path of the gracilis and the medial hamstrings to separate the fibers of the muscles of the medial thigh, followed by long gliding strokes. I used muscle stripping to lengthen the sartorius and medial hamstrings and performed a stretch to the medial hamstrings. I applied myofascial release, superficial cross-fiber strokes, and muscle stripping to reduce adhesions and lengthen ankle evertors.

I used similar, although less aggressive, treatment to the left thigh and leg. I also applied general deep tissue techniques to the low back, gluteals, calves, and feet.

Following treatment, the client stated feeling looser and less protective with steps. Ronja descended the stairs with less caution, although she did use the handrail.

Plan

I demonstrated a hamstring stretch with knee extension and hip flexor stretches with lunges. I recommended speaking with a podiatrist about shoes with good arch support or being fitted for orthotics to reduce eversion. I demonstrated strengthening for ankle invertors and vastus medialis and emphasized the importance of limiting exercises to a pain-free range. I suggested slowly reintroducing activities that had previously resulted in pain.

I explained that reducing symptoms at the knee alone is manageable with half-hour sessions but that biomechanical factors at the hip and ankle likely contribute to her pain and a more complete recovery would best be managed with 1-hour sessions. Ronja has agreed to 1-hour treatments twice a week until symptoms are absent for at least 4 consecutive days with reassessment at that time.

CRITICAL THINKING EXERCISES

1. In general, the most common presentation of patellofemoral syndrome emerges when the lateral structures that move and stabilize the knee in extension are stronger than the medial structures. Create a SOAP chart with a history, assessment, and treatment plan that describes a case of patellofemoral syndrome due to excessive medial tracking of the patella. This client likely presents with pain and tenderness at the lateral knee, weakening of structures that affect lateral tracking, and tension in structures that affect medial tracking. Treatment goals should include lengthening shortened tissues, strengthening weak muscles, and restoring proper neuromuscular function.
2. Develop a 10-minute stretching and strengthening routine for a client, covering all of the muscles involved in patellofemoral syndrome. Use Box 10-1 and Figure 10-4 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles. Describe each step of the routine in enough detail that the client can refer to these descriptions in your absence and perform them without harm.
3. A client calls to schedule a massage for knee pain. He states that he hears crunching and clicking in his knee when he stands up and sometimes when he walks. He explains that he has sprained the ankle of the affected leg twice and the ankle of the opposite leg once. He has also had an episode of myositis ossificans to the tibialis anterior after being kicked during a soccer game. Discuss the possible relationship between the injuries and patellofemoral syndrome. What questions would you ask this client? Are there questions that you need to ask his health care provider? What special considerations would you need to include in your treatment plan both for contributing factors and for contraindications?
4. Conduct a short literature review to explain the relationship between symptoms suggesting patellofemoral syndrome and the following:
   - Pes cavus
   - Arthritis
   - Insufficient anterior prominence of the lateral femoral condyle
   - Depth of the patellar groove
   - Patellar taping

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CHAPTER 11

Plantar Fasciitis

UNDERSTANDING PLANTAR FASCIITIS

Plantar fasciitis is irritation and inflammation of the plantar fascia. The plantar fascia is a strap of connective tissue that connects the calcaneus to the toes (Fig. 11-1). It is thick and strong in the center with thinner, weaker wings along the medial and lateral foot. The central band is often referred to as the plantar aponeurosis. It is attached to the medial calcaneal tubercle proximally and divides into five bands that merge with the flexor tendons at the proximal phalanx of each toe. The collagen fibers of the plantar fascia are oriented mostly longitudinally and are arranged in bundles but are reinforced by transverse fibers just inferior to the metatarsal heads. The plantar fascia and calcaneal tendon both have attachments on the calcaneus, linking their roles in plantar flexion and dorsiflexion.

Structurally, the plantar fascia connects the bones of the foot, supports the arch of the foot, and minimizes impact to the arch during weight-bearing activities. Functionally, the plantar fascia operates similarly to what is called the windlass mechanism: extending the toes puts tension on the fascia, which shortens the arch and creates a spring. In normal gait, plantar flexion initiates the heel-off phase, and the windlass mechanism of the plantar fascia increases the strength of propulsion at the push-off phase as the tension is released. The calcaneal attachment of the plantar fascia is much smaller than the distal attachments at the proximal phalanges. This concentrates a great amount of force on a small area at the calcaneal tubercle when either the support mechanism or the windlass mechanism is activated during weight-bearing activity.

The two heads of the gastrocnemius and the soleus blend into the calcaneal tendon. This grouping of muscles is called the triceps surae. The triceps surae attaches to the tuberosity of the posterior calcaneus via the calcaneal tendon. When the calcaneal tendon shortens during plantar flexion, it pulls the calcaneus posteriorly and superiorly while tensile stress in the plantar fascia draws the calcaneus anteriorly, leaving the small attachment site situated between tensile forces in virtually opposite directions (Fig. 11-2). When these structures are strong, flexible, and unhindered by dysfunction, forces are distributed efficiently to produce smooth movement. Plantar fasciitis is one possible result when biomechanical factors and soft tissue dysfunction keep those forces from being distributed efficiently.

Common Signs and Symptoms

Plantar fasciitis usually develops gradually, but it can appear suddenly and can be acute. It typically occurs unilaterally but can be bilateral. The most common symptom of plantar fasciitis is sharp, burning, or aching pain in the arch of the foot. The worst of the pain is often felt in the push-off phase of gait, when passive extension of the toes increases tensile stress in the plantar fascia. Pain is often most intense near the calcaneal attachment of the plantar fascia where tearing is most likely to occur, but pain sometimes spreads along the medial border of the arch of the

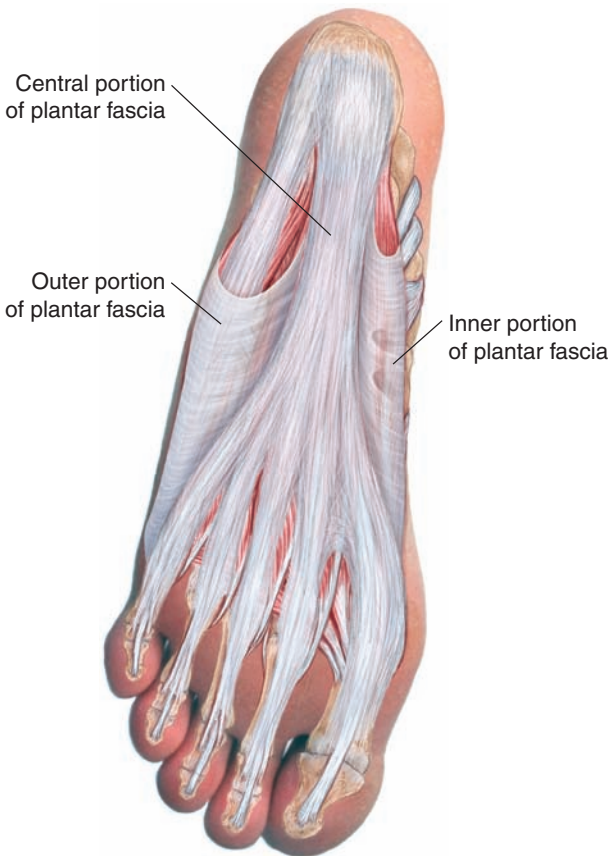


Figure 11-1 **Plantar fascia.** The plantar fascia is thick connective tissue that supports the arch of the foot. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

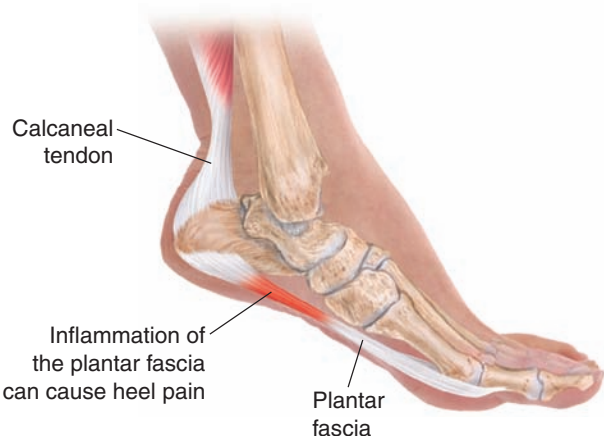


Figure 11-2 **Localized pain characteristic of plantar fasciitis.** The medial calcaneal tubercle is situated between tensile forces in virtually opposite directions, increasing the risk of injury.

foot toward the toes. Symptoms are felt most frequently with the first steps in the morning or after rest. During periods of inactivity, when the injured tissues undergo the process of repair, the plantar fascia contracts and loses flexibility, making those first steps the most painful. As the tissues warm up and become more flexible, symptoms may improve or subside temporarily, but if left untreated, they are likely to return following subsequent periods of rest.

Pain may also be felt while standing, when bearing weight increases tensile stress in the plantar fascia. This is particularly true when the toes are extended either actively or passively. Climbing stairs increases the demand on these structures and may also be painful. Standing on the toes involves plantar flexion of the ankle, which shortens the calcaneal tendon, and passive extension of the toes, which adds tensile stress to the plantar fascia. When the integrity of the plantar fascia is compromised, this action may cause pain, swelling, or tearing of fibers. In all of the cases described above, tension in the plantar fascia increases stress on the periosteum of its small bony attachment on the calcaneus, pulling the tissue away from the bone, which may result in the development of bone spurs. Likewise, stress and tearing of the tissue often result in inflammation of the plantar fascia, which in turn increases sensitivity and pain. When pes cavus is a contributing factor, or if the individual attempts to avoid pain in the arch by walking on the outside of the foot, pain may be felt on the lateral foot due to increased impact during activity.

Possible Causes and Contributing Factors

Many possible factors may contribute to plantar fasciitis, but the factor cited most frequently is overuse. Overuse occurs with any activity in which exaggeration of the normal mechanical function of the tissue may lead to inflammation and tearing. A new or intense exercise regimen that

involves running, jumping, or other actions that increase tensile stress on the plantar fascia puts the unconditioned tissues at risk for injury. Standing for long periods on hard, inflexible surfaces increases demand on the spring mechanism of the plantar fascia and also increases the risk of injury. The injured tissue, which repairs itself by forming scars, is continually at risk for further tearing, fibrosis, and inflammation, increasing the risk of bone spurs, and continuing the cycle until the contributing factors are resolved. In addition, because the plantar fascia has a limited blood supply, it heals slowly.

But while plantar fasciitis is often referred to as an overuse injury, underuse may also be a predisposing factor. Inactivity not only decreases circulation to the area, reducing hydration and nutrition to the tissues, but it may also contribute to adhesions, contractures, and joint dysfunction. Sedentary routines may affect the length and strength of the muscles that move the foot as well as the soft tissues that support the structures of the foot. If the foot is not rested flat on the floor while sitting, the ankle may rest in plantar flexion, passively shortening the plantar flexors and the calcaneal tendon, and the toes may be held in passive extension, increasing tension on the plantar fascia. Knee flexion also shortens the gastrocnemius and may affect its resting tone. During sleep or another recumbent position, the ankles generally rest in passive plantar flexion, which may contribute to adhesions and shortening of the plantar flexors, particularly if neuromuscular health is compromised.

Eversion contributes to pes planus, which stretches the plantar fascia taut, reducing its ability to provide the protective spring mechanism during weight-bearing activity. Pes cavus, conversely, brings the origin and insertions together, shortening and thickening the plantar fascia, reducing its ability to absorb shock during weight-bearing activity. Femoral and tibial rotations, common with patellofemoral syndrome, may also affect the orientation of the ankle and contribute to plantar fasciitis. Left untreated, chronic plantar fasciitis continues to affect gait and may contribute to the development of knee, hip, and back pain.

Improper footwear is a common contributing factor to plantar fasciitis. Shoes that do not fit well, that have worn around the edges increasing eversion or inversion, or that do not provide sufficient arch support may alter biomechanics and stress the plantar fascia. When such a deviation exists, an orthotic may be necessary. Orthotics are prescribed, and should be tailored to individual needs and reassessed frequently as gait patterns change and structures adapt. High-heeled shoes also contribute to plantar fasciitis because they increase plantar flexion and passive extension of the toes.

Weight gain, particularly when it occurs rapidly, increases the demand on the plantar fascia primarily by flattening the arch and stretching the fascia. During pregnancy there is rapid weight gain in addition to hormonal changes that loosen connective tissues, which may contribute to increased demand and reduced functionality of the plantar fascia. Some types of arthritis that affect tendons and ligaments may also contribute to plantar fasciitis. Ankylosing spondylitis—a form of arthritis that often begins in the spine and results in fusion of the vertebrae—may progress to affect the hips, knees, and ankles. Reiter's syndrome is an inflammatory disorder of the joints that often occurs following infection in the intestines or urinary tract, causing degeneration at the attachment sites of ligaments and tendons. Although it is unclear why, thickening of the deep tissues of the foot, which contributes to plantar fasciitis, is common among diabetics. Diabetics are also more prone to peripheral neuropathies, which may coexist or be confused with plantar fasciitis. Corticosteroids, which are often injected to relieve the pain and inflammation, may also contribute to the weakening of ligaments, tendons, and bone as well as atrophy of the fat pads in the foot, in turn contributing to chronic cases or the risk of more serious injury. For this reason, the number of repeated injections to a specific area is often limited, and local massage is contraindicated for several days following injections.

Table 11-1 lists conditions commonly confused with or contributing to plantar fasciitis.

Contraindications and Special Considerations

First, it is essential to understand the cause of foot pain. If the client has a history of arthritis, cartilage degeneration, or previously unresolved injuries or if you suspect the client has a fractured bone or significant tearing to the tissues, work with the client's health care provider and

Table 11-1 Differentiating Conditions Commonly Confused with or Contributing to Plantar Fasciitis

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Tarsal tunnel syndrome (compression of the posterior tibial nerve)	Tingling, burning, and numbness or sharp, shooting pain in the medial ankle, heel, arch, and toes Symptoms may extend into the calf Symptoms may occur at rest, and worsen with activity	Dorsiflexion-eversion test Tinel's sign MRI EMG Nerve conduction velocity test	Massage is indicated to reduce adhesions and hypertonicity that may contribute to compression. Take caution not to reproduce symptoms or further compress the nerve.
Stress fracture (calcaneus, tarsals, or metatarsals)	Symptoms may be mistaken for soft tissue trauma Swelling, bruising Pain increases with activity and often persists during rest Limited ROM	X-ray (stress fracture may not be apparent until symptoms have persisted for weeks) MRI Bone scan	Massage is locally contraindicated until bone is healed. Massage peripheral to injury or to reduce compensating patterns is indicated with caution. Circulatory massage distal to a cast is contraindicated to avoid congestion under the cast.
Calcaneal tendon injuries	Pain in joint crossed by tendon Swelling Pain worsens with weight-bearing activity such as jumping, squatting, or climbing stairs Reduced ROM	Physical exam ROM tests	Massage is indicated. See Chapter 14 for suggestions for treating calcaneal tendinitis.
Heel fat pad atrophy	Localized heel pain that does not radiate Deep, dull ache in middle of heel	Diagnosed by symptoms Tests may be performed if conservative treatment does not relieve symptoms	Massage is locally contraindicated until the symptoms subside. Massage peripheral to the heel may be supportive.
Ankylosing spondylitis	Pain often begins in the low back unilaterally and progresses bilaterally to the upper back, throughout the thorax, and possibly into the joints of the extremities Fatigue and anemia may develop	MRI Blood tests	Massage is indicated to reduce pain, maintain mobility, and slow the progress of joint distortion.
Reiter's syndrome (reactive arthritis)	Often preceded by infection, low-grade fever, or conjunctivitis Calcaneal tendon pain Heel pain Joint pain Skin lesions in palms or soles Redness, burning, or discharge from eyes Urinary urgency or burning	Physical exam Joint X-ray Urinalysis HLA-B27 antigen test	Massage is contraindicated until the infection is resolved and during active flare-ups of arthritis. Work with the health care provider to tailor the treatment plan to meet the individual's needs. Avoid skin lesions.

Table 11-1 Differentiating Conditions Commonly Confused with or Contributing to Plantar Fasciitis (Continued)

Condition	Typical Signs and Symptoms	Testing	Massage Therapy
Bone spur	Pain in heel, particularly with weight-bearing activity Local skin lesion may be present Reduced ROM	X-ray MRI CT scan	Massage will not reduce a bone spur but may be effective in reducing further damage due to tension in soft tissue. Be cautious with techniques that may fragment the spur.
Bursitis (retrocalcaneal)	Heel pain, particularly with activity or palpation Heat, redness, swelling, or tenderness at the back of the heel	Physical exam ROM tests X-ray or MRI if conservative treatment is not successful	Massage is systemically contraindicated if bursitis is due to infection, and locally contraindicated in the acute stage to avoid increased swelling. In the subacute stage, massage of the structures surrounding the joint is indicated.
Morton's neuroma	Burning and pain in the ball of the foot that radiates into the toes Numbness or tingling in the toes Symptoms most common between third and fourth toes	Palpation assessment for tender mass X-ray	Massage is indicated to reduce adhesions or scar tissue that may contribute to nerve irritation and to increase the space between the third and fourth metatarsals. Take care not to reproduce symptoms.
Gout	Redness, heat, and swelling Sudden, intense pain, often at night, that diminishes gradually over a couple of weeks	Physical exam Blood and urine uric acid concentration tests Synovial fluid test	Local massage is contraindicated during acute attacks. Gout may indicate other systemic conditions. Work with health care team.
Rheumatoid arthritis	Periods of flare-ups and remission Pain, swelling Aching and stiffness, particularly after rest or inactivity Reduced ROM Distortion of joint Rheumatic nodules Occasional low-grade fever and malaise	Physical exam Blood tests Synovial fluid tests Radiography	Massage is indicated in nonacute stages. Work with the health care team.

consult a pathology text for massage therapists before proceeding. These are a few general cautions:

- **Underlying pathologies.** Arthritis, bone fractures, or symptoms common to systemic conditions like diabetes may be contributing factors. If you suspect an underlying condition (consult Table 11-1 and your pathology book for signs and symptoms), refer the client to his or her health care provider for medical assessment before initiating treatment. If the client is diagnosed with an underlying pathology that is not a contraindication for massage, work with the health care team to develop a treatment plan that is appropriate for that individual.
- **Endangerment sites.** Be cautious with pressure around the dorsalis pedis artery where you feel its pulse.

- **Producing symptoms.** Symptoms may occur during treatment. If treatment produces symptoms, adjust the client to a more neutral posture. Reducing dorsiflexion may help. If this does not relieve the symptoms, reduce your pressure or move away from the area. You may be able to treat around the site that reproduced the symptoms, but proceed with caution.
- **Treatment duration and pressure.** If the client is elderly, has degenerative disease, or has been diagnosed with a condition that diminishes activities of daily living, you may need to adjust your pressure as well as the treatment duration. Frequent half-hour sessions may suit the client better. Take care when applying pressure or friction around the calcaneal attachment of the plantar fascia, particularly if there is any risk of tearing or rupture. If the client's symptoms are severe or his or her activities of daily living have been significantly reduced due to pain, recommend medical assessment to determine the degree of degeneration of tissue. If bone spurs are present, do not apply pressure directly, and avoid any techniques that might chip or detach the spur.
- **Friction.** Do not use deep frictions if the client has a systemic inflammatory condition such as rheumatoid arthritis, if the health of the underlying tissues is at risk for rupture, or if the client is taking anti-inflammatory medication. Friction creates an inflammatory process, which may interfere with the intended action of anti-inflammatory medication. Recommend that the client refrain from taking such medication for several hours before treatment if his or her health care provider agrees.
- **Injections.** If the client has had a steroid or analgesic injection within the previous 2 weeks, avoid the area. These injections reduce sensation, which may prevent the client from assessing your pressure adequately. Steroid injections may also alter the physiology of the tissues, increasing the risk of injury from deep massage techniques.
- **Tissue length.** It is important when treating myofascial tissues that you do not lengthen those that are already stretched. Assess for myofascial restrictions first and treat only those that are clearly present. Likewise, overstretched muscles should not be stretched from origin to insertion. If you treat trigger points in overstretched tissue, use heat or a localized pin and stretch technique instead of full ROM stretches.
- **Hypermobile joints and unstable ligaments.** Be cautious with mobilizations if the client has hypermobile joints or if ligaments are unstable due to injury, pregnancy or a systemic condition.

Massage Therapy Research

A thorough review of the literature revealed no research, case studies, or peer-reviewed articles specifically about the benefits of massage therapy for plantar fasciitis or heel pain. Many of the research studies of effective treatment for plantar fasciitis include stretching, although little attention is given to lengthening the muscles manually. In "A Combined Treatment Approach Emphasizing Impairment-Based Manual Physical Therapy for Plantar Heel Pain: A Case Series," Young et al. (2004) report the benefits of physical therapy techniques to mobilize the joints of the ankle and foot using manual therapy. Although this study involved treatment goals similar to those of massage therapy, the methods used to achieve them followed an impairment-based physical therapy approach, focused largely on mobilization, and did not include methods more common in massage therapy such as reducing adhesions, increasing local circulation, and releasing trigger points.

Several studies of treatment options including the use of orthotics, Botox, shock wave therapy, and splinting the ankle into dorsiflexion during sleep included "deep tissue massage" as part of the treatment, although none of these specified a procedure. Several articles reviewing recent literature regarding effective treatments suggest that while stretching increases ROM, it has not proven to be an effective, long-term solution for plantar fasciitis without other interventions. These results suggest a need for detailed studies of the specific benefits of massage therapy for treating not only the muscles but also the noncontractile tissues affected in plantar fasciitis. It

may be possible that focused stretching of the muscles without attention to fascia may not be sufficient for positive, long-term results.

The January 2001 issue of *The Journal of Bodywork and Movement Therapies* presented an interesting interdisciplinary look at plantar fasciitis. The survey begins with a case study of a single client with heel pain, followed by individual articles that consider the case from the perspectives of Chinese medicine, body-mind healing, neuromuscular therapy, physical therapy, and chiropractic care. While it provides no conclusive evidence of the benefits of these treatments, this series offers a rare and comprehensive examination into the variety of possible factors contributing to chronic pain.

WORKING WITH THE CLIENT

Client Assessment

While the symptoms of plantar fasciitis are fairly consistent, the biomechanical factors can vary. For this reason, each case should be considered individually. For example, pes planus often presents with eversion of the ankle; short and tight peroneal muscles, gastrocnemius, and soleus; and weakened tibialis muscles. With pes cavus, you may find the ankle inverted with a short and tight tibialis anterior, tibialis posterior, and the muscles that flex the toes. The impact on the knees, hips, and low back may also vary. Common presentations of plantar fasciitis are described here, but it is essential to assess every joint involved to put together an accurate picture for each individual client.

Assessment begins during your first contact with a client. In some cases, this may be on the telephone when an appointment is requested. Ask in advance if the client is seeking treatment for a specific area of pain so that you can prepare yourself.

Table 11-2 lists questions to ask the client when taking a health history.

POSTURAL ASSESSMENT

Allow the client to walk and enter the room ahead of you while you assess his or her posture and movements. Look for imbalances or patterns of compensation for deviations common with plantar fasciitis. Watch as the client climbs steps, looking for reduced mobility or favoring one side. Assess for joint instability, limping, rotation of the femur or tibia, or hyper- or hypolordosis. Have the client sit to fill out the assessment form, watching to see if he or she plantar flexes the ankle or flexes the toes to avoid stretching the calcaneal tendon and plantar fascia. Watch also as the client stands up to see if he or she can stand without assistance or if he or she avoids bearing weight on the affected foot.

When assessing the standing posture, be sure that the client stands comfortably. If he or she deliberately attempts to stand in the anatomic position, you may not get an accurate assessment of his or her posture in daily life. Excessive eversion of the ankle is noted when the inferior aspect of the calcaneal tendon bends laterally. The medial malleolus may also protrude more prominently (Fig. 11-3). With excessive inversion, the inferior aspect of the calcaneal tendon may bend medially, although this may not be as visible as the lateral curve of an everted ankle. With inversion, the lateral malleolus may protrude more prominently (Fig. 11-4). You can also inspect the soles of the client's shoes for wearing of the inside or outside edges, indicating an atypical position of the foot. The calcaneal tendon and fascia of the plantar flexors may appear thick or dimpled. Assess the arches of the feet for pes cavus or pes planus. Pes planus is more common with plantar fasciitis, particularly if the ankle is everted. Some extension of the metatarsophalangeal joint is normal but may be exaggerated with plantar fasciitis. Hyperextension of the metatarsophalangeal joint may force hyperflexion of the interphalangeal joints.

Table 11-2 Health History

Questions for the Client	Importance for the Treatment Plan
Was there a precipitating event, or can you remember a specific moment when the pain began?	The details of the activity or posture that initiated the pain may help you to determine contributing factors such as tendon injuries or stress fractures. A new regimen of running, a new activity that requires weight-bearing movement, or a newly developed sedentary posture may contribute to the symptoms of plantar fasciitis.
Where do you feel symptoms?	The location of symptoms gives clues to the location of trigger points, injury, or other contributing factors. Plantar fasciitis generally causes pain near the anterior, inferior calcaneus. Pain elsewhere in the foot, ankle, or calf is not uncommon and may suggest a coexisting condition.
Describe what your symptoms feel like.	Differentiate between possible origins of symptoms, and determine the involvement of bones, nerves, and soft tissues. See Chapter 1 for descriptions of pain sensations and possible contributing factors.
Do any movements make your symptoms worse or better?	Locate tension, weakness, or compression in structures producing such movements. Dorsiflexion, toe extension, and weight bearing often exacerbate symptoms of plantar fasciitis.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Medical tests may reveal stress fractures, bone spurs, nerve involvement, or other conditions. If no tests were performed to make a diagnosis of plantar fasciitis, use the tests described in this chapter for your assessment. If your assessment is inconsistent with the diagnosis, ask the client to discuss your findings with his or her health care provider or ask for permission to contact the provider directly.
Have you been diagnosed with a condition such as arthritis or diabetes? Are you pregnant?	Arthritis, diabetes, and other systemic conditions may contribute to signs and symptoms, may require adjustments to treatment, and may impact treatment outcomes. Pregnancy leads to weight gain and affects hormones that may contribute to symptoms.
Have you had a previous injury or surgery?	Injury or surgery and resulting scar tissue may cause adhesions, hyper- or hypotonicity, and atypical ROM.
What type of work, hobbies, or other regular activities do you do?	A new physical training program, repetitive motions that stress the ankle and foot, and static postures that shorten the plantar fascia may contribute to the client's condition.
Are you taking any prescribed medications or herbal or other supplements?	Medications of all types may contribute to symptoms or involve contraindications or cautions.
Have you had a corticosteroid or analgesic injection in the past 2 weeks? Where?	Local massage is contraindicated. A history of repeated corticosteroid injections may affect the integrity of the plantar fascia and calcaneal tendon, thus increasing the risk of tearing or rupture. Use caution when applying pressure or cross-fiber strokes.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure.
Have you taken anti-inflammatory medication within the past 4 hours?	Deep friction initiates an inflammatory process and should not be performed if the client has recently taken anti-inflammatory medication.

Improper alignment of the knee, hip, and pelvis, as well as calcaneal tendinitis, may coexist with plantar fasciitis. Review Chapters 8 (hyperlordosis), 9 (piriformis syndrome), 10 (patellofemoral syndrome), and 14 (tendinopathies) to assess for possible coexisting conditions.

Figure 11-5 compares a healthy posture to a posture affected by plantar fasciitis with pes planus and ankle eversion.

Figure 11-3 **Everted ankles.** Note the lateral bend of the inferior aspect of the calcaneal tendons and the prominence of the medial malleoli.

Figure 11-4 **Inverted ankles.** Note the medial bend of the inferior aspect of the calcaneal tendons and the prominence of the lateral malleoli.

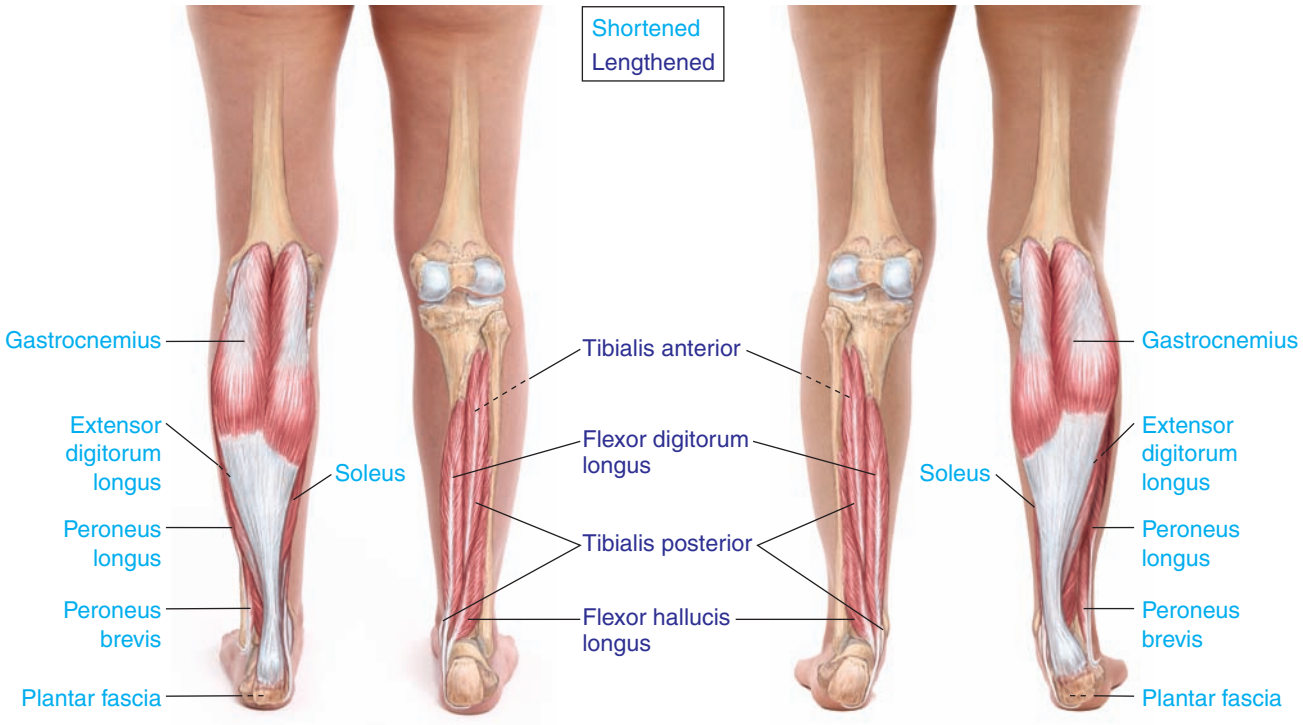


Figure 11-5 **Postural assessment comparison.** Compare the healthy posture in the image on the left to the deviated posture in the image on the right. Note the flat arch, curved calcaneal tendon, and prominent medial malleolus in the figure on the right.

Box 11-1 AVERAGE ACTIVE ROM FOR JOINTS INVOLVED IN PLANTAR FASCIITIS

Ankle

Dorsiflexion 20°
- Tibialis anterior
- Extensor digitorum longus
- Extensor hallucis longus

Plantar Flexion 50°
- Gastrocnemius
- Soleus
- Tibialis posterior
- Peroneus longus
- Peroneus brevis
- Flexor digitorum longus
- Flexor hallucis longus
- Plantaris

Inversion 45–60°
- Tibialis anterior
- Tibialis posterior
- Flexor digitorum longus
- Flexor hallucis longus
- Extensor hallucis longus

Eversion 15–30°
- Peroneus longus
- Peroneus brevis
- Extensor digitorum longus
- First toe

Flexion 45°
- Flexor hallucis longus
- Flexor hallucis brevis
- Abductor hallucis

Extension 70°
- Extensor hallucis longus
- Extensor hallucis brevis

Second to Fifth Toes

Flexion 40°
- Flexor digitorum longus
- Flexor digitorum brevis
- Lumbricals
- Dorsal and plantar interossei
- Abductor digiti minimi
- Flexor digiti minimi
- Quadratus plantae

Extension 40°
- Extensor digitorum longus
- Extensor digitorum brevis
- Lumbricals

ROM ASSESSMENT

Test the ROMs of the ankle and toes involving muscles as both agonists and antagonists. Since it allows the client to control the amount of movement and stay within a pain-free range, only active ROM should be used in the acute stage of injury to prevent undue pain or re-injury. Box 11-1 presents the average active ROM results for the joints involved in plantar fasciitis.

Active ROM

Compare your assessment of the client's active ROM to the values in Box 11-1. Pain and other symptoms may not be reproduced during active ROM assessment because the client may limit movement to a symptom-free range.

- **Active dorsiflexion of the ankle** may be restricted when tight plantar flexors limit movement.
- **Active extension of the toes** may be limited and cause pain when this action stretches the plantar fascia. In addition, because the flexor digitorum brevis, abductor digiti minimi, and abductor hallucis attach to the plantar surface of the calcaneus, extension of the toes may add tension to the attachment site they share with the plantar fascia.

Passive ROM

Compare the client's P ROM on one side to the other when applicable. Note and compare the end feel for each range (see Chapter 1 for an explanation of end feel).

- **Passive dorsiflexion of the ankle** may produce a painful stretch to the plantar flexors and plantar fascia.
- **Passive extension of the toes** may cause pain as the plantar fascia and toe flexors are stretched.

Resisted ROM

Use resisted tests to assess the strength of the muscles that cross the ankle. Compare the strength of the affected side to the unaffected side.

- **Resisted dorsiflexion of the ankle** may reveal weakness.

Figure 11-6 Dorsiflexion eversion test with Tinel's sign. This test is performed to assess for compression of the tibial nerve in the tarsal tunnel.

SPECIAL TESTS

The following special tests will help you to determine which structures are contributing to pain and when a client should be evaluated by a medical professional using X-ray or other tools, which may reveal conditions that contraindicate massage or require special considerations when planning treatment.

The **dorsiflexion eversion test** is used to assess compression of the tibial nerve within the tarsal tunnel—the space formed by the medial malleolus, calcaneus, and the flexor retinaculum through which the tendons of the tibialis posterior, flexor digitorum longus, and flexor hallucis longus along with the tibial artery, tibial vein, and tibial nerve pass (Fig. 11-6). **Tinel's sign**—a test that can be used to assess nerve conduction anywhere in the body—is often added when simple dorsiflexion and eversion alone do not reproduce symptoms. Use these tests together to assess for the possibility of tarsal tunnel syndrome in clients with heel pain:

1. Begin with the dorsiflexion eversion test. With the client supine, maximally dorsiflex the ankle and toes, and evert the ankle. This position pushes soft tissues deeper into the tarsal tunnel to assess their involvement in compressing the tibial nerve.
2. Hold the position for up to 15 seconds or until symptoms of numbness or tingling are produced.
3. Reproducing symptoms of numbness and tingling along the distribution of the nerve into the foot suggests compression of the nerve.
4. If no symptoms are produced, add Tinel's sign by tapping the tibial nerve between the medial malleolus and the medial aspect of the calcaneus.
5. Reproducing symptoms of numbness and tingling along the distribution of the nerve into the foot suggests nerve involvement.

The windlass test is used to assess whether the windlass mechanism of the plantar fascia produces pain (Fig. 11-7). The test is performed in non-weight-bearing and weight-bearing postures.

1. Begin with the non-weight-bearing test by asking the client to sit with the legs hanging off the edge of the table.

Figure 11-7 The windlass test. Test the windlass mechanism in both non-weight bearing (A) and weight bearing (B) positions.

2. With one hand, gently stabilize the ankle in a neutral position, free from plantar flexion and dorsiflexion.
3. With the other hand, fully extend the first toe passively at the metatarsophalangeal joint until you reach the end point or pain is reproduced.
4. Pain in the arch indicates a positive test for dysfunction of the plantar fascia when the windlass mechanism is activated. If no pain is produced, perform the test during weight bearing.
5. Ask the client to stand on a chair, stair, or other stable surface that allows a secure stance with the metatarsal heads at the edge, so the toes are uninhibited.
6. Passively extend the metatarsophalangeal joint of the first toe until you reach the end range or pain is reproduced.
7. Pain in the arch indicates a positive test for dysfunction of the plantar fascia when the windlass mechanism is activated.

PALPATION ASSESSMENT

Dysfunction in any joint from the sacroiliac to the metatarsals may cause or result from plantar fasciitis. Because contributing factors may vary widely, it is essential to assess the tissues of each individual client from the hips to the toes. It should not be surprising to find minor or even major differences in the ways the tissues respond to this dysfunction.

Assess the ankle and foot for atypical temperature, color, and texture. You may find inflammation, adhesions, fibrotic tissue, or tenderness around the malleoli or calcaneus or in the intrinsic muscles of the foot. The tenderest spot may be felt at the anterior calcaneus, where the plantar fascia attaches to the calcaneal tubercle. The gastrocnemius and soleus may be tight and the

calcaneal tendon may be thick and dense. If eversion of the ankle is a factor, the peroneus longus and brevis and the extensor digitorum longus may be short and tight.

Trigger points that refer pain into the heel and plantar surface of the foot may be found in the gastrocnemius, soleus, flexor digitorum longus, tibialis posterior, abductor hallucis, and quadratus plantae. See Figure 11-8 for common trigger points with referrals into the heel and plantar surface of the foot.

Condition-Specific Massage

Because the causes of heel pain vary widely, the exact cause can be difficult to pinpoint and more than one condition may coexist. Systemic conditions that involve cautions or contraindications for massage may be the underlying cause of heel pain. If you feel uncertain that the client's symptoms are caused by irritation or inflammation of the plantar fascia or by any of the soft tissue dysfunctions listed earlier, refer the client to his or her health care provider for medical assessment prior to treatment with massage.

It is essential for the treatment to be relaxing. You are not likely to eliminate the symptoms associated with plantar fasciitis or any coexisting conditions in a single treatment. Do not attempt to do so by treating aggressively. Be sure to ask your client to let you know if the amount of pressure you are applying keeps him or her from relaxing. If the client responds by tensing muscles or has a facial expression that looks distressed, reduce your pressure. Remember that you are working on tissue that is compromised. Ask the client to let you know if any part of your treatment reproduces symptoms, and always work within his or her tolerance. Deep palpation of a trigger point may cause pain at the upper end of the client's tolerance. Explain this to your client, describe a pain scale and what level of pain should not be exceeded, and ask him or her to breathe deeply during the application of the technique. As the trigger point is deactivated, the referral pain will also diminish.

The following suggestions are for treating heel pain caused by irritation or inflammation of the plantar fascia with weak dorsiflexion and increased eversion of the ankle. This is the most common presentation, although each client should be assessed for individual needs. If the client has an acute injury, the protocol is PRICE. You may work conservatively proximal or distal to the site, but avoid the area of injury until the subacute or chronic stage.

- Begin in the prone position with the ankles bolstered to reduce passive plantar flexion of the ankle.

- If you notice any swelling, apply superficial draining strokes toward the nearest lymph nodes.

- If swelling is minor or absent, apply moist heat to the plantar flexors and calcaneal tendon.


- Use your initial warming strokes to increase superficial circulation, soften tissues, and assess the tissues from the low back down to the feet. You should be able to minimally assess the tissues of the low back, hips, and leg, which may help you to determine where to focus the time remaining after treating the lower leg.

Treatment icons: Increase circulation; Reduce adhesions; Reduce tension; Lengthen tissue; Treat trigger points; Passive stretch; Clear area

Figure 11-8 **Common trigger points associated with plantar fasciitis and their referral patterns.**

- Before applying emollient, assess for and treat fascial restrictions in the lower leg. You may find restrictions along the gastrocnemius and soleus (Fig. 11-9).

- Once the superficial tissues are pliable enough to allow for deeper work, apply lengthening strokes to tissues that are short and tight. Plantar flexors and evertors of the ankle include the gastrocnemius, soleus (Fig. 11-9), peroneus longus and brevis, extensor digitorum longus (Fig. 11-10), tibialis posterior, flexor digitorum longus, and flexor hallucis longus (Fig. 11-11), although all of the muscles of the lower leg should be assessed. These muscles should be treated along their full length with special attention to the sections that cross the ankle.

- Treat any trigger points that are found.

- Apply moderate traction to the ankle to increase mobility between the talus and the tibia and fibula, which may improve dorsiflexion.


- Assess and treat the muscles of the foot if they are tight or adhered or contain trigger points. Gently knead the tissues between the metatarsals within the client's tolerance (Fig. 11-12).

- Soften the plantar fascia with kneading strokes. Begin superficially and progress into the deeper tissues (see Fig. 11-1).

- Once you feel pliability in the fascia, use cross-fiber strokes to reduce any adhesions. Treating the tissues near the calcaneal attachment may provide the greatest relief, but it is essential to take great care around this attachment, particularly in the first treatments, to avoid rupture of the tissue or encouraging bone spurs.

- Treat the flexor digitorum brevis, abductor digiti minimi, and abductor hallucis for hypertonicity, taking care with pressure at the calcaneal attachments.

- Apply lengthening strokes to the plantar fascia, beginning superficially and progressing to deeper tissues. Unless you are certain that there are no bone spurs or risk of rupture, apply strokes from the metatarsal heads toward the calcaneus to avoid pulling the plantar fascia away from the calcaneal attachment.

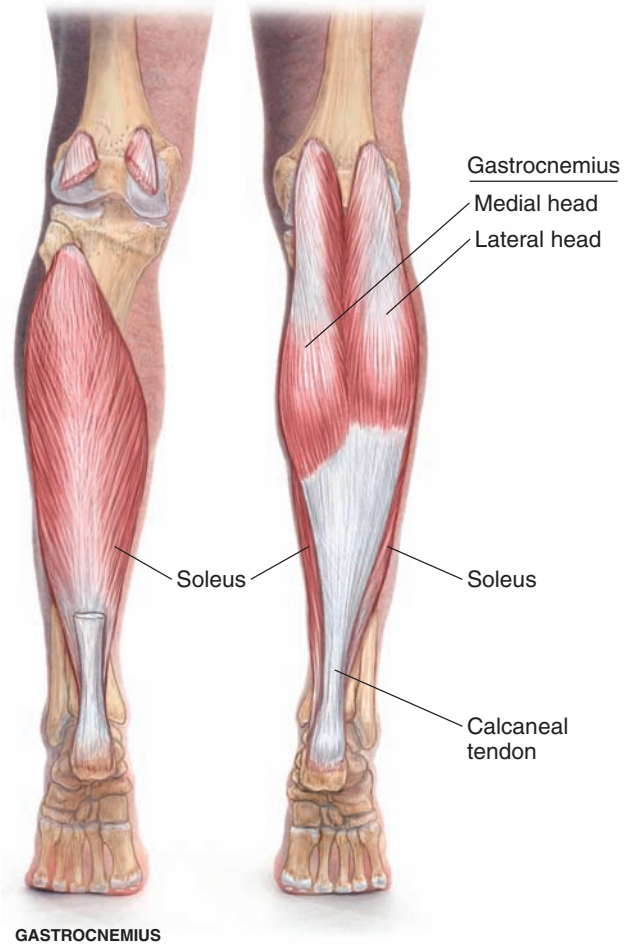
- Clear the leg from the foot toward the hips.

- Turn the client supine, and with the knee extended, stretch the plantar flexors, calcaneal tendon, and plantar fascia by performing passive dorsiflexion of the ankle and toes.

- Use PIR if you feel resistance to lengthening the plantar flexors.

- If time permits, assess and treat the muscles involved in any coexisting conditions.

The treatment overview diagram summarizes the flow of treatment (Fig. 11-13).



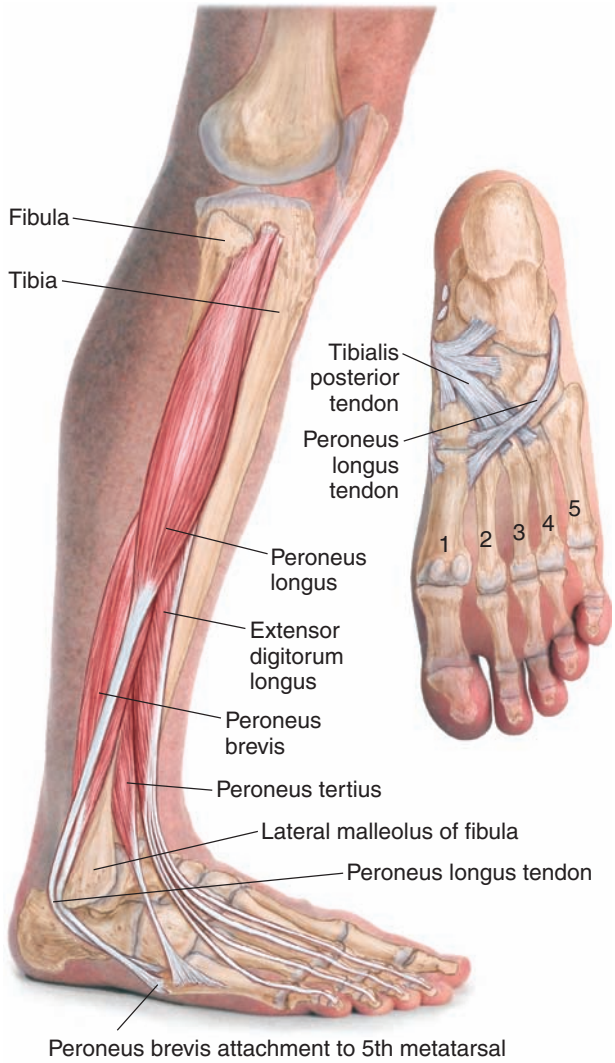
GASTROCNEMIUS

Origin	*Condyles of the femur, posterior surface of fibula and tibia.*
Insertion	*Calcaneus via calcaneal tendon.*
Action	*Flex knee, plantar flex ankle.*
Nerve	*Tibial.*

SOLEUS

Origin	*Soleal line, posterior surface of fibula and tibia.*
Insertion	*Calcaneus via calcaneal tendon.*
Action	*Plantar flex ankle.*
Nerve	*Tibial.*

Figure 11-9 **Gastrocnemius and soleus.** Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



PERONEUS LONGUS

Origin	*Proximal, lateral fibula.*
Insertion	*Base of 1st metatarsal and medial cuneiform.*
Action	*Evert ankle, assist in plantar flexion of ankle.*
Nerve	*Superior peroneal.*

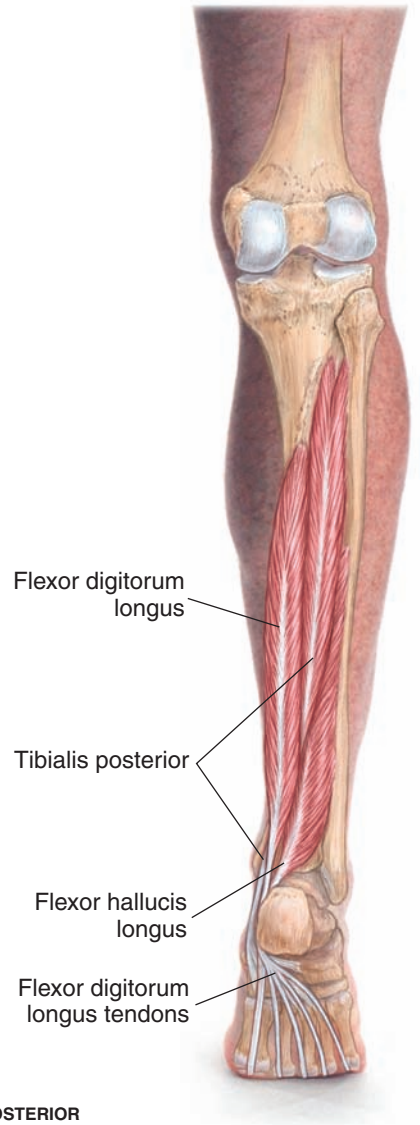
PERONEUS BREVIS

Origin	*Distal lateral fibula.*
Insertion	*Tuberosity of 5th metatarsal.*
Action	*Evert ankle, assist in plantar flexion of ankle.*
Nerve	*Superior peroneal.*

EXTENSOR DIGITORUM LONGUS

Origin	*Proximal anterior fibula, interosseus membrane.*
Insertion	*Middle and distal phalanges of toes 2–5.*
Action	*Extend toes 2–5, dorsiflex ankle, evert ankle.*
Nerve	*Deep peroneal.*

Figure 11-10 **Muscles that evert the ankle.** Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



TIBIALIS POSTERIOR

Origin	*Proximal tibia, fibula and interosseus membrane.*
Insertion	*Navicular, cuneiforms, cuboid, base of metatarsals 2–4.*
Action	*Invert ankle, plantar flexion.*
Nerve	*Tibial.*

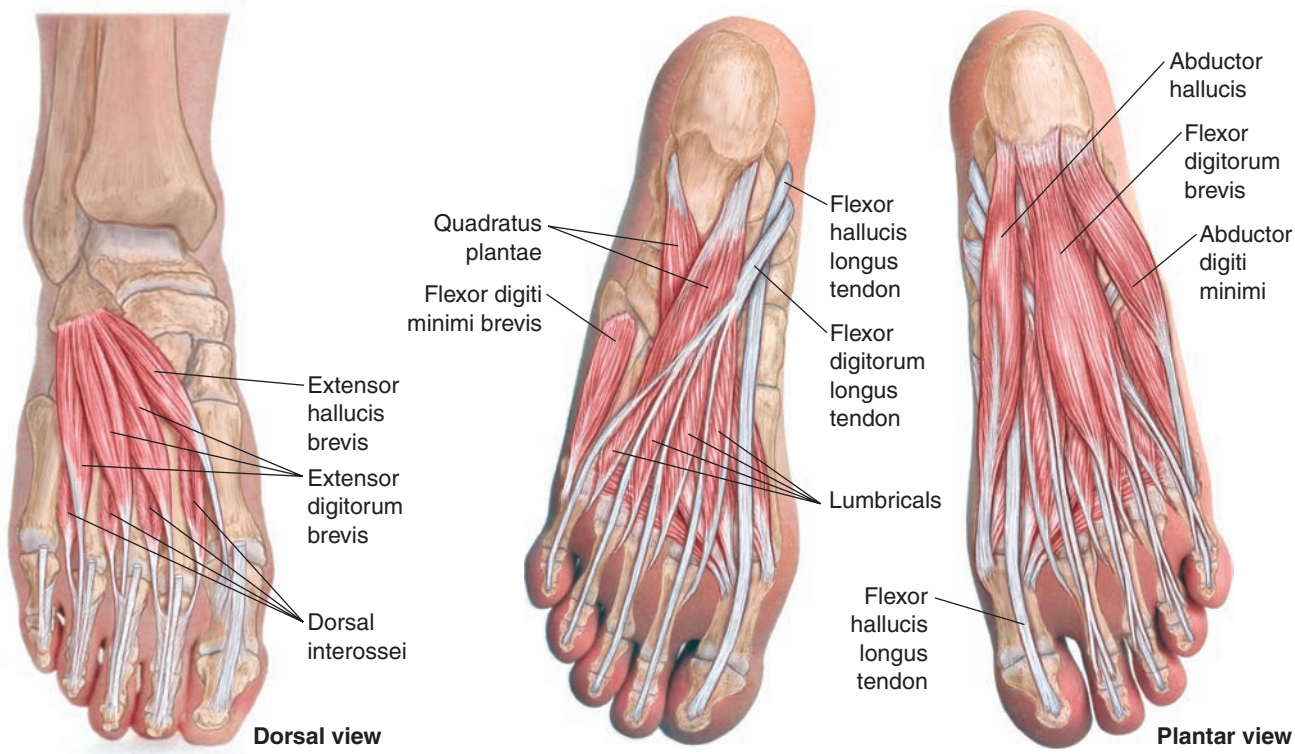
FLEXOR DIGITORUM LONGUS

Origin	*Middle, posterior tibia.*
Insertion	*Distal phalanges of toes 2–5.*
Action	*Flex toes 2–5, plantar flexion, invert ankle.*
Nerve	*Tibial.*

FLEXOR HALLUCIS LONGUS

Origin	*Middle posterior fibula.*
Insertion	*Distal phalanx of 1st toe.*
Action	*Flex 1st toe, plantar flexion, invert ankle.*
Nerve	*Tibial.*

Figure 11-11 Deep muscles that plantar flex and invert the ankle. Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.



EXTENSOR DIGITORUM BREVIS

Origin	*Calcaneus.*
Insertion	*Toes 2–5 via extensor digitorum longus tendons.*
Action	*Extend toes 2–4.*
Nerve	*Deep peroneal.*

EXTENSOR HALLUCIS BREVIS

Origin	*Calcaneus.*
Insertion	*Proximal phalanx of 1st toe.*
Action	*Extend 1st toe.*
Nerve	*Peroneal.*

FLEXOR HALLUCIS BREVIS

Origin	*Plantar surfaces of cuboid and lateral cuneiform.*
Insertion	*Proximal phalanx of 1st toe.*
Action	*Flex first toe.*
Nerve	*Medial plantar.*

DORSAL INTEROSSEI

Origin	*Metatarsals 1–5.*
Insertion	*Proximal phalanges of toes 2–4.*
Action	*Abduct toes 2–4.*
Nerve	*Lateral plantar.*

PLANTAR INTEROSSEI

Origin	*Base of metatarsals 3–5.*
Insertion	*Proximal phalanx of toes 3–5.*
Action	*Adduct and flex toes 3–5.*
Nerve	*Lateral plantar.*

QUADRATUS PLANTAE

Origin	*Plantar surface of calcaneus.*
Insertion	*Flexor digitorum tendons.*
Action	*Flex toes 2–5.*
Nerve	*Lateral plantar.*

ABDUCTOR HALLUCIS

Origin	*Calcaneus.*
Insertion	*Proximal phalanx of 1st toe.*
Action	*Abduct and flex 1st toe.*
Nerve	*Medial plantar.*

ABDUCTOR DIGITI MINIMI

Origin	*Calcaneus.*
Insertion	*Proximal phalanx of 5th toe.*
Action	*Flex and abduct 5th toe.*
Nerve	*Lateral plantar.*

ADDUCTOR HALLUCIS

Origin	*Base of metatarsals 2–4.*
Insertion	*Proximal phalanx of 1st toe.*
Action	*Adduct 1st toe, assist in maintaining arch.*
Nerve	*Lateral plantar.*

FLEXOR DIGITORUM BREVIS

Origin	*Calcaneus.*
Insertion	*Middle phalanges of toes 2–5.*
Action	*Flex middle phalanges of toes 2–5.*
Nerve	*Medial plantar.*

FLEXOR DIGITI MINIMI

Origin	*Base of 5th metatarsal.*
Insertion	*Base of proximal phalanx of 5th toe.*
Action	*Flex 5th toe.*
Nerve	*Lateral plantar.*

LUMBRICALS

Origin	*Tendons of flexor digitorum longus.*
Insertion	*Base of proximal phalanges 2–5.*
Action	*Flex proximal phalanges of toes 2–5, extend middle and distal phalanges 2–5.*
Nerve	*Medial and lateral plantar.*

Figure 11-12 **Muscles of the foot.** Adapted from Clay JH, Pounds DM. *Basic Clinical Massage Therapy: Integrating Anatomy and Treatment,* 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2008.

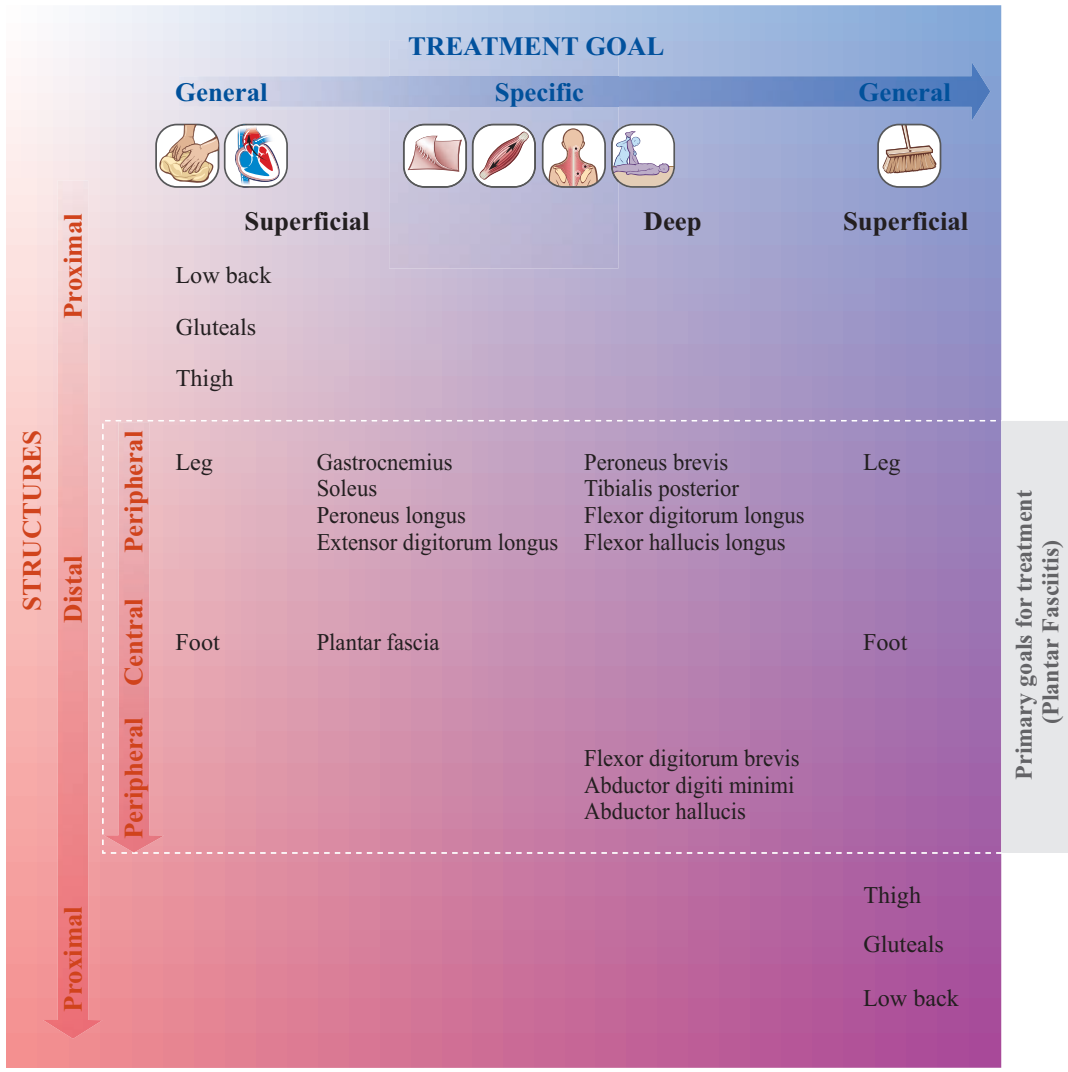


Figure 11-13 **Plantar fasciitis treatment overview diagram.** Follow the general principles from left to right or top to bottom when treating plantar fasciitis.

CLIENT SELF-CARE

When plantar fasciitis significantly reduces the client's activities of daily living, the individual should rest or at least minimize weight-bearing activity as much as possible to give the tissue time to initiate healing. Elevating the leg and applying ice to the plantar fascia are indicated to reduce inflammation. A client with chronic plantar fasciitis should also minimize weight-bearing activities that may re-injure tissues and prolong the healing process, reintroducing these activities as gradually as healing allows. That said, moderate activity to keep the tissues mobile and prevent chronic adhesions is an important part of the healing process. The client should be diligent in stretching the plantar flexors before activity. The client will likely benefit from wearing shoes with good arch support or tailored orthotic inserts to support pes cavus, slow the progression of pes planus, or to reduce eversion. Heel cups are used to cushion the heel of a client with fat pad atrophy. These should be used in all shoes and worn regularly, not just when participating in sports or other intensive activities. For chronic cases, the client may wear a night splint that prevents plantar flexion.

The following are intended as general recommendations for stretching and strengthening muscles involved in the client's condition. The objective is to create distance between the attachment sites of muscles that have shortened and to perform repetitions of movements that decrease the distance between the attachments of muscles that have weakened. If you have had no training in remedial exercises and do not feel that you have a functional understanding of stretching and strengthening, refer the client to a professional with training in this area.

Clients often neglect self-care due to time constraints. Encourage them to follow these guidelines:

- Instruct the client to perform self-care throughout the day, such as while talking on the phone, reading e-mail, washing dishes, or watching television instead of setting aside extra time.
- Encourage the client to take regular breaks from stationary postures or repetitive actions. If the client's daily activities include hours of sitting, suggest walking for at least a few minutes every hour to prevent the plantar fascia from tightening. If the client's daily activities require standing for long periods or repetitive actions that contribute to plantar fasciitis, suggest sitting for at least a few minutes every hour.
- Demonstrate gentle self-massage of the plantar fascia and the tissues surrounding the plantar fascia to keep adhesions and hypertonicity at bay between treatments. If no swelling is present, instruct the client to gently roll the foot over a tennis ball, can, or other sturdy round object, from the calcaneus to the metatarsals and back, to keep the tissues pliable. Soaking the feet in warm water prior to rolling over the object may soften the superficial tissues. If bone spurs are present, avoid the affected area or leave out this exercise.
- Demonstrate all strengthening exercises and stretches to your client and have him or her perform these in your presence before leaving to ensure that he or she is performing them properly and will not harm himself or herself when practicing alone. Stretches should be held for 15–30 seconds and performed frequently throughout the day within the client's limits. The client should not force the stretch or bounce. The stretch should be slow, gentle, and steady, trying to keep every other joint as relaxed as possible.
- Stretching and strengthening exercises should be recommended according to your findings in ROM testing and palpation.

Stretching

Maintaining the proper length and tone of the plantar flexors is essential to reduce hyperflexion and eversion of the ankle and to reduce the flattening of the arch that may contribute to plantar fasciitis. Stretches should be performed throughout the day, particularly before and after activity.

Instruct the client to stand at an arm's length away from a wall, leaning against it. Bring the toes of the unaffected foot forward close to the edge of the wall, and bend that knee. This will place the opposite, affected ankle into passive dorsiflexion. When the knee of the affected leg is extended, the gastrocnemius gets the best stretch. To stretch the soleus more, flex the knee of the affected leg. Both heels should be on the floor at all times, and the stretch should be held for 15–30 seconds or as long as is comfortable (Fig. 11-14). If the client is unable to keep the heel on the floor, instruct him or her to reduce the distance between the feet. Stretch the opposite ankle as needed.

To stretch the plantar flexors while seated, instruct the client to sit comfortably with the back supported, and then extend the knees, dorsiflex the ankles, and hold for 15–30 seconds (Fig. 11-15). This action also helps to strengthen the dorsiflexors. Suggest that the client repeat this action a few times, and then get up and walk around to mobilize the ankle and the foot.

If eversion is a contributing factor, instruct the client to simultaneously stretch the evertors and strengthen the invertors by actively inverting the ankle fully and holding for as long as it is comfortable. Repeat this action a few times, and then get up and walk around to mobilize the ankle.

Strengthening

Strengthening the dorsiflexors may prime them to better oppose plantar flexion. The seated calf stretch described above also strengthens the dorsiflexors. In addition, strengthening the intrinsic muscles of the foot may increase their ability to absorb shock and maintain both flexibility and structural support. Instruct the client to perform exercises in which he or she grasps items with the toes. Begin with bigger, flexible items, like a towel. As the foot becomes stronger, gradually progress to smaller items, such as a pen or marbles, picking them up between the toes as well (Fig. 11-16). Drawing the alphabet in the air with the foot is a simple exercise for strengthening the ankle and improving ROM. Instruct the client to make the movements only as big as is comfortable and to draw only as many letters as possible until he or she feels fatigue.

SUGGESTIONS FOR FURTHER TREATMENT

Ideally, a client with plantar fasciitis will have treatments twice a week until he or she can perform activities of daily living with minimal or no pain for at least 4 days. Once this is achieved, reduce

Figure 11-14 **Stretch the plantar flexors.**

Figure 11-15 **Stretch the hamstrings and plantar flexors while strengthening the quadriceps.** Sit comfortably with the back supported, and then extend the knees and dorsiflex the ankles.

frequency to once per week until symptoms are absent for at least 7 days. When the client reports that he or she has been pain-free for more than 7 days, treatment can be reduced to twice per month. If the client is pain-free for 3 or more consecutive weeks, he or she can then schedule once per month or as necessary. If the client's symptoms are localized and other postural deviations are minimal, half-hour treatments may be sufficient to effect a change in plantar fasciitis. When treating plantar fasciitis caused by soft tissue dysfunction, there should be some improvement with each session. If this is not happening, consider the following possibilities:

- There is too much time between treatments. It is always best to give newly treated tissues 24–48 hours to adapt, but if too much time passes between treatments in the beginning, the client's activities of daily living may reverse any progress.
- The client is not adjusting activities of daily living or is not keeping up with self-care. As much as we want to fix the problem, we cannot force a client to make the adjustments we suggest. Explain the importance of his or her participation in the healing process, and encourage the client to follow your recommendations, but be careful not to judge or reprimand a client who does not.
- The condition is advanced or has other musculoskeletal complications that are beyond your basic training. Refer this client to a massage therapist with advanced clinical massage training. Continuing to treat a client whose case is beyond your training could turn the client away from massage therapy altogether and hinder healing.
- The client has an undiagnosed, underlying condition. Discontinue treatment until the client sees a health care provider for medical assessment.

If you are not treating the client in a clinical setting or private practice, you may not be able to take this client through the full program of healing. Still, if you can bring some relief in just one

Figure 11-16 **Strengthen the muscles of the foot.** Begin with items that are easy to grasp (A) and progress to items that require more fine motor skill (B).

treatment, it may encourage the client to discuss this change with his or her health care provider and seek manual therapy rather than more aggressive treatment options. If the client agrees to return for regular treatments, the symptoms are likely to change each time, so it is important to perform an assessment before each session. Once you have released superficial tissues in general areas, you may be able to focus more of your treatment on deeper tissues in a specific area. Likewise, once you have treated the structures specific to plantar fasciitis, you may be able to pay closer attention to compensating structures and coexisting conditions.

PROFESSIONAL GROWTH

CASE STUDY

Dewan is a 45-year-old married male. Four years ago, he moved from a small Caribbean island, where he was a professional soccer player and coach, to the United States to attend university. He began feeling pain in his right foot approximately 1 month ago, which has gradually gotten worse.

Subjective

Dewan complained of pain in his right foot, which began approximately 1 month ago and has gotten progressively worse. Prior to moving to the United States to attend school, Dewan was a professional soccer player and soccer coach. He played soccer nearly every day. After moving to the United States, his life has become more sedentary. Between his studies and work, he had little time for physical fitness. Now that he

has completed his degree and secured a job, he has returned to coaching his son's high school soccer team. The pain in his right foot began within the first week of coaching soccer 3 days a week. When it first began, he felt the pain during practice and in the mornings after. When he had more than 48 hours between practices, he felt no pain. Over the past month, the pain has become more regular. He stated that he feels it most often in the morning, at the beginning of a practice, and in the evenings after practice. He stated that icing the foot brings temporary relief, but that his first steps in the morning and his first run of a practice are very painful. Because he goes to practice right after work, he has not made time to properly stretch before practice, and he stated that stretching after practice is painful.

Dewan described a healthy diet. He had several minor injuries to his legs and ankles while playing soccer that he stated never kept him from playing for more than a day or two with the exception of a kick to the posterior right leg that resulted in myositis ossificans. This required 1 week of rest followed by a few weeks of manual therapy to encourage reabsorption of calcium and to restore normal tone. He has not consulted his health care provider about his foot pain. His soccer team in the Caribbean had a full-time massage therapist on staff, and he thought massage might help his foot pain. His goal is to be able to continue coaching soccer without pain.

Objective

Dewan appears very healthy and vibrant, lean and muscular. He showed no signs of pain or dysfunction when climbing the stairs, walking, or standing from a seated position. He sat with his feet flat on the floor.

Postural assessment revealed a slight increase in the kyphotic curve with internally rotated shoulders. His knees remain slightly flexed when standing, and his ankles are slightly everted bilaterally. The four lateral toes of the right foot are hyperextended at the metatarsophalangeal joint, and flexed at the interphalangeal joint. The arches are within normal height, very slightly flatter on the right.

The passive dorsiflexion-eversion test reproduced a level 3 pain, on a scale of 1–10, near the calcaneus with no referral, numbness, or tingling. Tinel's sign was negative for tarsal tunnel syndrome. Weight-bearing plantar flexion with passive extension of the toes, performed by asking the client to stand on his tip-toes, reproduced pain that the client suggested was closest to what he feels during activity. The non-weight-bearing windlass test was positive and produced pain at level 8. I did not perform the weight-bearing test. There is no visible or palpable swelling in the foot or ankle. The calcaneal tendon and superficial fascia into the mid calf are dense and adhered. There is an area of dimpled, dense tissue in the right leg just below the musculotendinous junction of the gastrocnemius. When asked, Dewan answered that this was the area of his past myositis ossificans. The right calcaneal tendon is less flexible than the left. The skin of the plantar surface of both feet is thick, dry, and cracked superficially around the edges of the heel. There was no local or specific pain with palpation of the calcaneus, and there is no indication of a bone spur. The tenderest spot on the sole of the foot is approximately 1 cm distal to the medial calcaneal tubercle. Still, only deep cross-fiber strokes reproduced pain at a level 3.

Action

Treatment today focused on lengthening shortened plantar flexors, reducing adhesions in the intrinsic muscles of the feet, reducing adhesions and lengthening the plantar fascia. I treated both legs, with more aggressive treatment on the right. I began with general massage to the low back, gluteal area, and thighs bilaterally. Nothing remarkable was noted.

I used myofascial release on the posterior leg with special attention paid to the distal tendinous area. I used kneading followed by longitudinal gliding and deeper muscle stripping to the plantar flexors and evertors, namely the gastrocnemius, soleus, tibialis posterior, peroneus longus and brevis, and the extensor digitorum longus. I applied specific, localized cross-fiber strokes followed by superficial and deep muscle stripping to the area affected by myositis ossificans. A trigger point was found in the soleus, approximately 2 inches superior and slightly posterior to the lateral malleolus, and it referred into the heel. Ischemic compression followed by muscle stripping reduced pain from level 7 to level 3. I used cross-fiber strokes followed by longitudinal strokes to the calcaneal tendons bilaterally. There was no change in texture. I applied gentle kneading to the intrinsic muscles of the foot followed by longitudinal stripping between the metatarsals. I used gliding and kneading to warm and soften the plantar fascia until the tissue felt pliable enough to apply deeper pressure. I applied cross-fiber strokes to the plantar fascia, beginning superficially and slowly working deeper, avoiding the medial calcaneal tubercle until pain with the extension of the first toe reduced to a level 3. I also applied deep muscle stripping to the plantar fascia from distal to proximal. Finally, I used clearing strokes on the full leg.

Turning the client supine with no bolster, I stretched the plantar flexors and plantar fascia with a passive dorsiflexion of the ankle. This produced pain at the medial calcaneal tubercle at a level 2. Adding passive extension of the toes increased pain to level 6. Decreasing the extension of the toes reduced pain to a level 3. I held the stretch for 15 seconds. At the end of the stretch, the pain remained at level 3. I applied general Swedish techniques to the anterior leg. I found that the iliotibial bands were dense and adhered bilaterally. I cleared the whole leg, and then attempted to stretch the plantar flexors and plantar fascia again. Dorsiflexion alone produced no pain. Adding extension of the toes increased pain to a level 3. After holding the stretch for 15 seconds, the client's pain reduced to a level 2.

Plan

As a life-long athlete, Dewan is familiar with stretching and strengthening exercises, so simple demonstrations were sufficient. His symptoms are not debilitating and do not severely hinder his activities of daily living. For this reason, I think it is unnecessary for him to stop coaching but suggested that he take it slowly and be gentle on the feet until symptoms become less frequent. It is essential that he make time to thoroughly stretch the plantar flexors and plantar fascia before each practice. I suggested making this the first activity for the whole team at each practice. I recommended applying ice to the sole of the foot for approximately 3 minutes after practice. Icing for too long could stiffen the tissues and increase the risk of tearing. I also suggested stretching the plantar flexors and plantar fascia and strengthening the dorsiflexors by extending the knees and dorsiflexing the ankles while seated during the workday. I suggested avoiding extending the toes during this exercise until this action no longer produced pain greater than level 3.

Dewan will return for treatment 3 days from today and twice next week. As symptoms decrease and the risk of tearing is minimized, treatment can be reduced to once weekly.

I will plan to focus more intently on lengthening the flexor hallucis during the next treatment.

CRITICAL THINKING EXERCISES

1. Excessive eversion of the ankles is commonly seen with plantar fasciitis and is described in the treatment guidelines above. Create a SOAP chart with history, assessment, and a treatment plan that describes a case of plantar fasciitis due to excessive inversion of the ankle. How might inversion of the ankle affect posture at the knees, hips, or low back? Treatment goals should include lengthening shortened tissues, strengthening weak muscles, and restoring proper neuromuscular function.
2. A client calls to schedule a massage for foot pain. She states that she sprained the ankle of the affected leg a few times. She was also diagnosed with calcaneal tendonitis in the affected leg for which she received no treatment. A month or so after the diagnosis, the daily pain was gone, but the tendon continued to hurt when she stretched her calves deeply in yoga. Discuss the possible relationship between the injuries and plantar fasciitis. What questions would you ask this client? Are there questions that you need to ask her health care provider?
3. Develop a 10-minute stretching and strengthening routine for a client that covers all of the muscles involved in plantar fasciitis. Use Box 11-1 and Figure 11-5 as a guide. Remember that a stretch increases the distance between the origin and insertion of a muscle and is important for those muscles that are shortened while strengthening is performed by actively bringing the origin and insertion closer together and is important for the antagonists of shortened muscles. Describe each step of the routine in enough detail that the client can refer to these descriptions in your absence and perform them without harm.
4. Conduct a short literature review to learn about the relationship between symptoms resembling plantar fasciitis and the following:
   - Diabetes
   - Rheumatoid arthritis
   - Morton's toe
   - Night splinting

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