

# Muscle Strains

# Home Study Course

1 CE Hour

Text, Examination, and Course Guide

Presented by the:

*Center for Massage Therapy Continuing Education*

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## Instructions for the Muscle Strains home study course

Thank you for investing in the Muscle Strains home study course, a 1 CE hour course designed to further your knowledge in the principles and practice of treating clients with signs and symptoms of muscular pain and/or muscle strains. This guide will contain all of the instructions you will need to complete this course. This is a 1 CE hour course, so that means it should take you approximately 1 hour to read the text and complete the multiple choice exam and course evaluation.

### **The following are steps to follow in completing this course:**

- 1. Read and review the exam and text in this file. The exam is provided for review before testing online and is the same as the online exam.**
- 2. When you are ready to test online, access the online examination by logging in to your account at <https://www.massagetherapyceu.com/login.php>.**
- 3. Complete your examination and print your certificate. The exam is open book and there is no time limit for completion.**

You must pass the exam with a 70% or better to pass this home study course. You are allowed to access and take the exam up to 3 times if needed. There is no time limit when taking the exam. Feel free to review the text while taking the test. This course uses the text *Muscle Strains, an excerpt from Condition-Specific Massage*, by Celia Bucci. All of the answers can be found in the text. It is advised to answer the exam questions in the study guide before testing online. That way, when you are testing you do not have to go back and forth through the online exam.

If you have any questions please feel free to contact us at 866-784-5940, 712-490-8245, or [info@massagetherapyceu.com](mailto:info@massagetherapyceu.com). Most state boards require that you keep your “proof of completion” certificates for at least four years in case of audit. Thank you for taking our Muscle Strains home study course.

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It is the responsibility of the practitioner to determine the appropriateness of the techniques presented in terms within the scope of practice. This information is in no way meant to diagnose or treat medical conditions. Written medical opinions are always the best way to resolve any questions regarding contra-indications to or advanced treatment of muscle strains.

## Muscle Strains Exam

1. Which of the following types of muscles are most susceptible to acute strain?
  - A. Muscles with a low concentration of fast-twitch fibers that are occasionally recruited to contract eccentrically
  - B. Muscles with a high concentration of fast-twitch fibers that are frequently recruited to contract eccentrically
  - C. Muscles that are regularly recruited to perform repetitive actions
  - D. When an acute strain is not fully treated and continues to contribute to dysfunctional patterns
2. What is a grade 2 strain?
  - A. Minor stretch or tear
  - B. Tearing of several to the majority of fibers
  - C. Complete rupture of muscle belly, separation of muscle from tendon, or tendon from bone
  - D. All of the above
3. All of the following are instances in which you should refer a client to their health care provider before treatment EXCEPT:
  - A. The client is unable to move the joint
  - B. The client heard a popping sound
  - C. The client has significant weakness
  - D. The client has moderate pain with normal ROM
4. What is the importance of asking the client “when did the symptoms begin”?
  - A. It may help to identify the precise location of stretched or torn fibers and contributing factors
  - B. It may help you determine the degree of strain
  - C. It may help you to determine the stage of the injury and the health of the tissue
  - D. It may help you to locate the strain and determine contributing factors
5. Swelling that persists and continues to feel dense or hard may indicate:
  - A. A hematoma
  - B. A strain in the chronic stage
  - C. A broken or fractured bone
  - D. A strain in the sub-acute stage
6. What is essential to effectively treat a strain?
  - A. To have a correct diagnosis and permission from the client’s health care provider
  - B. To work aggressively on the site of the injury at least 3 times per week
  - C. To stretch the tissues and restore normal range of motion
  - D. To locate the precise site of injury and to know the direction of fibers of the affected muscle

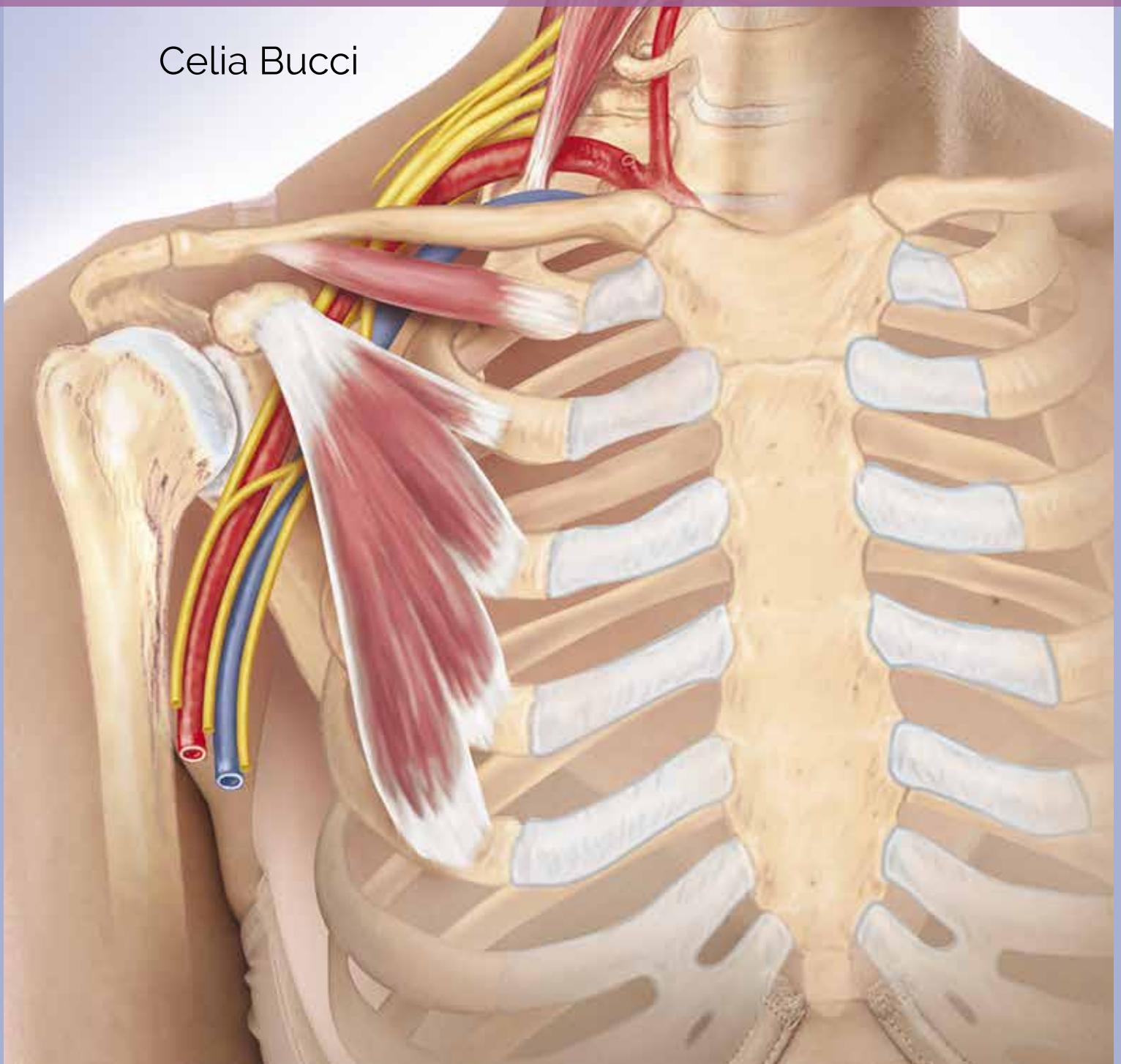
7. Once the superficial tissues are pliable enough to allow for deeper work, apply \_\_\_\_\_ to reduce the remaining adhesions and lengthening strokes to tissues that are short and tight.
- A. Friction strokes
  - B. Kneading strokes
  - C. Effleurage strokes
  - D. Lymphatic strokes
8. Longitudinal strokes should be applied:
- A. Directly on top of the tear
  - B. Never, only cross-fiber strokes should be used on strains
  - C. To the full length of the injured muscle
  - D. Proximal to the injured muscle
9. Which of the following may be a reason when there is no improvement with each session?
- A. There is too much time between treatments
  - B. The condition is advanced or has other musculoskeletal complications that are beyond your basic training
  - C. The client has an undiagnosed, underlying condition
  - D. All of the above

This completes the Muscle Strains exam. Proceed to the next page to view the text.

# Condition Specific Massage Therapy

SECOND EDITION

Celia Bucci



## Chapter 12:

# Muscle Strains

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# Muscle Strains

## Understanding Muscle Strains

**M**uscle strain, often called a pulled muscle, occurs when muscle fibers are overstretched. Increased tensile stress—force that elongates a muscle—is the primary cause of muscle strains. Overstretching may result in tears to the muscle fibers and tendons at the musculotendinous junction or at the site of attachment to the bone (Fig. 1). Overstretching can occur if the muscle is forced to lengthen beyond its normal range when the muscle is activated during a stretch or when a muscle affected by spasm, fatigue, scar tissue, dehydration, or other dysfunction is stressed by quick, intense movement, particularly against resistance, even within the normal ROM. Eccentric contraction of a compromised muscle is a common cause of strains. For example, a person with a sedentary lifestyle may develop shortened hip flexors with a high resting tone. If this person stands too quickly, the poorly conditioned hip flexors may not adapt to the quick, eccentric contraction, and strain may occur.

Strains can occur in any muscle but are most likely in muscles that cross two joints, particularly when the muscle lengthens across both joints simultaneously. Muscles commonly strained include the hamstrings, quadriceps, gastrocnemius, the muscles of the rotator cuff, pectoralis major, biceps brachialis, and the muscles of the neck (particularly with whiplash). An acute strain occurs when a muscle is recruited to perform a contraction quickly and intensely, particularly against resistance. Muscles with a high concentration of fast-twitch fibers that are frequently recruited to contract eccentrically are most susceptible to acute strain. A chronic strain occurs when a muscle is regularly recruited to perform repetitive actions or when an acute strain is not fully treated and continues to contribute to dysfunctional patterns. Postural muscles such as the erector spinae, which contract against gravity for long periods throughout the day, are most susceptible to chronic strain. Strain can occur in any part of a muscle and may involve just a few or all of its fibers. The most common site of strain is at or near the musculotendinous junction, where the very elastic muscle fibers meet the less malleable tendon. The risk of acute strain increases when the health of the muscle is compromised.

The more a muscle is lengthened, the less able it is to absorb stress. As a muscle approaches its maximum length, muscle spindles initiate a reflex response to resist further stretching by activating or tensing the stretched fibers. This activation of the muscle increases its ability to absorb stress, protecting the muscle from injury. The velocity of contraction and reflex response, resistance against the action, muscle fatigue, weakness, tension, temperature, and prior injuries all affect whether the contraction is smooth and healthy or results in an injury.



Figure 12-1 Muscle strain.

## COMMON SIGNS AND SYMPTOMS

The signs and symptoms of muscle strains differ depending on the grade (severity of the injury) and stage (duration of symptoms) of the injury. Fig 2 illustrates grades of strain in the acute stage. Table 1 outlines the common signs and symptoms for each grade and stage of muscle strain. In general, strains produce local pain, stiffness, pain on resisted movement or passive stretch, reduced strength, and impaired ROM.

## POSSIBLE CAUSES AND CONTRIBUTING FACTORS

The cause of strain is overstretching with too much tensile stress. The affected muscle lengthens beyond its capability when the joint it crosses is forced beyond its maximum range, particularly when the movement occurs quickly and passively. Strain can also occur when an unhealthy muscle is unable to lengthen within the average normal range. Previous injury, even if the injury was minor and caused no reduction in activities of daily living, may result in scar tissue, weakness, hypertonicity, spasm, or trigger points, which if left untreated, increases the risk of strain. When scar tissue forms, it alters the shape and impedes the function of the affected fibers. Collagenous scar tissue does not have the flexibility or contractile strength of healthy muscle tissue, putting the torn fibers at risk for re-injury if the muscle is overstretched. This dysfunction also increases the load that the healthy fibers must bear, putting them at risk for tearing and the muscle as a whole at risk for more serious injury including rupture. Previous strains, sprains, contusions, and dislocations often alter biomechanics and increase the risk of chronic strain if they are not properly treated.



**Figure 12-2** Grades of muscle strain.  
Image Credit: Chu KyungMin/Shutterstock

When the antagonists of an action are much weaker than the agonists, an intense concentric contraction may overpower the eccentric contraction, forcing the joint beyond the antagonist's capability. This can also occur when the antagonist is fatigued and unable to adequately regulate motion at the joint. When a muscle is hypertonic, in spasm, or contains trigger points, it may be less capable of lengthening to accommodate an eccentric contraction. In this case, a strong or quick concentric contraction of an opposing muscle intensifies the tensile stress in the antagonist and may lead to tearing of its fibers. In addition, when the health of a muscle is compromised, the reflex response may be insufficient to inhibit overstretching.



Table 12-1: Grades and Stages of Muscle Strain

	<b>GRADE 1</b>	<b>GRADE 2</b>	<b>GRADE 3</b>
	Mild strain Minor stretch or tear Client can continue activity with mild pain	Moderate strain Tearing of several to the majority of fibers Pain and weakness may make continued activity difficult	Severe strain Complete rupture of muscle belly, separation of muscle from tendon, or tendon from bone. Pain and weakness halt continued activity.
<b>Acute stage</b> (symptoms typically last 3–4 days following injury)	Minimal loss of strength Mild discomfort with activity Minimal or no local edema Minimal or no bruising Mild local tenderness	Snapping sound or sensation at moment of injury Moderate local edema Moderate bruising, red or purple Possible hematoma Possible palpable gap at site of injury Moderate local tenderness Moderate pain with activity Moderate weakness with activity Moderate decrease in ROM Protective muscle spasm crossing affected joint(s)	Snapping sound or sensation at moment of injury Severe pain Immediate loss of strength Immediate loss of ROM Inability to perform activity involving the affected muscle Considerable local edema Considerable bruising, red or purple Possible hematoma Palpable gap at site of injury Ruptured muscle may contract and gather into a palpable mass Protective muscle spasm crossing affected joint(s)
<b>Subacute stage</b> (symptoms typically remain from 3 days to 3 weeks following acute stage)	Minimal to no pain Minimal to no reduction of strength Scar developing at site of injury Adhesions developing at site of injury and between surrounding muscles and other soft tissues Trigger points in affected muscle, synergists, and antagonists	Moderate to minimal pain improved since the acute stage Moderate to minimal reduction of strength improved since the acute stage Bruising remains and may be changing color to yellow or green Possible hematoma Palpable inconsistency in muscle shape at the site of injury Injury may be splinted or casted Scar at the site of injury Adhesions developing at the site of injury and between the surrounding muscles and other soft tissues Protective muscle spasm may diminish and may be replaced by hypertonicity Trigger points in affected muscle, synergists, and antagonists	Significant pain Significantly reduced strength, particularly against resistance Bruising remains, may be changing color to yellow or green Possible hematoma Palpable gap at the site of injury if muscle was not surgically repaired Significant scarring if muscle was surgically repaired. Injury may be splinted or casted Protective muscle spasm may continue, or may diminish and may be replaced by hypertonicity Trigger points developing in affected muscle, synergists, and antagonists
<b>Chronic stage</b> (symptoms continue beyond the subacute stage)	Bruising has cleared Trigger points, scars, adhesions, and hypertonicity may still affect injured muscle and compensating structures and may cause ischemia Discomfort when affected muscle is stretched Increased risk of re-injury if not properly treated Chronic inflammation if not properly treated	Bruising has cleared Trigger points, scars, adhesions, and hypertonicity affect the injured muscle and compensating structures and may cause ischemia Discomfort or pain when the affected muscle is stretched ROM in joint(s) crossed by the affected muscle has improved but is still restricted Increased risk of re-injury if not properly treated Chronic inflammation if not properly treated Possible atrophy if not properly treated	Bruising has cleared Trigger points, scars, adhesions, and hypertonicity affect the injured muscle and compensating structures and may cause ischemia Reduce ROM in joint(s) crossed by the affected muscle Reduced strength if the affected muscle was not surgically repaired Increased risk of re-injury if not properly treated Increased risk of overuse injury to synergists if the affected muscle was not surgically repaired Chronic inflammation if not properly treated Possible atrophy if not properly treated

Athletes are particularly prone to strains, particularly in sports involving quick, intense movements using maximum strength. Athletes are also more prone to other injuries, which, if they do not properly heal, increase the risk of strains. Athlete or not, the muscles of a person participating in an intense activity following a period of relative inactivity may not be well conditioned and may suffer from strains. In general, using improper techniques when participating in sports, dancing, or other intense activity increases the risk of muscle strains.

Age may also play a role in the increased risk for muscle strains. In adolescents, growth spurts sometimes increase the length of the bones more quickly than the muscle can adapt. This increases tensile stress and the risk of strain until the muscles grow to fit the joint. In older adults, the tone, strength, and general health of tissues begins to deteriorate, putting muscle fibers at risk for tearing. Temperature may also play a role in the risk of strain injuries. In cold temperatures, superficial vessels contract to prevent substantial heat loss. This cooling affects elasticity and may increase the risk of muscle fiber rupture. Simple contractions performed before intense activity can increase muscle temperature by a full degree or two.

Because strains can occur anywhere in the body, they can be confused with many other conditions throughout the body. For example, pain in the back of the calf may be a muscle strain, but it may also be a Baker's cyst or blood clot. Low back pain may involve strains, a herniated disc, or both. Pain in the chest could indicate a strain to the pectorals but can also be a symptom of a cardiac event. Muscle strain is usually associated with a precipitating event, whether a single, acutely painful injury or the introduction of new activity after a period of inactivity. Palpation of the area usually produces more intense pain at the specific site of the injury. Table 2 lists some general conditions commonly confused with or contributing to muscle strains. Because the pattern of pain from strains can present so differently, it is particularly important to understand the client's health history, precipitating events, and other possible causes of pain in the area before treatment. Consult your pathology book for more detailed information. If you are unsure and the client's symptoms resemble a more serious condition, particularly if the client has other risk factors, refer them to a health care provider for medical assessment.

**Table 12-2: Differentiating Conditions Commonly Confused with or Contributing to Muscle Strains**

CONDITION	TYPICAL SIGNS & SYMPTOMS	TESTING	MESSAGE THERAPY
<b>Sprain</b>	Inflammation, heat, redness, and pain in acute stage  Remaining inflammation and weakness reduce ROM in subacute and chronic stages	Often self-assessed	Massage is indicated.
<b>Tendinitis</b>	Often has gradual onset  Pain, tenderness, and swelling at affected tendon	Physical exam  Localized pain on full passive stretch  X-ray may be performed to rule out other conditions	Massage is indicated.
<b>Delayed onset muscle soreness (DOMS)</b>	Stiffness and discomfort 24–72 hours after activity  Common when new activity is initiated after a period of inactivity  Risk increases with activities involving eccentric contractions  Temporary reduction in strength  Temporary reduction in ROM  Continuing activity and increasing the frequency and intensity may improve symptoms	By signs and symptoms	Treatment is not necessary, although massage may improve symptoms and prevent further injury.

**Table 12-2: Differentiating Conditions Commonly Confused with or Contributing to Muscle Strains (continued)**

CONDITION	TYPICAL SIGNS & SYMPTOMS	TESTING	MASSAGE THERAPY
<b>Spasm/cramp (contracture)</b>	Sudden, often sharp pain in affected voluntary muscle Palpable and often visible mass of hypertonic muscle tissue	Most often self-assessed X-ray or MRI may be used to assess extent of damage	Massage is indicated. Discuss with health care provider if repeated spasm is related to an underlying condition or medication.
<b>Myofascial pain syndrome</b>	Persistent muscle aches or pain Muscle or joint stiffness Muscle tension Trigger points Pain interrupts sleep	Physical exam Palpate for trigger points Referred pain or twitch response Other tests may be performed to rule out other sources of pain	Massage is indicated. Myofascial pain syndrome is associated with trigger points.
<b>Avulsion fracture</b>	Bone fragments at the attachment site of a tendon or ligament Often accompanies strains and sprains Moderate local pain Bruising and inflammation	X-ray	Local massage is contraindicated in the acute stage. Caution is used when treating the surrounding tissues to avoid further injury. Massage may help to prevent further injury when muscle tension is a contributing factor.
<b>Bursitis</b>	Pain, particularly with activity or palpation Heat, redness, swelling, or tenderness	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 to the structures surrounding the joint is indicated.
<b>Hernia</b>	Bulge in the area Pain or discomfort, particularly when bending, coughing, sneezing, or lifting heavy objects	Physical exam	Massage is locally contraindicated until the hernia is repaired.

## CONTRAINDICATIONS AND SPECIAL CONSIDERATIONS

First, it is essential to understand the cause of the client's pain. If the client is unable to move the joint, heard a popping sound, or has significant weakness 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 consult a pathology text for massage therapists before proceeding. These are a few general cautions:

- **Protective muscle splinting.** When a muscle is injured, its synergists and antagonists may spasm reflexively in an attempt to keep the joint's movement within a range that prevents further injury. Do not reduce protective muscle splinting in the acute stage of injury. Wait until the subacute or chronic stage, when sufficient scarring and muscle fiber regeneration reduces the need for protective splinting.
- **Bruises.** A bruise indicates damage to blood vessels allowing blood to accumulate in surrounding tissue. Avoid direct pressure to a bruise that is still healing. As the vessels heal and blood is reabsorbed, the color changes from red or purple to green or yellow. Severe bruising may result in a hematoma—a

localized pooling of blood outside the vessels. In some cases, a sac-like enclosure forms around the pool of blood to minimize internal bleeding. A hematoma often resolves on its own, like a simple bruise, but if it grows or hardens it may require medical attention. Avoid direct pressure to a hematoma, and refer the client to a health care professional if the area becomes hard, if the client reports feeling pressure from the hematoma, or if it does not show signs of resolving over the course of a week or two.

- **Muscle testing.** Use only active ROM testing in the acute stage of a grade 2 or 3 strain. The client usually limits active movement to the pain-free range. P ROM and R ROM testing in the acute stage may cause further injury.
- **Hydrotherapy.** Do not apply heat near the edges of a cast to prevent the accumulation of fluid under the cast.
- **Reproducing symptoms.** Symptoms may occur during treatment. If treatment reproduces symptoms, adjust the client to a more neutral posture. Shortening or adding slack to the muscle 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 older, 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.
- **Friction.** Do not use deep frictions if the health of the underlying tissues is at risk for rupture or if the client is taking anti-inflammatory medication or anticoagulants. Allow time for scarring and tissue regeneration to avoid re-injury. 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 the health care provider agrees. Because anticoagulants reduce clotting, avoid techniques that may cause tearing and bleeding.

## MASSAGE THERAPY RESEARCH

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Many articles and research studies describe a healing program for muscle strains including massage, deep friction, and stretching. There are also many articles that include massage as part of a program to prevent muscle strains in athletes. However, a thorough review of the literature resulted in no research, case studies, or peer-reviewed articles testing the benefits of massage therapy alone in the treatment of muscle strains, and none of the studies that include massage in a healing program specifies the treatment used. While massage is cited as an important element in healing strains, no study has tested the specific effect of massage therapy on the healing process, reduction of scar tissue and adhesions, release of protective muscle splinting, regeneration of muscle tissue, restoration of strength and ROM, or reduction in the risk of re-injury.

In “Evaluation of the Effect of Two Massage Techniques on Hamstring Muscle Length in Competitive Female Hockey Players,” Hopper et al. (2005) reported that reduced muscle length predisposes the athlete to injury; they studied the benefits of two forms of massage therapy in lengthening the hamstrings of 35 subjects treated over 3 consecutive days. Treatment was performed by experienced physiotherapists. One group received what the authors refer to as “standardized classic massage intervention,” which included proximal to distal effleurage, circular kneading, proximal to distal picking up, and shaking. Each massage lasted 8 minutes. The second group received what the authors refer to as “dynamic soft tissue mobilisation (DSTM),” which involved the classic massage described above for a shorter duration, followed by longitudinal and cross-fiber strokes to the specific tissues identified as tight. The technique was applied during passive then active extension of the knee. DSTM treatments also lasted 8 minutes. Hamstring length was measured before, directly after, and 24 hours after treatment. Both groups showed a significant increase in hamstring length following treatment, and

there was no significant difference between the two groups. While the benefits were not maintained 24 hours after treatment, the authors recommended a study of the two treatments on subjects in the subacute phase of injury and recommended investigating treatment designed to reflect the clinical setting.

Delayed onset muscle soreness (DOMS) results from the breakdown of muscle fibers following exercise, seen more often following resisted eccentric contractions than following concentric contractions. Several sources refer to DOMS as mild muscle strain, although DOMS is differentiated as a random pattern of injury to muscle belly fibers that do not require rest for recovery while strain refers to an identifiable pattern of tearing—frequently involving the tendon or musculotendinous junction—which requires a period of rest for proper healing. In “The Effects of Therapeutic Massage on Delayed Onset Muscle Soreness and Muscle Function Following Downhill Walking,” Farr et al. (2002) described performing a 30-minute massage to one leg of each of eight male subjects 2 hours after each performed a 40-minute, downhill treadmill walk. Massage included only effleurage and petrissage to all major muscles of the leg and did not include deep tissue massage. Participants experienced reduced pain in the leg massaged, but there was no significant improvement in the strength or function of the affected muscles. While treatment did not focus on a single strained muscle, the study did show the benefit of massage for reducing the pain associated with muscle damage due to repeated eccentric contraction by increasing local circulation, reducing edema and the accumulation of metabolites, and decreasing nerve sensitization and pain. Further study of the effects of massage on the healing process of muscle strains is needed.

## Working with the Client

### CLIENT ASSESSMENT

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**M**uscle strain is a common cause of musculoskeletal pain, experienced in some degree by most people. Strain is often one element of musculoskeletal injuries or chronic pain conditions. For example, when short plantar flexors contribute to plantar fasciitis, lengthening those muscles against resistance, such as when walking, can cause tearing of the fibers. When mild, first-degree strains contribute to the symptoms of other conditions, the following treatment recommendations can aid healing and reduce the risk of re-injury. Reducing adhesions and scar tissue, reorienting muscle fibers, lengthening shortened muscles, and strengthening weak muscles are the basic goals for treating muscle strains.

More serious second- and third-degree strains require more focused attention. An acute third-degree strain requires medical attention. You are not likely to see a client in the acute stage of a third-degree strain. When surgical repair presents more risk than benefit, the muscle may be left detached. In most cases, the muscle is surgically repaired, and the client is prescribed physical therapy. You are most likely to see a client in this condition as part of a program to reduce pain, limitations in ROM, or compensating patterns that may have developed. Swelling and bruising in the acute stage of a second-degree strain can be significant enough to contraindicate treatment locally or to a broad area surrounding the injury. Significant swelling that occurred within 20 minutes of injury may indicate bleeding that poses a greater risk for the development of a hematoma or injury to structures other than muscle and requires medical attention.

Because any muscle can be strained, the following descriptions do not identify specific muscles to be treated. Use your knowledge of anatomy to determine fiber direction, joints crossed, superficial versus deep muscles, common trigger points and referral areas, and so on.

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 12-2: Health History

QUESTIONS FOR THE CLIENT	IMPORTANCE FOR THE TREATMENT PLAN
Where do you feel symptoms?	Location of the symptoms helps to identify the precise location of stretched or torn fibers and contributing factors.
Describe what your symptoms feel like.	A description of symptoms including weakness, heat, or fullness in the area may help you to determine the stage and degree of strain.
What activity were you performing when you first felt the pain? Did you hear or feel a snap in the area at the time of injury?	The details of the activity or posture that initiated the pain may help you to determine its cause. A new regimen of exercise, weight-bearing activity, or repetitive action, particularly following a period of inactivity, may contribute to a strain.
When did the symptoms begin?	The date of the injury may help you to determine the stage of the injury and the health of the tissue.
To what degree were you able to continue activity following the injury?	The activity level after the injury may help you determine the degree of strain. An inability to continue activity suggests a third-degree strain and should be referred for medical assessment.
Do you have a history of injury or surgery to this area?	An explanation of prior injury to the area may help you to locate the strain and determine contributing factors. Surgery and resulting scar tissue may increase the risk of strain.
Do any movements make your symptoms worse or better?	Locate weakness in the structures producing such movements. Resisted activity of the affected muscle is likely to increase symptoms. Adding slack or reducing tension in the muscle may decrease symptoms.
Have you seen a health care provider for this condition? What was the diagnosis? What tests were performed?	Medical tests may reveal the degree of strain, fractures, or coinciding injuries. If no tests were performed to make a diagnosis, use the tests described in this chapter for your assessment. If your assessment is inconsistent with a diagnosis, ask the client to discuss your findings with a health care provider or ask for permission to contact the provider directly.
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. A history of repeated corticosteroid injections may affect the integrity of the muscle and tendons, increasing the risk of tearing or rupture. Use caution when applying pressure or cross-fiber strokes even after the period of contraindication has passed. Analgesics reduce sensation and may cause the client to allow you to work too aggressively.
Have you taken a pain reliever or muscle relaxant within the past 4 hours?	The client may not be able to judge your pressure and may allow you to work too aggressively.
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.

## Postural Assessment

Allow the client to walk and enter the room ahead of you while you assess their posture and movement. Look for imbalances in movement of the joint(s) crossed by the affected muscle or muscle group or patterns of compensation that may develop to protect the injured structures. If the lower body is affected, watch as the client walks or climbs steps. If the upper body is affected, watch as the client opens the door, takes off their coat or lifts a pen. If the thorax is affected, notice how the client moves the spine. Look for reduced mobility

or favoring of one side. Watch as the client sits, stands from sitting, lifts or sets down objects, turns to talk to you, and so on to see if they can perform these activities without assistance or if they avoid bearing weight on the affected joint. The grade and stage of the strain will influence the level of imbalance and compensation.

When assessing the client's standing posture, be sure that the client stands comfortably. If they deliberately attempt to stand in the anatomic position, you may not get an accurate assessment of their posture in daily life. When strain affects the lower body, the client may stand in a position that keeps weight off the affected joint(s). When the upper body is affected, the client may hold the joint in a position that keeps the injured muscle from stretching. If the client has a removable device bracing the injured area, ask them to remove it if it is possible to bear the weight without it so that you can get an accurate picture of the strength of the injured muscles.

## **ROM Assessment**

Test the ROM of the joint(s) crossed by the strained muscle. Only active ROM testing should be performed with a second- or third-degree strain in the acute stage to avoid further injury.

### **Active ROM**

Compare your assessment of the client's active ROM in the affected joint(s) to the values listed for the joint's average ROM in prior chapters. Pain and other symptoms may not be reproduced during active ROM assessment because the client may limit movement to a symptom-free range.

- **Active ROM of the affected joint** will be limited. Limitations are more significant with more severe grades of strain and diminish as the stage of injury progresses from acute to chronic. A first-degree strain in the acute stage may be limited by discomfort caused by stretching the affected muscle; second-degree strains may be limited by pain with concentric and eccentric contraction; third-degree strains produce severe pain and allow little or no movement of the affected joint.

### **Passive ROM**

P ROM should not be performed in the acute stage of a second- or third-degree strain to avoid further injury. Compare the client's P ROM on one side to that on the other when applicable. Note and compare the end feel for each range.

- **P ROM of the affected joint** in the acute stage of a first-degree strain may be slightly limited, may cause pain due to reflexive muscle spasm, and may cause pain when ROM lengthens the affected muscle. Results may be similar in the subacute and chronic stages for all grades of strain with varying degrees of limitation and pain according to grade. Note that ROM testing following a third-degree strain that was not surgically repaired is intended to assess the synergists and antagonists of the ruptured muscle.

### **Resisted ROM**

R ROM should not be performed in the acute stage of a second- or third-degree strain to avoid further injury. Use resisted tests to assess the strength of the muscles that cross the affected joint for a first-degree strain and in the subacute or chronic stages of second- and third-degree strains. Compare the strength of the affected side to that of the unaffected side when possible.

- **R ROM of the affected joint** in the acute stage of a first-degree strain in all stages may be slightly limited or painful. R ROM with a second- or third-degree strain in the subacute and chronic stages should be performed with a gradual increase in resistance to avoid further injury when assessing muscle strength. R ROM is limited by reduced strength and pain at the injury site. The structure

being tested may tremble as the client reaches their limit of strength. Note that ROM testing following a third-degree strain that was not surgically repaired tests the synergists and antagonists of the ruptured muscle.

## Special Tests

Because strains can occur in any muscle, there is no single special test. Length and strength assessment of the affected muscle, its synergists, and antagonists along with locating the specific site of injury are the primary assessment strategies for strains. Use ROM testing as described above to assess strength and length. When appropriate for the grade and stage of strain, test the strength of the muscle(s) you suspect to be injured with active and resisted concentric contraction. Test the length of the muscle(s) you suspect to be injured with passive or active eccentric contractions.

## Palpation Assessment

Bruises may be present in the acute and early subacute stages (Fig. 3). Avoid direct pressure on a fresh bruise. Minor bruising may occur with a first-degree strain or with the second-degree strain of a small muscle or of relatively few fibers in a larger muscle. A larger bruise may be evident with a second-degree strain to a larger muscle or more than one muscle or with a third-degree strain. As the injury heals, bruising changes colors and then disappears. In the chronic stage, the bruise is usually gone unless repeated tearing continues to occur. Edema may also be present in all stages. Avoid direct pressure on an edematous area in the acute stage. In the acute stage, when the inflammatory process is active, the area may be red and hot, and the texture of the edematous area may be dense or hard as if the area is too full and stretching the skin. When the inflammatory process diminishes, the edematous area may feel softer and less dense. In the chronic stage, the edematous area may feel boggy or gelatinous. Swelling that persists and continues to feel dense or hard may indicate a hematoma. Refer the client to their health care provider for medical assessment.

On palpation, the site of injury may be tender in all stages. Tenderness diminishes as the injury heals. Tenderness on palpation may radiate to the surrounding tissue, and the area of radiating pain also diminishes as the injury heals. You may feel a gap in the affected fibers, particularly with a second- or third-degree strain. The gap will fill in with scar tissue as the injury heals. If a third-degree strain is not surgically repaired, the gap remains and can often be seen and palpated. You may feel the remaining muscle bunched up near one of the attachment sites if it ruptured at the opposite musculotendinous junction or detached from the bone, or more rarely, at both attachment sites if the muscle belly ruptured.

As time passes, scar tissue becomes thicker, denser, and possibly fibrous. Adhesions may develop, reducing mobility between the skin and affected muscle or between the affected muscle and those surrounding it. If not properly treated, scarring, adhesions, and remaining edema may reduce local circulation, resulting in ischemia.



Figure 12-3 Bruise following muscle strain.



The ischemic area may feel cool to the touch. When assessing muscle tone, you may find protective spasms in the affected muscle, its synergists, or its antagonists in the acute and early subacute stages. This protective spasm serves to keep the joint from moving through a range that may cause further injury. Do not attempt to reduce protective spasms in the early stages. As healing progresses and the risk of re-injury diminishes, the spasm may cease naturally or can be treated manually. In the late subacute and chronic stages, the affected muscle and synergists may remain hypertonic. Holding the injured muscle in a shortened position to reduce the risk of pain or re-injury is a natural impulse and may cause the antagonists to remain overstretched and stressed. Trigger points may develop in any of the muscles involved in the movement of the joint crossed by the strained muscle. If the severity of the injury prevents movement of the joint or if the injury was not treated well enough to restore ROM, you may find atrophy in the affected muscle(s) or synergists.

To effectively treat a strain, it is essential to locate the precise site of injury and to know the direction of fibers of the affected muscle. Refer to the images of specific muscles throughout this text for fiber direction. Take your time palpating the location. Once you have identified the affected muscle(s) with ROM testing, palpate them slowly, covering approximately 1 inch of tissue in 5–10 seconds. Stay focused and allow the receptors in your fingers to transmit important information. Feel for gaps, scars, or other anomalies in texture, tone, temperature, and tenderness.

## CONDITION SPECIFIC MASSAGE

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This section focuses on first-degree strains in all stages and second- or third-degree strains in the late subacute or chronic stage. While massage therapy may be beneficial for second-degree strains in an earlier stage, the potential contraindications and complications require more advanced training. An acute third-degree strain requires medical attention. Healing in the subacute stage of a third-degree strain is best supervised by a professional experienced in treating severe muscle strains.

The treatment goals and techniques are the same for first-degree strains in all stages and second- or third-degree strains in the subacute or chronic stage, but the intensity of treatment should be adjusted according to the severity of injury. For example, a first-degree chronic strain that has developed minor scarring and dysfunction does not present as significant a risk of re-injury during a stretch as a second-degree strain with moderate scarring or a third-degree strain with severe scarring. A third-degree strain is likely to have developed much more extensive protective muscle spasms, adhesions, and scars, and requires more warming of superficial tissues and a slower pace approaching the deeper tissues. You are more likely to be able to focus directly on the injured muscle with a first-degree strain while a second-degree strain requires more attention to the compensating and surrounding structures before addressing the torn fibers directly.

It is essential for the treatment to be relaxing. You may not be able to eliminate the symptoms associated with muscle strain 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 them from relaxing. If the client responds by tensing muscles or their facial expression 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 their 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 them 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 pain, weakness, and limited ROM caused by overstretching or tearing of muscle fibers. The following are general principles for any muscle affected by strain.

**Treatment Goals:**

Increase circulation



Reduce adhesions



Reduce tone/tension



Lengthen tissue



Treat trigger points



Passive stretch



Clear area

- Positioning and bolstering depends on which muscles are to be treated. In the early stages following injury, the affected muscles should rest comfortably in a position that prevents stretching. Full lengthening of the affected muscle may cause pain and increase the risk of re-injury.



- If you find edema, apply superficial draining strokes toward the nearest lymph nodes and, when possible, bolster the area to allow gravity to draw fluid toward the thorax.



- If swelling is minor or absent and bruises have sufficiently faded, apply moist heat to the affected area to soften scars and adhesions and increase local circulation.



- Use your initial warming strokes to increase superficial circulation, soften tissues, and assess the tissues broadly surrounding the site of injury or compensating for the injured muscle. If time permits, apply initial warming strokes to the whole body. You should be able to minimally assess tissues surrounding the injury for adhesions, hypertonicity, protective muscle spasm, and tensile stress, which will help you to determine how to focus your time.



- Based on your findings, treat muscles proximal to the site of injury for adhesions, shortening, hypertonicity, and trigger points.



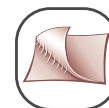
- Before applying emollient, assess for and treat fascial restrictions around the injured area. Tissues that have shortened to prevent re-injury, particularly those closest to the injury are most likely to develop fascial restrictions.



- Reduce tension in the tissues that surround the site of injury. Pay special attention to the synergists of the muscle's primary actions. If the antagonists are accessible, treat these now, or perform this after the client changes position.



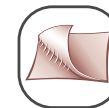
- Once the superficial tissues are pliable enough to allow for deeper work, apply friction strokes to reduce the remaining adhesions and lengthening strokes to tissues that are short and tight. Muscles with fiber direction and actions in common with the injured muscle are likely to have shortened, possibly in spasm, to protect the injured muscle from overstretch and re-injury.



- Treat any trigger points found in the synergists of the affected muscle or in muscles compensating for the injury. Treat trigger points in antagonists if they are accessible now, or treat them later after the client changes position. Follow trigger point treatment with lengthening strokes, but do not stretch the muscles until you have treated the precise site of injury.



- Locate the precise site of the strain, and assess the direction of the tear. Using short, slow strokes within the client's pain tolerance, apply cross-fiber strokes to reduce scar tissue at the site of injury. Follow this with longitudinal strokes to redirect the fibers. Alternate rounds of cross-fiber and longitudinal strokes until you feel a change in texture. If the area gets hot or begins to swell, discontinue this step, and briefly ice the area.





- Apply longitudinal strokes to the full length of the injured muscle.



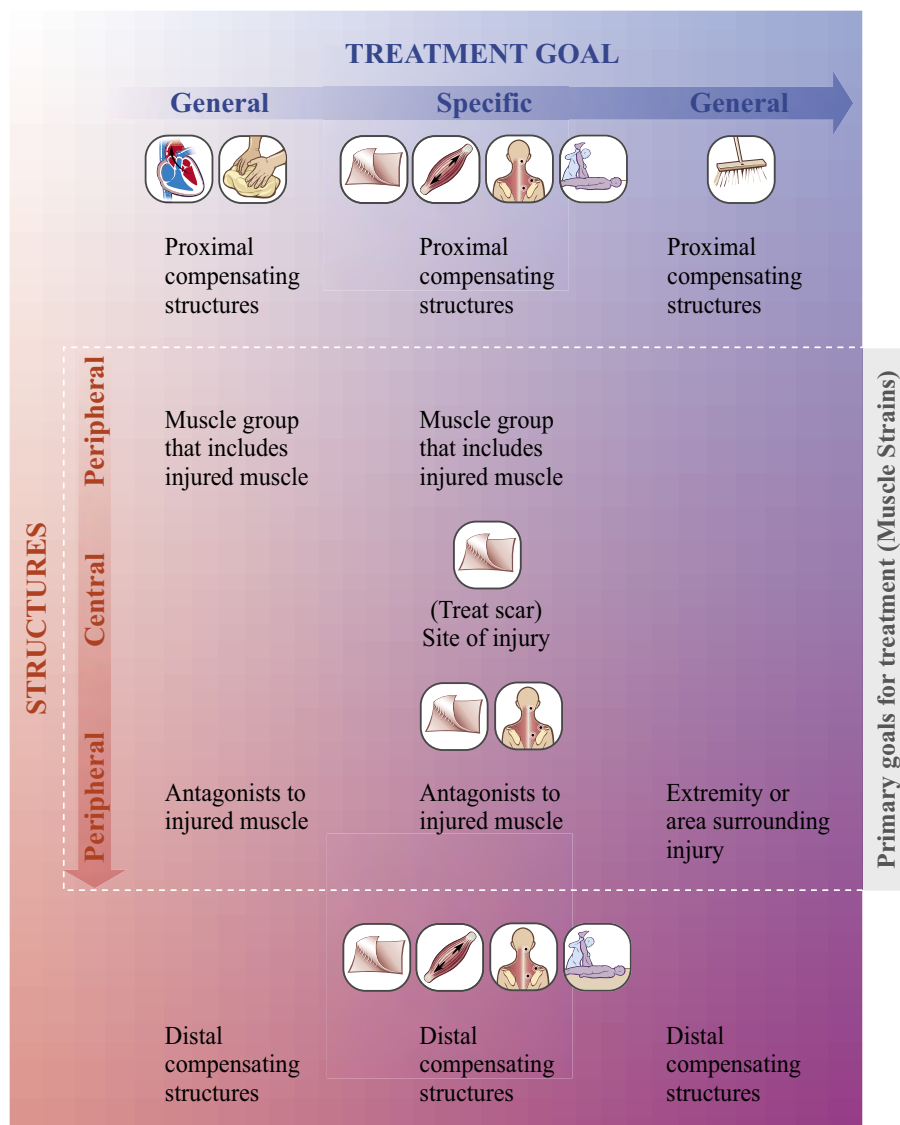
- Treat tissues distal to the injury for compensating patterns if needed.



- Passively stretch the affected muscle or perform PIR within the client’s tolerance to lengthen the affected muscle and its synergists. This may require repositioning the client.



- If you were earlier unable to address the antagonists of the injured muscle, reposition the client and address them now.



## CLIENT SELF-CARE

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Avoiding re-injury is a primary concern when recommending self-care. Clients with an acute or subacute second- or third-degree strain should be prescribed self-care by a professional with advanced training and experience in treating severe musculoskeletal injuries. For clients with first-degree strains, or those in the chronic stage of a second- or third-degree strain, the following suggestions may encourage proper healing.

These suggestions are intended as general recommendations for stretching and strengthening the 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 inactivity, suggest moving for at least a few minutes every hour to prevent adhesions and reduced circulation. If the client's daily activities require repetitive actions that contribute to strains, suggest resting for at least a few minutes every hour.
- Demonstrate gentle self-massage of the tissues surrounding the injury to keep adhesions and hypertonicity at bay between treatments.
- Demonstrate all strengthening exercises and stretches to the client and have them perform these in your presence before leaving to ensure that they are 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. 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 based on your findings in ROM testing and palpation.

### Stretching

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Maintaining proper length and tone of the strained muscle, its synergists, and its antagonists is essential to reduce the risk of re-injury. Stretches should be performed throughout the day, particularly before and after activity. ROM testing and palpation identify which muscles have shortened and need to be stretched. In general, stretching occurs when the distance between the attachment sites of the muscle is increased. Take care to instruct the client to stretch slowly and to limit stretches to the comfortable range, beginning slowly and gradually increasing the stretch as symptoms diminish and the risk of re-injury is reduced. Stretching an injured muscle too quickly or too deeply may initiate a reflex response that may result in spasm. In addition, when the affected muscle is lengthened, its antagonists are shortened. If the antagonists are involved in protective splinting, contracting them too quickly or too deeply may also result in spasm.

### Strengthening

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Strengthening weakened or atrophied muscles is also important for restoring proper function of the affected joint. ROM testing and palpation identify which muscles have weakened and need to be strengthened. In general, active or resisted concentric contractions strengthen muscles. As with stretching, a strengthening program should progress gradually. Pain-free, active ROM is effective for gradually restoring strength to weakened muscles. As healing progresses and the risk of re-injury diminishes, add resistance to active ROM.

## SUGGESTIONS FOR FURTHER TREATMENT

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Ideally, a client with a strained muscle 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 has been achieved, reduce frequency to once per week until symptoms are absent for at least 7 days. When the client reports that they have 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, they can then schedule once per month or as necessary. 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 their 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 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 treatment, it may encourage the client to discuss this change with a health care provider and seek manual therapy rather than more aggressive treatment options. If the client receives regular treatments, the signs and 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 specific symptoms of the strain, you may be able to pay closer attention to compensating structures and coexisting conditions.

## Professional Growth

### Case Study

*Andy is a 32-year-old male. Two weeks ago while playing basketball, he heard and felt a snap at the back of his thigh, immediately followed by pain. He could walk using the leg but felt pain and limped. Within half an hour after injury, only minimal swelling at the site of injury was present. Within 24 hours the back of his thigh was covered with bruises. He called this office, and PRICE plus a visit to his health care provider was recommended before scheduling a massage. He iced the area immediately after returning home and intermittently for 1 week following injury. He also elevated the injured thigh and wrapped the injury. He felt the worst pain when seated due to pressure on the thigh against the chair, so he sat at the edge of the chair, which led to low back pain.*

*Andy’s health care provider diagnosed a second-degree strain to the right semimembranosus. No MRI was performed. Diagnosis was made by palpation and the pattern of bruising and swelling, which followed the long, proximal musculotendinous junction of the semimembranosus. Andy stated that his*

provider agreed with the recommendation to rest, ice, and compress the area and to allow healing to start before beginning massage treatment. His first massage treatment was 1 week after the injury. At that time, Andy stated that the pain on walking had diminished somewhat but that he still felt sharp pain when the seat of a chair compressed the area of injury. He had been sitting on the edge of his seat at work to avoid contact with the injury, which he stated was causing some low back pain. He stated that he felt moderate pain when extending the knee upon lying down but noticed that if he extended the knee slowly, pain was minimal. Upon visual assessment, a spiral pattern of accumulated blood was evident, suggesting that the injury had been wrapped with a narrow ACE bandage, possibly too tightly. A solid compressive bandage without elastic edges contacting the bruised area was recommended to minimize this accumulation.

At the time of his first appointment, bruising was still too significant to work directly on the site of injury. Treatment focused on reducing compensatory low back pain and treating the uninjured leg to prevent hypertonicity and trigger points. Treatment to the injured leg focused on reducing edema at the site of injury, increasing local circulation, and reducing adhesions and hypertonicity in the synergists and antagonists. The injury is now 2 weeks old, and Andy has returned for a second treatment.

### **SUBJECTIVE**

Today, Andy states that he has been more mobile since his massage last week. He still feels some discomfort with activity but feels significant pain only at the end of the day when he is fatigued. He is still unable to fully extend the knee without pain, although the pain has decreased. Andy followed my recommendation to rest the foot of the injured leg on a box or stack of books while sitting to prevent his thigh from contacting his chair while at work, as an alternative to sitting at the edge of the chair. He has not experienced low back pain since the last session.

### **OBJECTIVE**

Andy is still limping slightly but can bear more weight on the injured leg. When standing still, Andy still bears weight on the left leg. The left hip is elevated slightly. The right hip and knee are flexed, and the right femur is slightly rotated medially. The bruise is now green and fading. Inflammation that followed the proximal musculotendinous junction of the semimembranosus is now gone, and the gap at the middle third of the proximal semimembranosus tendon has filled with scar tissue. It is still tender to the touch, but he can tolerate moderate pressure. ROM has improved, although he was unable to fully extend the knee and flex the hip due to pain.

Andy felt no tenderness on palpation of the proximal and distal ends of the hamstrings, minimal tenderness surrounding the injury, and pain upon palpation of the site of strain that radiated to the area immediately surrounding the strain. The local and radiating pain have diminished somewhat since last week. The texture of the surrounding muscles is dense and adhered.

The left gluteus maximus and the posterior fibers of the gluteus medius remain hypertonic, although they have improved since the last treatment. The hypertonicity of the right gastrocnemius has improved. Andy is able to rest the right foot flat when standing.

### **ACTION**

I began in a prone position with the ankles bolstered to reduce hamstring stretch. I applied general Swedish and deep tissue strokes to the low back and glutes to assess the remaining compensatory patterns. I applied kneading, cross-fiber, and longitudinal strokes to continue reducing adhesions and hypertonicity in synergists and compensating limb. I applied slow muscle stripping to assess for trigger points. The client felt pain and referral upon crossing the site of injury. It is still unclear if this is due to a trigger point in the semitendinosus or scar tissue and referred pain from the semimembranosus strain.

*As healing continues and referred pain from the injury ceases, I will revisit this area to determine if compression produces trigger point referral. A trigger point in the adductor magnus referred into the pelvis, and I treated it with compression and muscle stripping, reducing the referral from level 5 pain to level 3.*

*I applied cross-fiber strokes to the precise site of injury. The client's pain tolerance continues to prevent deep, direct access to the semimembranosus, but I was able to mobilize tissues through the semitendinosus and by working toward the injury from its periphery. I followed this with longitudinal strokes. The area was warm to the touch following treatment. I applied ice to prevent possible swelling, but removed the ice within 2 minutes to avoid chilling the muscle before the stretches. I used general kneading and gliding strokes to the distal limb to increase circulation and reduce remaining compensatory hypertonicity. I treated the unaffected leg with general Swedish techniques to keep hypertonicity and adhesions at bay.*

*Turning the client supine, I applied a slow and minimal passive stretch to the hamstrings and adductors but was unable to stretch either to full ROM because of the client's discomfort. I applied kneading and longitudinal strokes to the quadriceps of the affected leg and found minimal tension in the rectus femoris. I used general Swedish techniques on the unaffected leg and clearing strokes bilaterally toward the thorax.*

#### **PLAN**

*Because the bruising is resolving and the protective muscle splinting is no longer needed, I suggested that warm hydrotherapy to the synergists and antagonists followed by gentle stretches may be effective to maintain pliability if he feels stiffness. I recommended continuing mild, pain-free exercises including gentle flexion and extension of the hip and knee and walking to maintain circulation and prevent adhesions and shortening of the muscles. I suggested increasing activity as tolerance permits but cautioned against stretching the hamstrings quickly or fully until the scar is strong enough to withstand tension. I suggested avoiding resisted activity for at least another week. I will reassess at the next appointment. Andy rescheduled for one week from today. If symptoms continue to improve, I will attempt to access the semimembranosus directly and continue to treat the scar. If this is possible, we will increase visits to twice per week for 1 or 2 weeks while realigning the scar tissue. Goals include softening and redirecting scar tissue, continuing to reduce hypertonicity, treating trigger points if found, and continuing to gradually increase ROM and strength. I explained that second-degree strains can take 1–2 months to heal completely.*

## **CRITICAL THINKING EXERCISES**

1. Your client states that she feels pain in her left shoulder and points to the medial border and superior angle of the scapula up to the neck. Her neck is laterally flexed and rotated to the right. Which muscle(s) might be strained? Which muscle(s) may be contributing to the strain because they are stronger, shortened, or hypertonic, causing the strained muscle(s) to lengthen? Write a SOAP note for this client. Create a scenario that describes how this pattern may have developed, signs and symptoms, possible coinciding conditions, a postural assessment, testing, precautions or contraindications, and specific treatment. Use a reference book that describes the actions of the affected muscles to help you associate signs and symptoms. There is no single, correct SOAP note for this exercise. Be creative as the possibilities are virtually endless.

2. This chapter contains references to the coincidence of strains with the individual conditions described in Chapters 4–11. Choose one of the conditions described in those chapters and identify which muscles could be strained or are at risk for strain based on the client's posture or activities. Strains may occur when impaired muscles are forced to stretch beyond their capacity or to contract quickly and intensely. How would you add treatment of the strain into the treatment described for the other condition?
3. Conduct a short literature review to learn about the relationship between chronic strains and the following:
  - Age
  - Insufficient hydration
  - Lactic acid accumulation



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