

Carpal Tunnel Syndrome 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 Carpal Tunnel Syndrome home study course

Thank you for investing in the Carpal Tunnel Syndrome 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 carpal tunnel syndrome. 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 *Carpal Tunnel Syndrome, 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. 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 Carpal Tunnel Syndrome 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 carpal tunnel syndrome.

Carpal Tunnel Syndrome Exam

1. Which of the following nerves is compressed within the carpal tunnel of the wrist in carpal tunnel syndrome?
 - A. Ulnar
 - B. Median
 - C. Musculocutaneous
 - D. Radial
2. Which of the following are possible causes and/or contributing factors to carpal tunnel syndrome?
 - A. Anatomical variations such as bone dislocations or cysts
 - B. Repetitive or forceful actions or vibrations at the wrist such as data entry jobs or electrical work
 - C. Health factors such as obesity, arthritis, or gout
 - D. All of the above
3. Which of the following are typical signs and/or symptoms of cubital tunnel syndrome?
 - A. Numbness, pain, paraesthesia, or weakness in the ulnar nerve distribution
 - B. Local inflammation and point tenderness
 - C. Weak deltoid and shoulder pain with no radiating pain or paraesthesia
 - D. Stiff, painful joints which are usually felt in more than one joint
4. What is the importance of asking the client if they have had a cortisone shot and where in the past 2 weeks?
 - A. Local massage is indicated
 - B. It tells you if the injury is acute or chronic
 - C. Local massage is contraindicated
 - D. Systemic massage is contraindicated
5. Which of the following muscles may be shortened in cases of carpal tunnel syndrome?
 - A. Extensor digitorum
 - B. Extensor carpi radialis longus
 - C. Extensor carpi radialis brevis
 - D. Pronator teres
6. Resisted ROM tests are used to:
 - A. Assess the strength of the muscles that cross the joints involved
 - B. Assess the client's pain free ROM
 - C. Diagnose conditions associated with carpal tunnel syndrome
 - D. Compare ROM on each wrist to determine deficiencies
7. In palpation assessment for carpal tunnel syndrome, compression of the nerve or vessels may cause all of the following EXCEPT:
 - A. Cool or warm skin
 - B. Pink skin
 - C. Pale skin
 - D. Reduced hair growth

8. Which of the following best describes how to perform the retinaculum stretch?
 - A. Pinning the tissue at its attachments and gently pushing them toward each other
 - B. Performing friction lengthening strokes from the palm toward the forearm
 - C. Pinning the tissue at its attachments and gently pulling them away from each other
 - D. Performing friction lengthening strokes from the forearm toward the palm

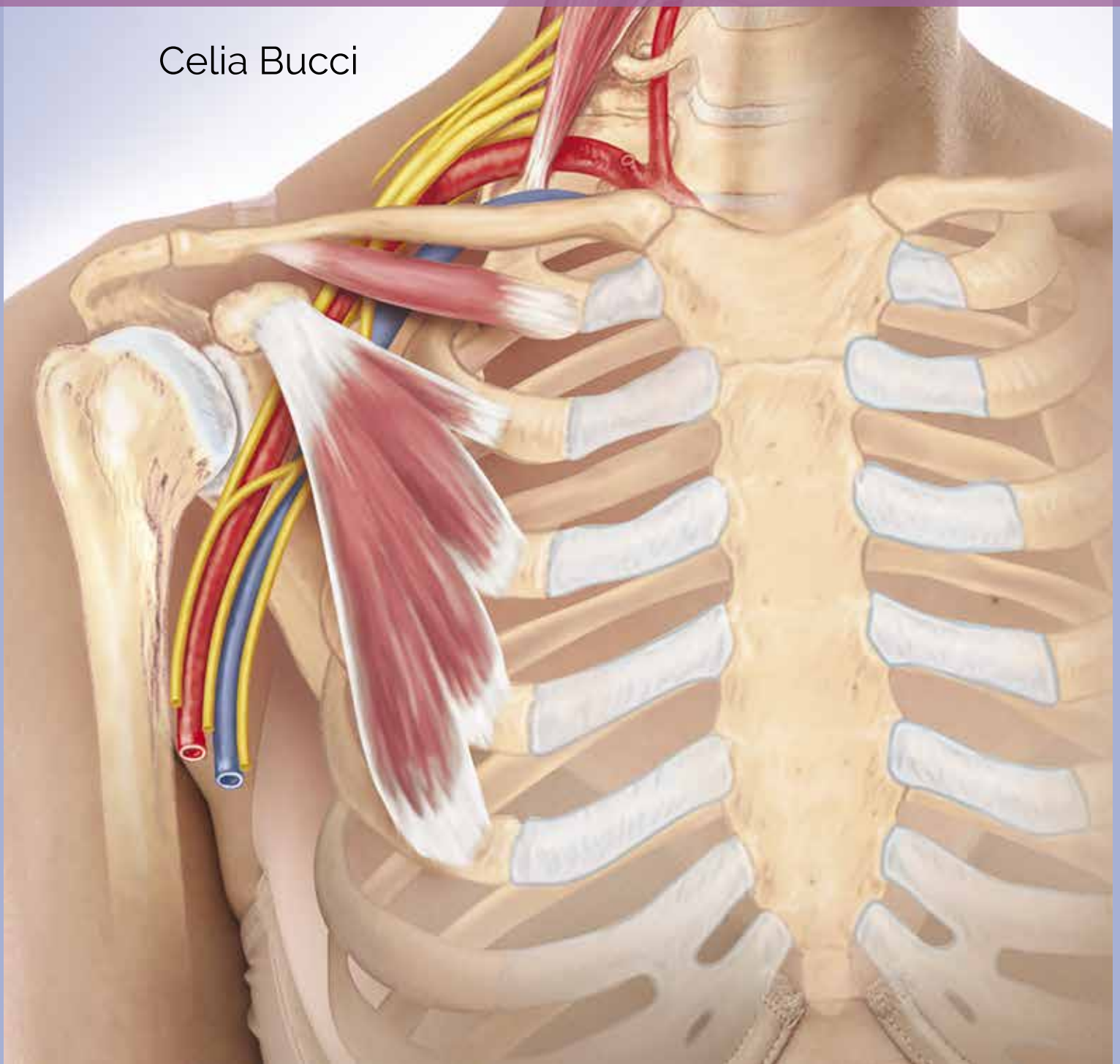
9. If there is no improvement in the client's symptoms after each treatment, which of the following is a possibility?
 - A. There is sufficient time between treatments
 - B. The client has carpal tunnel syndrome and you are focusing treatment on the correct area
 - C. The client is adjusting her or her activities of daily living
 - D. The syndrome is advanced or involves other complications beyond your basic training

This completes the Carpal Tunnel Syndrome exam. Proceed to the next page to view the text.

Condition Specific Massage Therapy

SECOND EDITION

Celia Bucci



Chapter 7:

Carpal Tunnel Syndrome

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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. 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. 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

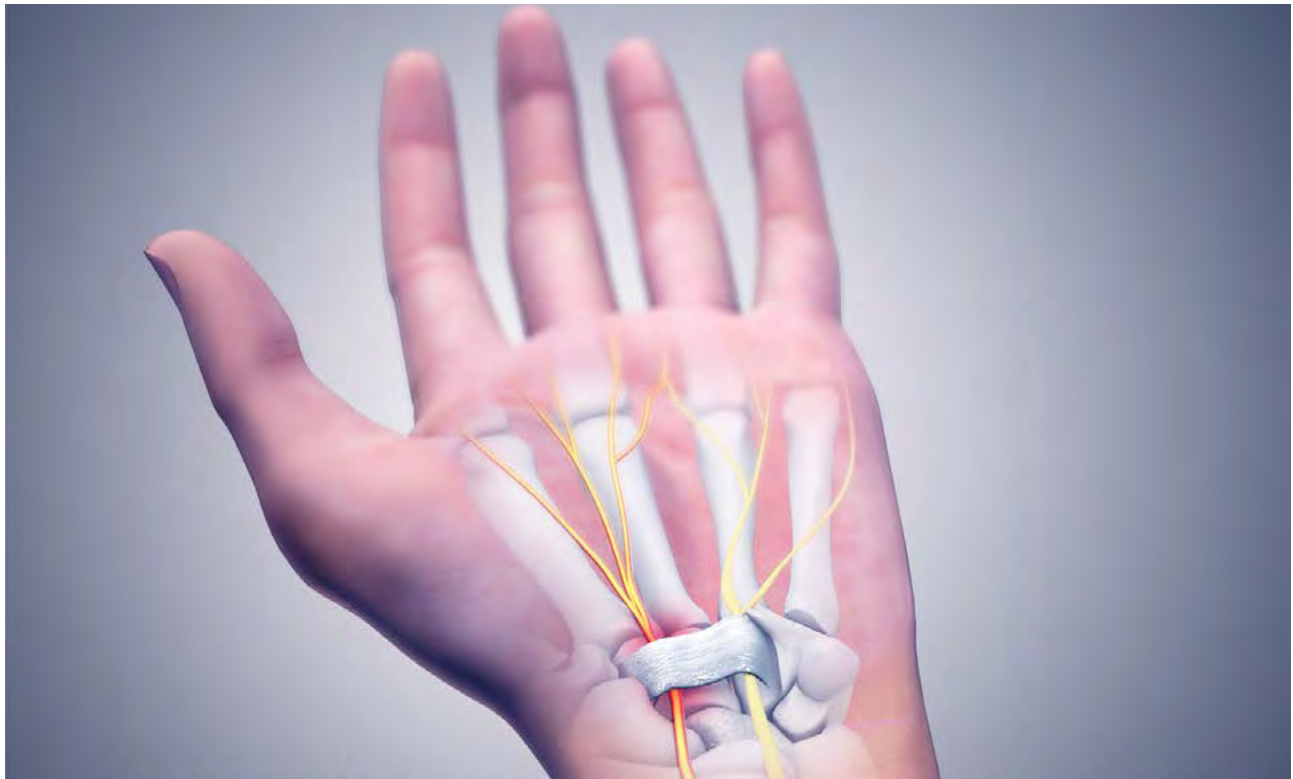


Figure 7-1 The Carpal Tunnel

Image Credit: www.scientificanimations.com/wiki-images/, CC BY-SA 4.0 <https://commons.wikimedia.org/w/index.php?curid=78385033>

carpal tunnel, and into the palm (Fig. 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

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. 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

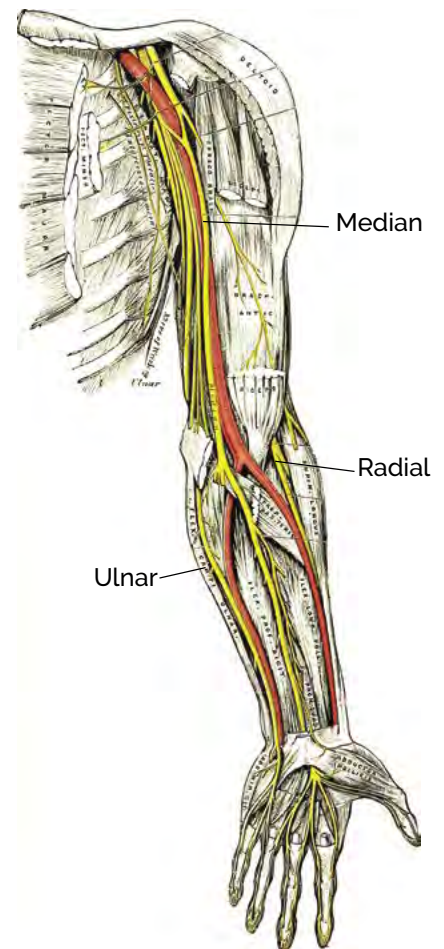


Figure 7-2 Path of the Median Nerve

Image Credit: Gray, Henry, 1825-1861; Carter, H. V. (Henry Vandyke), 1831-1897; Pick, T. Pickering (Thomas Pickering), 1841-1919. No restrictions, via Wikimedia Commons



Figure 7-3 Carpal Tunnel Symptoms

Image Credit: Joel Bubble Ben/Shutterstock

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 their 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 their 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 1 lists conditions commonly confused with, or that contribute to carpal tunnel syndrome.

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

CONDITION	TYPICAL SIGNS & SYMPTOMS	TESTING	MASSAGE THERAPY
Herniated disc	Symptoms may increase when coughing, laughing, and straining	Kemp's test Spurling's test CT scan	Massage is indicated with caution and proper training. Acute inflammation and acute injury are contraindications. Work with the health care team.
C4-5	Weak deltoid Shoulder pain Usually no radiating pain or paresthesia	Myelography MRI	
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		
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 Thoracic Outlet Syndrome
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 Tendinopathy
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.

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

CONDITION	TYPICAL SIGNS & 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.

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 cautions and 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 1 and your pathology book for signs and symptoms), refer the client to their 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 their 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.
- **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.

MESSAGE 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 symptoms so that you can review or research treatment options and contraindications to prepare yourself for the session. Table 2 lists questions to ask the client when taking a health history.

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 what your symptoms feel like.	Differentiate possible origins of symptoms. Nerve compression often results in numbness and tingling along the distribution of that nerve.
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 their health care provider, or ask for permission to contact their provider directly.

Table 7-2: Health History (continued)

QUESTIONS FOR THE CLIENT	IMPORTANCE FOR THE TREATMENT PLAN
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 medications 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 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.

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 them 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 their 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 their 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 4 compares the anatomical position to the posture affected by carpal tunnel syndrome.

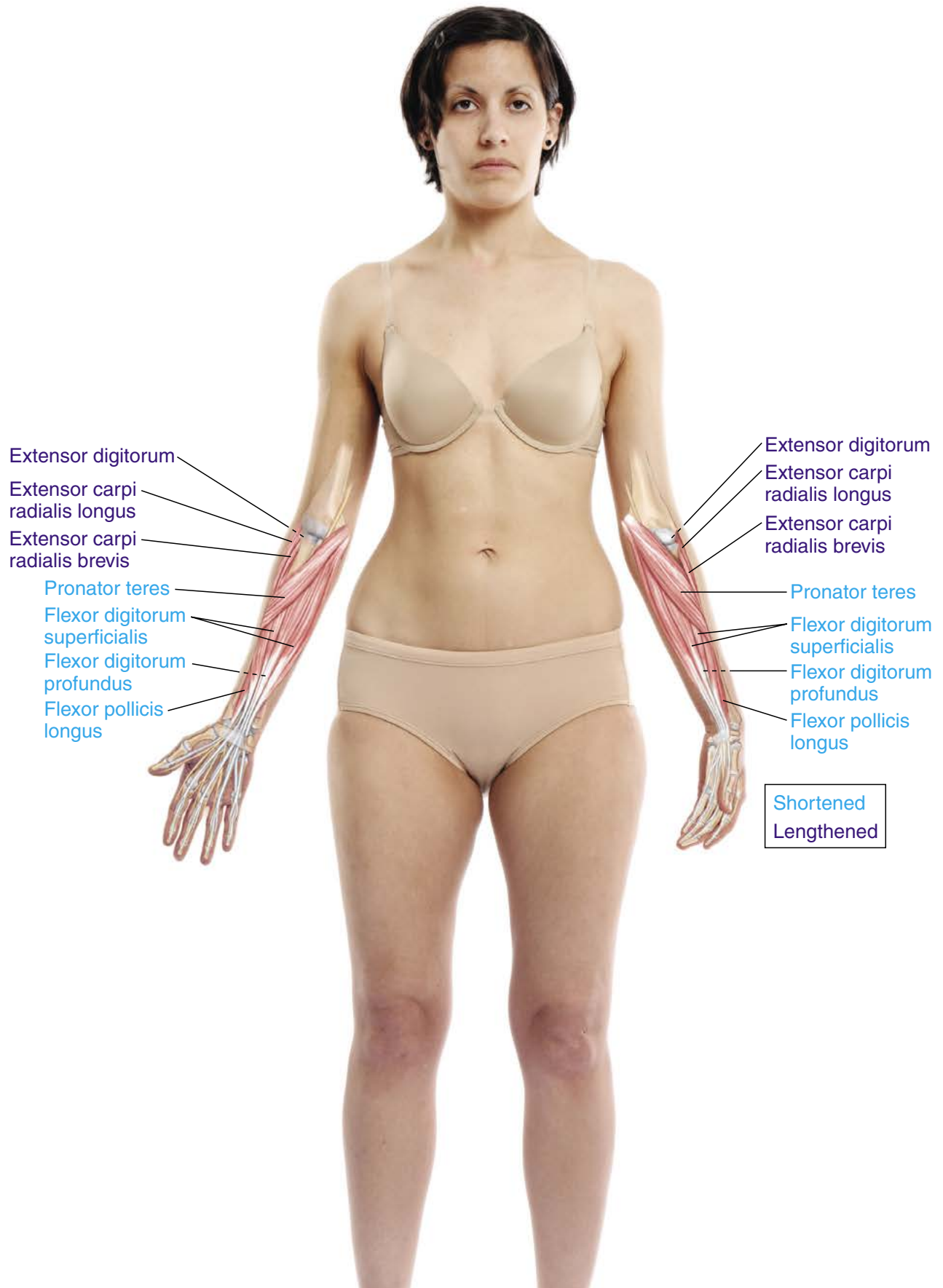


Figure 7-4 Note how the shortened flexors may contribute to compression of the contents in the carpal tunnel

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 Joint (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 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

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 1 presents the average active ROM results for the joints involved in carpal tunnel syndrome.

Active ROM

Compare your assessment of the client's active ROM with the ranges in Box 1. Carpal tunnel syndrome symptoms may not be reproduced with active ROM assessment because the client may limit their 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.

- **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.
- **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. 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.

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. 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).
2. The test is considered positive for carpal tunnel syndrome if the client feels tingling along the median nerve distribution.



Figure 7-5 Phalen's maneuver.



Figure 7-6 Pronator teres test.



Figure 7-7 Tinel's sign at the carpal tunnel.

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 them 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 them relax.

If palpation of a trigger point refers pain elsewhere, explain this to your client and ask them 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 8.



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

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.

Treatment Goals:



Increase circulation



Reduce adhesions



Reduce tone/tension



Lengthen tissue



Treat trigger points



Passive stretch



Clear area

- 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.

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



- 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. 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.



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



- Assess the flexor retinaculum for adhesions and release them if found. 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. 9). 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.



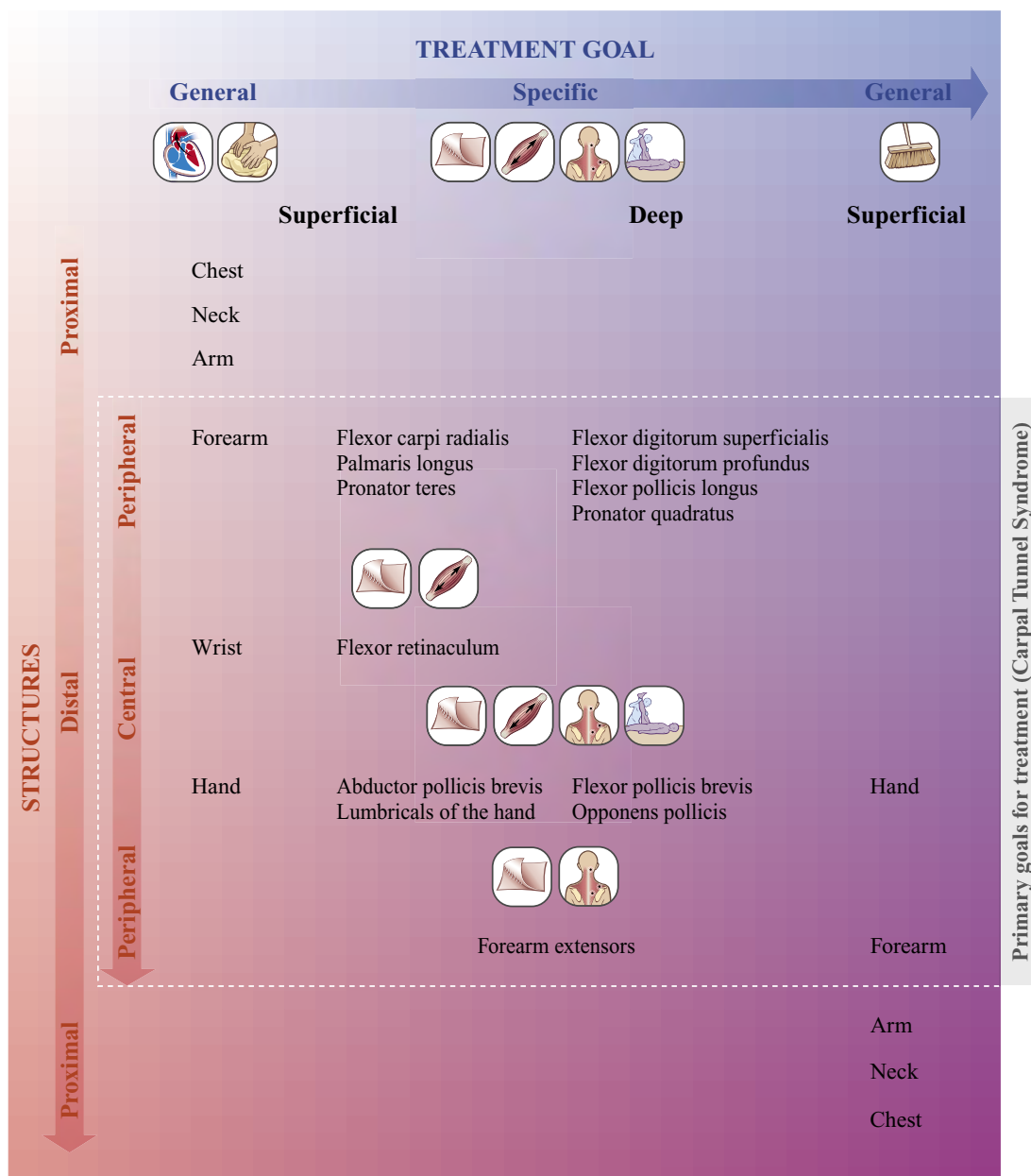
- Assess the wrist extensors for adhesions and trigger points and treat as necessary.



- 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.



Figure 7-9 Retinaculum stretch.



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 their wrist flexors (Fig. 10). 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 their tolerance.

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 the course on the thoracic outlet syndrome.

Strengthening

Because wrist flexion is opposed by the wrist extensors, it is important to assess the extensors for length and strength. If the wrist 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 wrist extensors within their tolerance by extending the affected wrist while gently resisting the movement with the opposite hand or a stable surface (Fig. 11).

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 their health care provider, encourage the client to remove the splint occasionally and gently move the wrist through its full range



Figure 7-10 Wrist flexor stretch.



Figure 7-11 Wrist extensor strengthening.

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 they feel 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 their 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 their 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 their full program of healing. Still, if you can bring some relief, the client may be encouraged to discuss this change with their 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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