Carpal Tunnel Syndrome

The symptoms of carpal tunnel syndrome (CTS) are caused by compression of the median nerve as it courses through the carpal tunnel in the wrist. Median nerve motor functions allow for forearm pronation; thumb, index & long digit flexion, & thenar palmar abduction/opposition. These movements are essential for grasp and precision pinch. Sensory functions of the median nerve include the volar aspect of the radial side of the hand, without which, fine motor coordination is lost. (Fundamentals of Hand Therapy, Cynthia Cooper, ed., Mosby 2007) CTS involves compression at the carpal tunnel that may result from position, wrist trauma, anatomic anomalies, & metabolic conditions. Some systemic conditions associated with carpal tunnel syndrome, include diabetes, hypothyroidism, arthritis, and pregnancy. Repetitive motion of the wrist (e.g. computer keyboard use) may contribute to the condition due to the development of tenosynovitis, which can lead to constriction of the median nerve. Carpal tunnel syndrome is most common in the middle aged and elderly, with over 80% of patients over 40 years of age.

**Symptoms:**
Symptoms vary but may include hand and wrist pain, dysesthesias (tingling and numbness) in the fingers (radial side of hand,) weakness in specific muscles of the hand, particularly the thenar muscles with wasting of thenar eminence sometimes noted in advanced cases. Pain may extend up the arm, and the pain from carpal tunnel syndrome is often worst at night, often interfering with sleep. Symptoms are often bilateral.

Medical Management may include physician examination, anti-inflammatory medications, cortisone injections, and carpal tunnel release surgery.

**Carpal Tunnel Syndrome Evaluation**
Components of evaluation should include:
- Thorough history including time since onset of symptoms, description of activities that exacerbate/relieve symptoms, medications, past treatments, and functional impact of condition
- VAS pain measure
- Sensory testing (light touch, monofilament)
- Grip/pinch strength testing
- Edema
- Coordination testing (9 hole peg test)
- Tactile gnosis (timed test of ability to grasp small objects & put into cup with vision occluded)
- Observe for thumb function (Can the thumb rise up from the plane of the palm = ABDUCTION
  Can the thumb stretch so that its pad rests on the pad of the 5th digit (small finger)=EXTENSION.
  Observe for thenar eminence atrophy and adductor contracture of the thumb.

**Other Tests:**
- **Tinel’s Sign**
  Tinel's test is performed by tapping the median nerve along its course in the wrist. A positive test is found when this causes worsening of the tingling or “pins & needles” in the thumb, index and middle fingers. An examination test that is used by doctors to detect an irritated nerve. Tinel's sign is performed by lightly banging (percussing) over the nerve to elicit a sensation of tingling or “pins and needles” in the distribution of the nerve.

- **Phalen’s Sign**
  Phalen’s test is done by fully flexing the wrists for one minute. This compresses the carpal tunnel and is positive when it causes tingling, numbness, or pain in the fingers and/or an “electric” sensation. This test is best performed with elbows extended to avoid provocation of the ulnar nerve which may confound your findings.

- **Static Two Point Discrimination**
  Vision occluded, test an area of normal sensation as a reference. Using calipers set 10 mm apart, randomly apply the calipers starting at fingertip & moving proximally &
Carpal Tunnel Syndrome

longitudinally in line with the digital nerves, with two points touching the skin. The skin should not be blanched by the caliper. Decrease the caliper distance until the pt. no longer feels two distinct points, and parui sportive online measure the distance.

*normal 2 point discrimination at fingertips is 6mm
*3 to 4 seconds should be allowed between applications and the pt. should have 4 out of 5 correct responses

Goals of Conservative TherapyTreatment (no surgical intervention):
1. Effective positioning to rest inflamed tissues through neutral wrist splints
2. Reduce pain, tingling/numbness & inflammation
3. Improve functional hand use (coordination, grip)
4. Work activity analysis & intervention if relevant to reduce overuse & symptom exacerbation

Conservative Carpel Tunnel Rehabilitation: Usually a 3-4 week program

Weeks 1-2 (focus: joint rest in neutral and inflammation reduction)
1. Provide wrist splints to maintain neutral wrist position (wrist at 0-2° of flexion and about 3° of ulnar deviation) to reduce compression of median nerve. Prefabricated splints available in pharmacies are commonly used, but must be adjusted to proper position to avoid aggravating symptoms. The metal insert may be replaced with custom thermoplastic insert if needed to achieve proper position. Typical wear schedule: nighttime wear for 6-8 weeks, with selective day time wear during provoking activities. Sample splint is illustrated at right.
2. Nerve & tendon gliding exercises
3. Edema management (retrograde massage, elevation,cryotherapy, anti-inflammatory medication)
4. Patient education about activity modification including reducing repetitive work, extreme wrist postures and vibration. Ergonomic evaluation of daily tasks that may contribute to symptoms may be helpful.
5. Ultrasound may be incorporated per physician’s approval, but has not been shown to be effective in reducing symptoms in the literature (Hayes EP et al: Capal tunnel syndrome. Rehab of the Hand and Upper extremity, ed 5 St Louis 2002)

Weeks 3-4 (focus: increasing hand function)
1. Begin light functional activities – dressing, bathing
2. Coordination exercises
3. Continue nerve gliding exercises
4. Progress to resisted grip strength exercise
5. HEP that incorporates proximal (shoulder) conditioning exercises and postural training to promote proper position of shoulders and cervical spine to promote upper extremity nerve health may be helpful.
6. Ongoing joint protection strategy training
6. Increasing functional hand use during the day

Outcome Measures:
Disabilities of the Arm, Shoulder, and Hand (DASH)
Severity of Symptoms and Functional Status in Carpal Tunnel (Levine et al.)
Jebsen Test of Hand Function
9 hole peg test
Carpal Tunnel Syndrome

Carpal Tunnel Release Surgery  
Therapy to address symptoms as a conservative measure prior to surgery is common. In the event that surgery is needed, the physician may refer to therapy post-surgery.

Goals of Therapy post Carpel Tunnel Release (CTR) Surgery (note endoscopic surgery generally allows therapy to begin earlier than open procedure)

1. Promote post surgical healing and prevent adhesions.
2. Effective positioning with elastic wrist support and/or splint
3. Reduce pain, tingling/numbness & inflammation
4. Work analysis & intervention if relevant
5. Active therapy to improve ROM and function will begin based on surgeon’s specifications

Precautions after surgery  Contact the physician in the event of:

- Excessive swelling
- Increased numbness
- Bleeding
- Cool fingertips and/or a color change in the hand or fingers
- Signs of infection in the incision
  - warmth and/or redness, cloudy, pus-like drainage, excessive swelling, fever - temperature above 101° F

Post-Operative Rehab Treatment

1. Wound and scar care begin after the referral and evaluation. Scar pain is common after CTR and patient may avoid using the post-surgical hand. Apply a compressive dressing to minimize edema and scar formation. Elastic stockinette may be used initially for edema control then add a silicone gel insert or Micropore paper tape over the scar once sutures are removed to promote improved scar osmosis.
2. Pain management may include oral pain medications, therapeutic modalities and massage.
3. Splinting the wrist in neutral is appropriate for the first 2-3 weeks postoperatoratively if the patient complains of nocturnal pain or if there is a risk of overuse of flexed postures of the wrist due to occupational roles. Follow the referring surgeon’s guidelines.
4. Mobilization with active wrist, thumb and finger exercises may begin within the first 24-48 hours to promote adequate median nerve and flexor tendon gliding. Introduce median nerve glides and progress based on their tolerance.
5. Week 3 post-op may initiate gentle strength exercises if pain & edema are well controlled. Progress strengthening exercises weeks 3-6, depending on the patient’s tolerance. Use caution introducing repetitive gripping exercises (e.g. putty & handgrippers) before 6 weeks after CTR as it has been found to contribute to inflammation and development of trigger finger complications.
6. Client may resume light household tasks such as laundry week 3. A work rehab program may begin 5-6 weeks post-op to address residual deficits and work demands as needed.

Resources:

http://orthopedics.about.com/cs/carpaltunnel/a/carpaltunnel_2.htm retrieved 6/13/11

Functional Tool Box Carole Lewis, DPT  
http://www.ninds.nih.gov/disorders/carpal_tunnel/carpal_tunnel.htm retrieved 6/13/11

Adv Ther, 2005 Sep-Oct;22(5):467-75. Can we use nerve gliding exercises in women with carpal tunnel syndrome?

Treatment Guidelines for Common Diagnoses of the Upper Extremity, Cooper C, ed. Trombly 2007
Outcome Measures
Carpal Tunnel

Population: Adult population, patients with carpal tunnel syndrome

Description: This test was designed to provide an assessment of the severity of symptoms of patients with carpal tunnel syndrome. The test consists of eleven questions with multiple choice responses.

Mode of Administration: This is a paper and pencil self administered exam.

Completion:

Time to Complete: 5 minutes

Time to Score: 5 minutes

Scoring: The test consists of eleven questions with five responses each. The responses have a five point range with 1 representing mildest and 5 representing most severe. The individual points are then added and the mean is computed. The mean represents the total score on the measure.

Interpretation: The higher the patients mean score on the measure the more severe their symptoms are.

Reliability: In a study of 31 carpal tunnel syndrome patients with a median duration of symptoms of 18 months a high degree of test-retest reliability was found. Pearson correlation coefficients of 0.91 and 0.93 were found for the Symptom Severity Scale and the Functional Status Scale respectively, demonstrating excellent reproducibility.

Internal consistency was also determined to be very good for both scales. A Cronbach alpha of 0.89 and 0.91 was found for the Symptom Severity Scale and the Functional Status Scale.

Validity: Construct validity was established by a comparison of the specific items on the scale with their predicted relationships.
All of the items were found to have occurred in their expected direction. Validity of this scale was further confirmed by the correlation of the functional status scores with the severity of symptoms scores. The two subsets were highly correlated indicating that the patients with many symptoms had lower functional ability.

Responsiveness validity was established in a study of 38 patients who were operated on in 1990. These patients completed the questionnaire in 1991 and their scores were compared. The results indicated that the Questionnaire demonstrated a good level of responsiveness.

Reference:

Severity of Symptoms and Functional Status in Carpal Tunnel

The following questions refer to your symptoms for a typical twenty-four hour period during the past two weeks (circle one answer to each question).

How severe is the hand or wrist pain that you have at night?
1. I do not have hand or wrist pain at night.
2. Mild pain
3. Moderate pain
4. Severe pain
5. Very severe pain

How often did hand or wrist pain wake you up during a typical night in the past two weeks?
1. Never
2. Once
3. Two or three times
4. Four or five times
5. More than five times

Do you typically have pain in your hand or wrist during the daytime?
1. I never have pain during the day.
2. I have mild pain during the day.
3. I have moderate pain during the day.
4. I have severe pain during the day.
5. I have very severe pain during the day.

How often do you have hand or wrist pain during the daytime?
1. Never
2. Once or twice a day
3. Three to five times a day
4. More than five times a day
5. The pain is constant

How long, on average, does an episode of pain last during the daytime?
1. I never get pain during the day.
2. Less than 10 minutes
3. 10 to 60 minutes
4. Greater than 60 minutes
5. The pain is constant throughout the day.

Do you have numbness (loss of sensation) in your hand?
1. No
2. I have mild numbness
3. I have moderate numbness
4. I have severe numbness
5. I have very severe numbness.

Do you have weakness in your hand or wrist?
1. No weakness
2. Mild weakness
3. Moderate weakness
4. Severe weakness
5. Very severe weakness

Do you have tingling sensations in your hand?
1. No tingling
2. Mild tingling
3. Moderate tingling
4. Severe tingling
5. Very severe tingling

How severe is numbness (loss of sensation) or tingling at night?
1. I have no numbness or tingling at night.
2. Mild
3. Moderate
4. Severe
5. Very severe

How often did hand numbness or tingling wake you up during a typical night during the past two weeks?
1. Never
2. Once
3. Two or three times
4. Four or five times
5. More than five times

Do you have difficulty with the grasping and use of small objects such as keys or pencils?
1. No difficulty
2. Mild difficulty
3. Moderate difficulty
4. Severe difficulty
5. Very severe difficulty

Jebsen Test of Hand Function

Please note: The following is a partial test. The entire test can be found in:

Jebsen Test of Hand Function

Population: Adult population

Description: The Jebsen Test of Hand Function is designed to assess a patient's functional hand use. The test consists of 7 sections that represent a large range of tasks using the upper extremities.

Mode of Administration: This is a task performance exam consisting of seven subsets. The patient performs the tasks while being observed.

Completion:

Time to Complete: variable depending on the level of disability of the patient

Time to Score: minimal

Scoring: The sections are scored by recording the amount of time it takes the patient to complete each task.

Interpretation: The longer the time required by the patient to complete the tasks the greater the level of disability the patient possesses.

Reliability: Interrater reliability was established for the Jebsen Test of Hand Function through a study of five patients who were timed and scored simultaneously by two testers. The intraclass coefficient ranged from 0.82 to 1.00 for the seven subsections.

Test-retest reliability was studied with five patients. The Pearson product correlation ranged from 0.84 to 0.85.

Validity: In a study of 18 patients who were treated at home moderate correlations were found between the Jebsen Test of Hand Function and the Klein-Bell scale. These correlations indicate that the Jebsen Test of Hand Function is a reasonable valid instrument (Lynch 1989).
References:


**Jebson Test of Hand Function (Partial Test)**

**Writing**

*Procedure*—The subject is given a black ballpoint pen and four 8-by-11-inch sheets of unruled white paper fastened, one on top of the other, to a clipboard. The sentence to be copied has 24 letters and is of third grade reading difficulty.* The sentence is typed in all capital letters and centered on a 5-by-8-inch index card. The card is presented with the typed side face down on a bookstand. After the articles are arranged to the comfort of the subject (see instructions), the card is turned over by the examiner with an immediate command to begin. The item is timed from the word "go" until the pen is lifted from the page at the end of the sentence. The item is repeated with the dominant hand using a new sentence.

*Instructions (if the subject is right handed)—"Do you require glasses for reading? If so, put them on. Take this pen in your left hand and arrange everything so that it is comfortable for you to write with your left hand. On the other side of this card (indicate) is a sentence. When I turn the card over and say 'Go,' write the sentence as quickly and clearly as you can using your left hand. Write, do not print. Do you understand? Ready? Go."

**Simulated Feeding**

*Procedure*—Five kidney beans approximately ½-inch long are placed on a board† clamped to a desk in front of the subject 5 inches from the front edge of the desk. The beans are oriented left of center, parallel to and touching the upright of the board 2 inches apart. An empty 1-pound coffee can is placed centrally in front of the board. A regular teaspoon is provided. Timing is from the word "go" until the last bean is heard hitting the bottom of the can. The item is repeated with the dominant hand, the beans being placed right of center.

*Instructions*—"Take the teaspoon in your left hand, please. When I say 'Go' use your left hand to pick up these beans one at a time with the teaspoon and place them in the can as fast as you can beginning with this one (indicate bean on the extreme left). Do you understand? Ready? Go."

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* Different sentences were used when subsequent tests were given to a single individual. Available sentences were: (1) The old man seemed to be tired. (2) John saw the red truck coming. (3) Whales live in the blue ocean. (4) Fish take air out of the water.

† A wooden board 4½ inches long, 11¼ inches wide, and ½ inches thick was secured to the desk with a C clamp. The front edge of the board (¾ inches thick) was marked at 4-inch intervals for easy reference when placing objects. A center piece of plywood, 20 inches long, 2 inches high, and ½ inch thick, was glued to the board 4¾ inches from the right end and 6 inches from the front (for a secretary type desk with a right-sided kneehole). The front of the center upright should be marked at 2-inch intervals beginning 1 inch from each end for convenience in placing objects.

WHALES LIVE IN THE BLUE OCEAN.
Jebsen Test of Hand Function

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Observations:
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Therapist
Table 3:
Females, 16 to 25, non-dominant hand

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Number of subjects: 35

Table 4:
Females, 16 to 25, dominant hand

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Table 2:
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<td>3.12</td>
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Number of subjects: 33

Table 1:
Males, 16 to 25, non-dominant hand

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<th>Percentile</th>
<th>Grip (kg/cm²)</th>
<th>Write (sec)</th>
<th>Card (sec)</th>
<th>Small (sec)</th>
<th>Feed (sec)</th>
<th>Check (sec)</th>
<th>Light (sec)</th>
<th>Heavy (sec)</th>
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</table>

Number of subjects: 33

Patient Resources
Perform each exercise for a count of ___ seconds ___ times each day.

Other instructions:

___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________

Splint wear:

☐ Not applicable
☐ On except for exercises and bathing
☐ Night time only
☐ As needed for comfort

Contact your therapist _____________ at ________________ with any questions or concerns.
Fact Sheet: Carpal Tunnel Syndrome

What is Carpal Tunnel Syndrome?

The carpal tunnel is a passageway in the wrist formed by the eight carpal (wrist) bones, which make up the floor and sides of the tunnel, and the transverse carpal ligament, a strong ligament stretching across the roof of the tunnel.

Inside the carpal tunnel are nine flexor tendons which flex (bend down) your fingers and thumb. Also running through the carpal tunnel is the median nerve, a cord about the size of a pencil containing thousands of nerve fibres supplying sensation (feeling) to the thumb middle and index fingers, and half of the ring finger.

Carpal tunnel syndrome is caused by increased pressure in the carpal tunnel resulting in compression of the median nerve. Thickening of the tendons can restrict the space within the tunnel and cause the nerve to become pressed against the ligament forming the roof of the tunnel. When the relatively soft structure of the median nerve is pushed up against this ligament, blood flow to the nerve is restricted, causing a sensation often described as “pins and needles” to the fingers. In severe or chronic cases, numbness can occur.

What are the causes?

Carpal tunnel syndrome can be caused by a variety of problems. Most patients are healthy women over 40 years of age. In these patients the cause is an age-related gradual thickening of the tendons so that they take up more space in the carpal tunnel and cause nerve compression.

Certain medical conditions that may lead to compression of the median nerve include:

- Diabetes
- Hypothyroidism
- Wrist fractures & dislocations
- Rheumatoid/degenerative arthritis
- Pregnancy
- Inflammation of the tendons
- Fluid retention
- Tumours (very rare)
Occupational activities which involve all of the following 3 factors may cause carpal tunnel syndrome:

1. Repetitive strong grasp
2. Vibrating tools
3. Cold exposure

Non-work related activities of daily living and leisure may provoke symptoms of carpal tunnel syndrome in those who are susceptible. Some examples include lawn-mowing, long distance driving, knitting or wood carving. Not all people involved in these types of work or other activities will develop carpal tunnel syndrome. Proper work pacing, regular rest breaks, reducing repetition and force, and the use of ergonomically designed tools and equipment can minimise the risk.

What are the signs and symptoms?

Numbness, burning or tingling of one or more digits is the most common symptom. Often these symptoms occur at night and can waken the individual from sleep. This occurs because our body fluid redistributes into the hands and feet at night causing more swelling in the carpal tunnel in the early hours of the morning. An aching, burning or electric pain may extend up the arm, into the elbow, and as far up as the shoulder and neck.

Numbness and tingling may occur when performing everyday activities that involve flexing the wrist or grasping such as holding a telephone or driving. A decrease in sensation or feeling may result in clumsiness or weakness of the affected hand. Dropping of objects and difficulty doing up buttons or picking up small objects are common in more severe cases.

How is it treated?

Most people will eventually require surgery as the natural course of carpal tunnel syndrome is to slowly get worse. If left unattended sensation may be lost and the hand can become very weak and clumsy. Conservative treatment of patients with mild symptoms usually involves use of a splint and avoidance of activities that provoke symptoms.

Your doctor may prescribe a splint to be worn to restrict movement of the wrist. Depending on the severity of the condition, the splint may be worn during the day and/or night. The length of time the splint is needed varies. Usually a splint is worn until the symptoms quiet down, which may be approximately 4–6 weeks.

In some instances, a cortisone injection may be administered into the carpal tunnel to decrease swelling. This may greatly reduce the symptoms. In general cortisone does not give permanent relief of the symptoms but may be helpful for several months.

When conservative treatment is not successful or in cases involving more severe symptoms, such as extensive weakness or numbness, surgery may be recommended.
Fact Sheet: Carpal Tunnel Syndrome

What is involved in surgery?

Carpal tunnel release is performed as a day surgery procedure under sedation with local anaesthetic. The operation takes approximately 20 minutes. You shall have to fast before the operation and shall be given these details. You will be admitted to the day surgery one hour before the operation and usually discharged one hour after the surgery.

A 2cm incision is made in the palm of the hand and the surgeon will cut (release) the ligament forming the roof of the tunnel. This relieves the pressure on the median nerve. There shall be three sutures and a bandage around the palm and wrist which leaves the fingers and thumb free to use.

What happens after surgery?

When you go home your hand will be numb for many hours due to the anaesthetic. This will keep you painfree. You will be given pain medication to take for the first few days after the operation and a clear list of instructions. The bandage must be kept dry for 5 days and you may then remove it and leave the wound open or apply a light dressing if you prefer. You will see the surgeon 10–14 days later for removal of the sutures. During this time you may use your hand for light activities.

What about recovery?

With the blood flow to the median nerve restored, the symptoms of burning and tingling are usually relieved soon after surgery. Due to weakness, most people are unable to drive for 7–10 days after surgery. Return to work depends on the particular occupation. Light clerical workers may return to work in a few days. If possible 10–14 days off work is ideal. Heavy manual workers shall be on restricted duties for approximately 12 weeks.

You can expect soreness from the incision for 4–6 weeks and discomfort from deep pressure for as long as several months. Your surgeon shall arrange to see you again 6–8 weeks following your operation. Improvements in strength and sensation depend on the extent of nerve damage prior to treatment. Normal grip strength may not return for several months following surgery. The natural healing process and regeneration of nerve fibres will continue throughout the following 6–12 months.
Carpal Tunnel Syndrome

Tips for Carpal Tunnel Patients

1. Think of your median nerve as a vacuum cord that may be damaged if it is bent (flexed) too much. Your median nerve won’t work well if it is bent too often or with too much force at the wrist. Try to prevent further damage by reducing extreme wrist flexion at work and while sleeping.

2. Try to keep your wrist flat or “neutral” during daily tasks.

3. Avoid prolonged gripping or pinching, especially avoid these motions with a flexed wrist.

4. Use your splint at night to keep from sleeping with a flexed wrist.

5. Use tools to help grip items in the kitchen, garden and at work. You can adjust grip handles with foam to pad the surface and increase the diameter to make gripping easier on the nerves of your hand.

6. Set up your work station (for example, computer desk) to prevent motions that aggravate your symptoms. Ergonomic work station designs are available for free on the internet.

Adapted from Treatment Guidelines for Common Diagnoses of the Upper Extremity, Cooper C, ed. Trombly 2007