

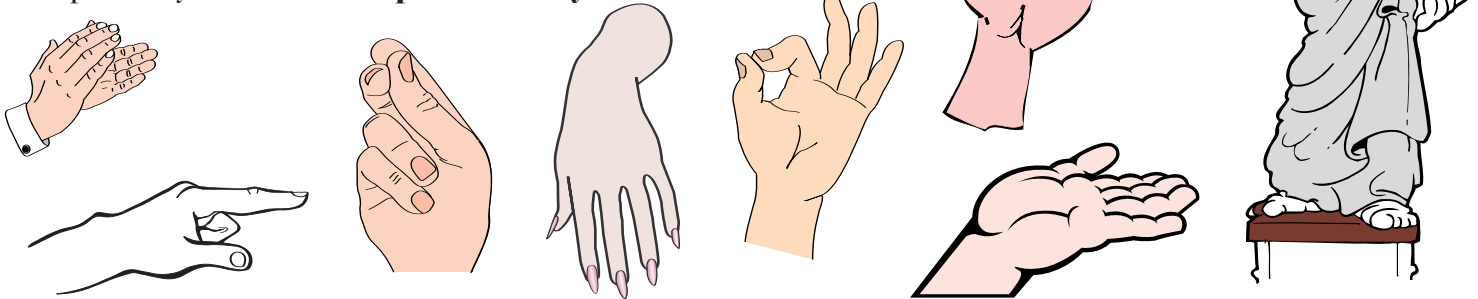
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Carpal Tunnel Syndrome

INTRODUCTION

The hand and wrist are one of the most active and intricate parts of the upper extremity. This area is extremely vulnerable, and has a high incidence of injury. One of the most common peripheral nerve entrapment syndromes is **carpal tunnel syndrome**.

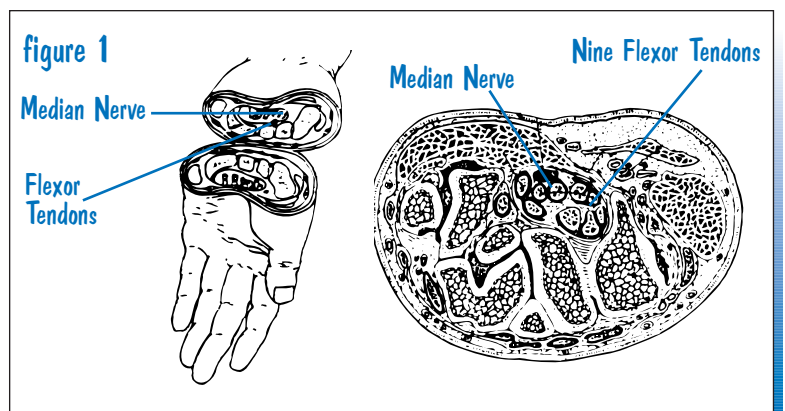


ANATOMY

The carpal tunnel is defined by four palpable bony prominences. Proximally, it is formed by the pisiform and tubercle of the navicular, and distally by the hook of the hamate and tubercle of the trapezium. Anteriorly, the carpal tunnel is formed by the transverse carpal ligament, which runs between these four bony prominences. Posteriorly, it is bordered by the carpal bones. The carpal tunnel houses the median nerve and the wrist and finger flexor tendons (Figure 1).

Clinically, the carpal tunnel plays an important role because of the structures it contains and because of its frequent incidence in carpal tunnel syndrome.

Compression of the median nerve is known as carpal tunnel syndrome, which leads to both decreased motor function and sensation in the thumb, index, middle, and the radial aspect of the ring finger.



ETIOLOGY

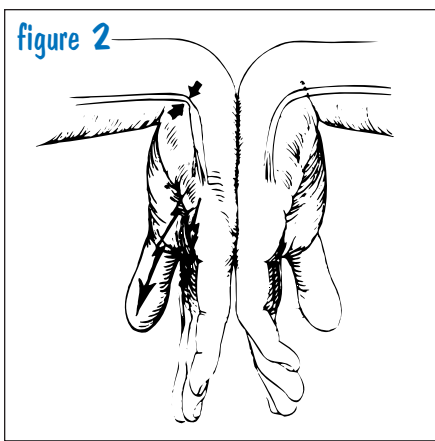
Repetitive stress injuries (RSI) are the most prevalent occupational injuries as reported by the U.S. Bureau of Labor Statistics. Of all RSI, carpal tunnel is the most common, and most debilitating. Carpal tunnel syndrome is caused by sustained or repetitive activities, acute wrist angles, vibration, temperature extremes, and localized contact stresses.

When the wrist is in the neutral/straight position, the flexor tendons glide along the tunnel walls lubricated within the fluid of the synovial sheaths. When the wrist is in either flexion or extension, the tendons do not glide as smoothly within the tunnel. Repetitive movement in these positions create irritation of the tendons and their sheaths, producing swelling within the confines of the carpal tunnel. This swelling causes pressure upon the median nerve, and encourages the growth of fibrous tissue, which constricts movement of the tendons. Greater exertion is then necessary to perform the same job tasks.

Symptoms of median nerve compression include pins and needles, numbness, tingling, and pain in the hand. These symptoms are usually greatest at night.

Without treatment, the median nerve compression can lead to partial/complete loss of motor function in the affected hand.

Individuals may have characteristics which predispose them to carpal tunnel syndrome. One factor is a square shaped wrist. When the thickness of the wrist approaches the thickness of the palm of the hand, a square or block shaped wrist exists. Carpal tunnel is



also three times more prevalent in females, and affects people between the ages of 30-50 years. Other contributory factors include obesity, pregnancy, diabetes, and tobacco abuse. Vasculitides, such as lupus, and

inflammatory conditions such as gout and rheumatoid arthritis also contribute to the development of carpal tunnel syndrome.

Family history, as well as pre-existing contralateral carpal tunnel syndrome, can increase the incidence of carpal tunnel syndrome. Sixty-percent of the time carpal tunnel occurs bilaterally.

PHYSICAL EVALUATION

Various tests can be performed to evaluate a patient for carpal tunnel syndrome. Visual inspection can determine if the patient has a square shaped wrist. A ratio can be determined by measuring the anterior/posterior thickness of the wrist and dividing by the medial/lateral width of the wrist. Measurements are performed at the distal wrist crease and a ratio of .70 or greater is indicative of a sensitivity of 70%.

The Phalen sign is performed by passively flexing the wrist for 30-60 seconds. It is positive for carpal tunnel syndrome when tingling in the median nerve distribution is reproduced (Figure 2). However, a negative Phalen sign does not exclude carpal tunnel syndrome.

Light touch sensation testing can be performed to the median nerve distribution.

The LeBan sign also has a high sensitivity for carpal tunnel syndrome. To perform this test, the forearm is supinated while extending the wrist

Chart 1

Commonly Accepted

1. Median-to-radial sensory ne (10cm distance for each an
2. Median-to-ulnar sensory ne (14cm antidromic techniqu
3. Median-to-ulnar motor onso (8cm orthodromic techniqu
4. Median-to-ulnar orthodrom (8cm technique with recor

Chart 2

General o these devel

- 1) overuse of the body parts,
- 2) overdevelopment overused mus
- 3) shortening of and tendons t overused,
- 4) inflammation overused tend (and/or their s
- 5) entrapment of nerve by the s tendons, and
- 6) eventual dama nerve itself, le nerve dysfunc

Nerve Conduction Studies Supportive of CTS

	Difference
Median nerve peak distal latency comparison (stimulation technique to the thumb)	0.5 msec or greater
Median nerve peak distal latency comparison (stimulation to the long finger and little finger)	0.5 msec or greater
Peroneal distal latency comparison (stimulation to the thenar and hypothenar eminences)	1.0 msec or greater
Median nerve mixed nerve peak latency comparison (stimulation at the wrist)	0.3 msec or greater

and index finger. A positive test refers pain to the proximal anterior forearm.

Strength testing of the thenar musculature, especially the abductor pollicis brevis is an essential part of the evaluation process. This is assessed by asking the patient to oppose the thumb to the 5th digit, while applying pressure over the IP joint of the thumb towards the 2nd MP joint.

The most reliable test for carpal tunnel syndrome is the nerve conduction study. This is considered the “gold standard” for carpal tunnel diagnosis (Chart 1).

TREATMENT

Normal daily activities involve grabbing, holding, and handling items which require activation of the flexor muscle group of the hand. The hand flexors become much stronger than the hand extensors. Overuse of the flexor muscle group causes the muscles to remain in a state of semi-contraction even at rest, resulting in decreased finger ROM. When in a semi-contracted state, the flexor tendons become shorter and thicker, creating crowding in the carpal tunnel. The blood supply to

the tunnel is then compromised, impairing the body’s normal healing process (Chart 2).

Rehabilitation through non-invasive means is based on balancing the over and under development condition of the respective flexor and extensor musculature. This is accomplished through stretching and strengthening exercises, in conjunction with preventative measures.

Strengthening is targeted to the extensor muscle group. The use of exercise bands and putty are a few of the tools used for strengthening. By strengthening the weaker extensor musculature, abnormal pressures on the carpal tunnel and median nerve, are reduced, thus improving the body’s natural healing process.

Stretching of the flexor musculature is imperative. This combats the shortening of the overused flexor musculature as well as mobilizing the median nerve. This stretch is performed by extending the wrist and fingers while the elbow is extended.

These exercises help alleviate the symptoms of numbness, pain, and loss of strength through reduction of abnormal pressures in the carpal tunnel. Along with the exercise program, anti-inflammatory drugs and wrist splints are also used.

Carpal tunnel surgery is the last method used to relieve carpal tunnel syndrome. During the surgery, the transverse ligament is severed making the tunnel bigger and decreasing the pressures within the tunnel.

CONCLUSION

With the increase of computer users, the incidence of repetitive stress injuries such as carpal tunnel syndrome have increased over the past few years. Treatment of these injuries with exercises and prevention are one of the best methods of rehabilitating the problem and preventing reoccurrence.

