CARPAL TUNNEL SYNDROME

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Definition

- True CTS defined as *objective confirmation of median nerve slowing in a patient with at least some of the nonspecific symptoms of CTS.*

Exposure:

- Amount of a factor to which a group or individual is in contact to. Sometimes contrasted with dose, the amount that enters or interact with the organism.

  Proximity or contact with a factor in such a manner that an injury, disease or illness may occur (Last, 1988 as in Hagberg, et al 1995)

Injury:

- Damage to individual anatomic, physiologic and/or psychiatric resulting from exposure to termal, mechanical or chemical energy or other stressors or from other essentials as heat or oxygen

- Risk Factor:

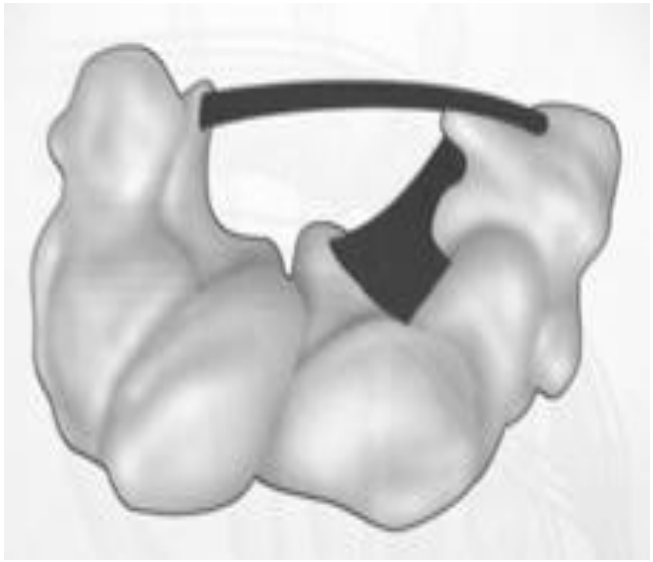
  An aspect of personal behavior or lifestyle, an environmental exposure (including work) or an inborn or inherited characteristic, which on the basis of epidemiologic evidence is known to be associated with health-related conditions.

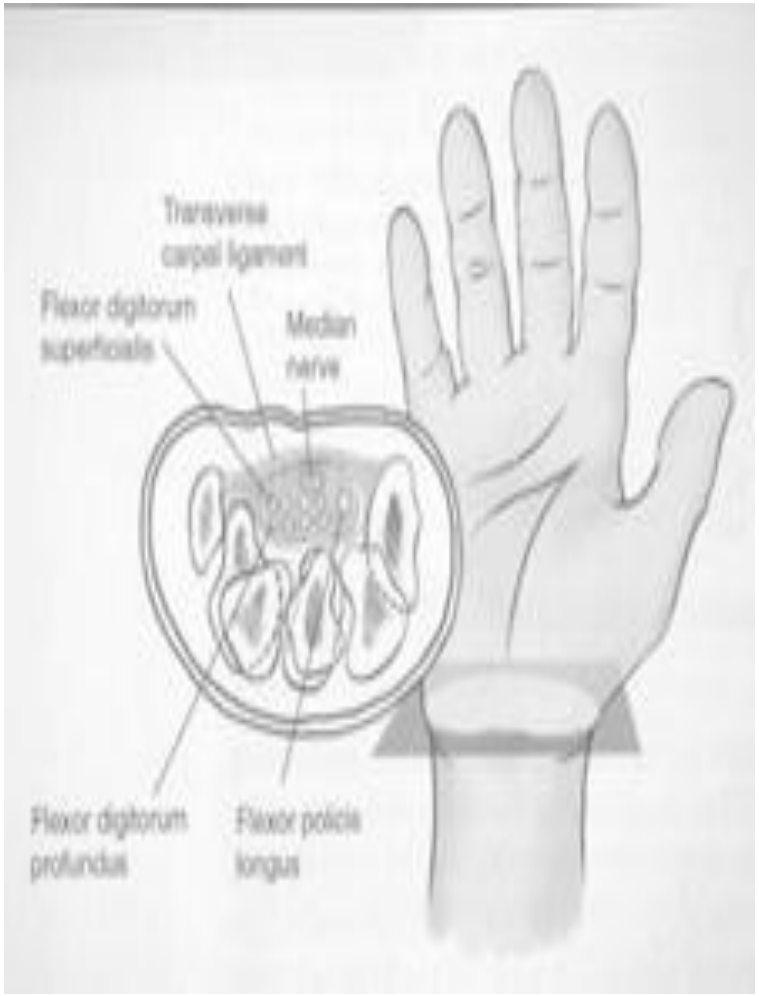
The term 'risk factor is also use with the following meaning:

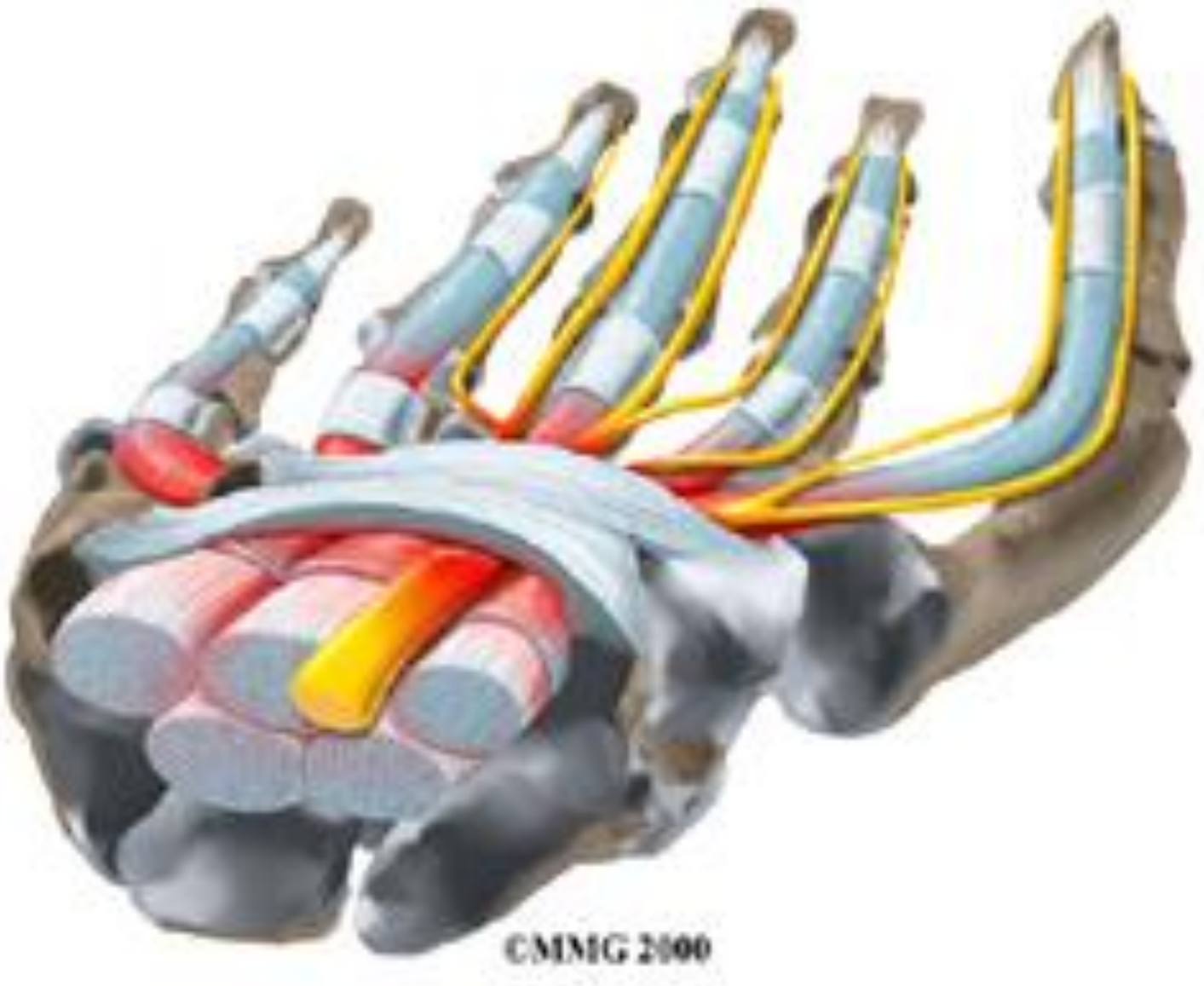
a) An attribute or exposure that is associated with an increased probability of a specified outcome. **Not necessarily a causal factor**

b) An attribute or exposure that increases the probability of occurrence of disease or other especified outcome. **A determinant**

ANATOMY




Transverse
carpal ligament
Flexor digitorum
superficialis
Median
nerve
Flexor digitorum
profundus
Flexor pollicis
longus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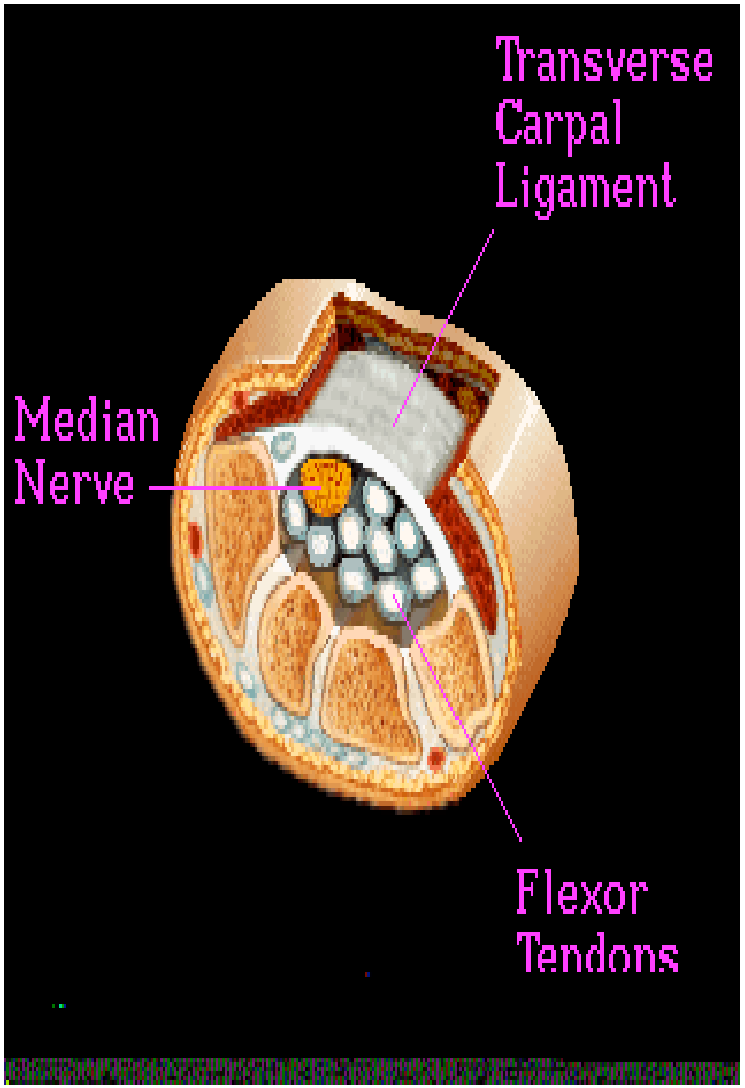
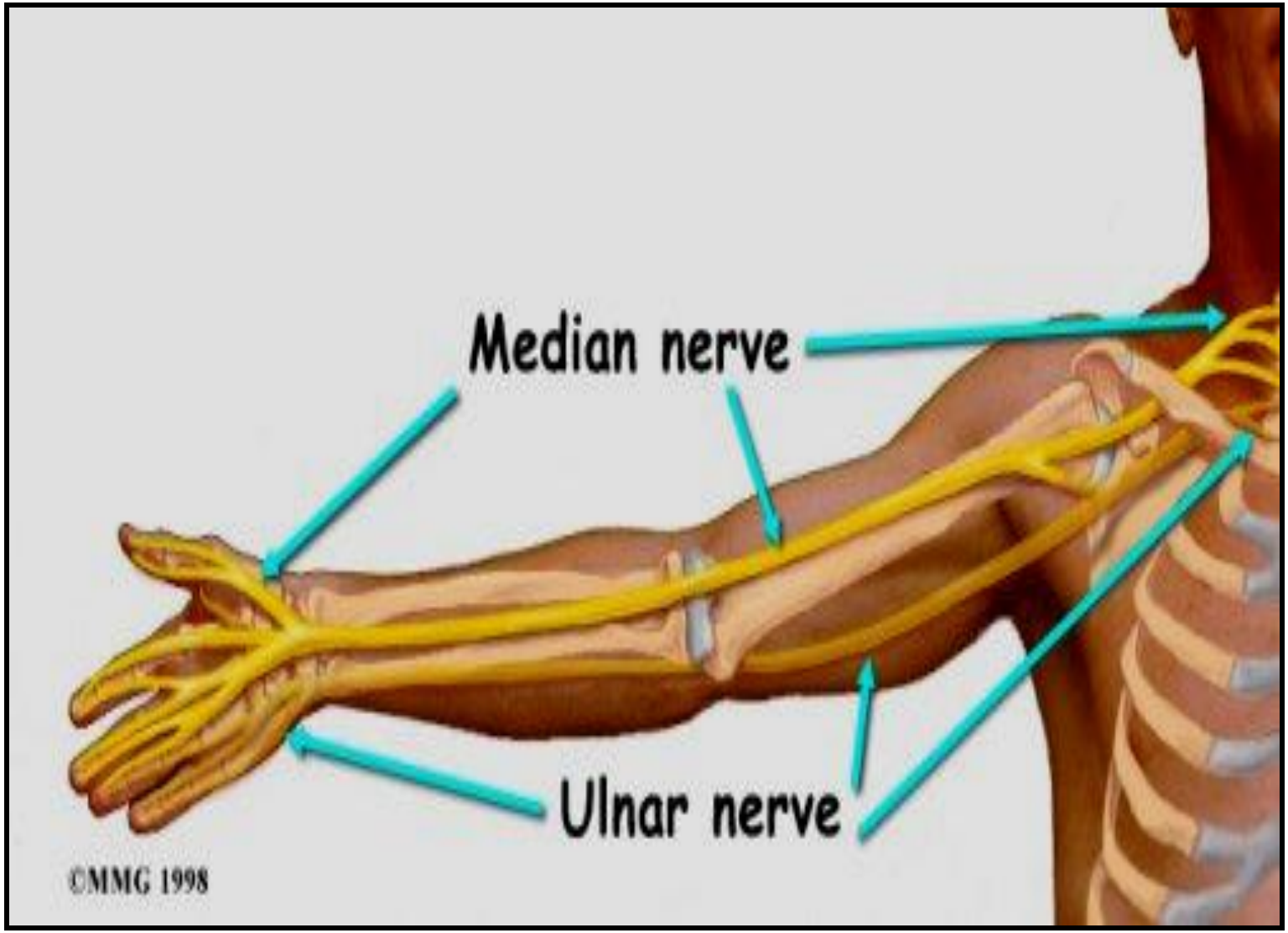
- Fibro-osseous tunnel bounded by the carpal bones (dorsal side), the interosseous ligaments and the transverse carpal ligament (the flexor retinaculum)(volar side).
- Content : 4 tendons of FDP, 4 tendons of FDS, tendon of FPL & Median nerve. (some consider FCR as the 10th tendon to pass through CT)




Median nerve
Ulnar nerve
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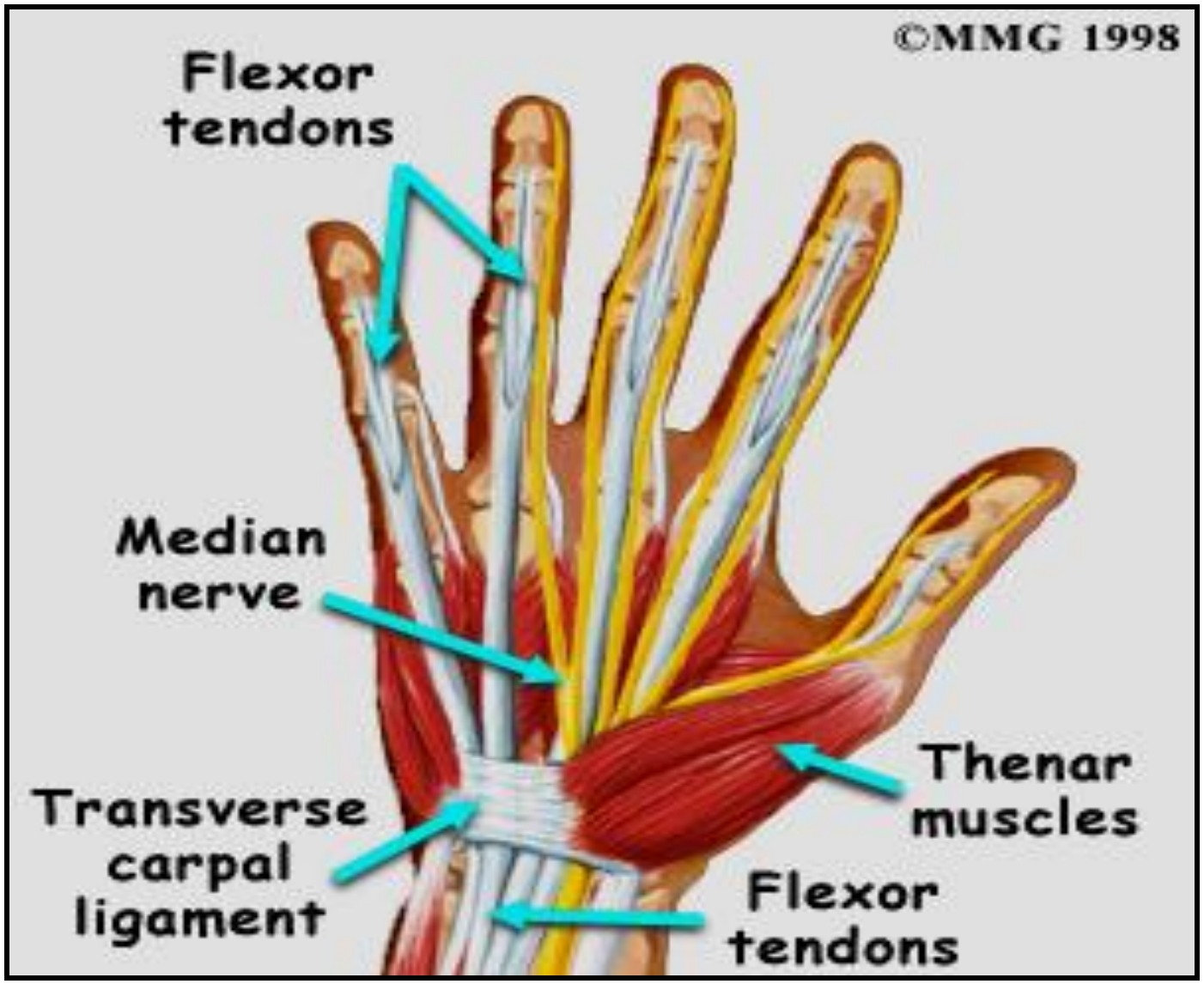
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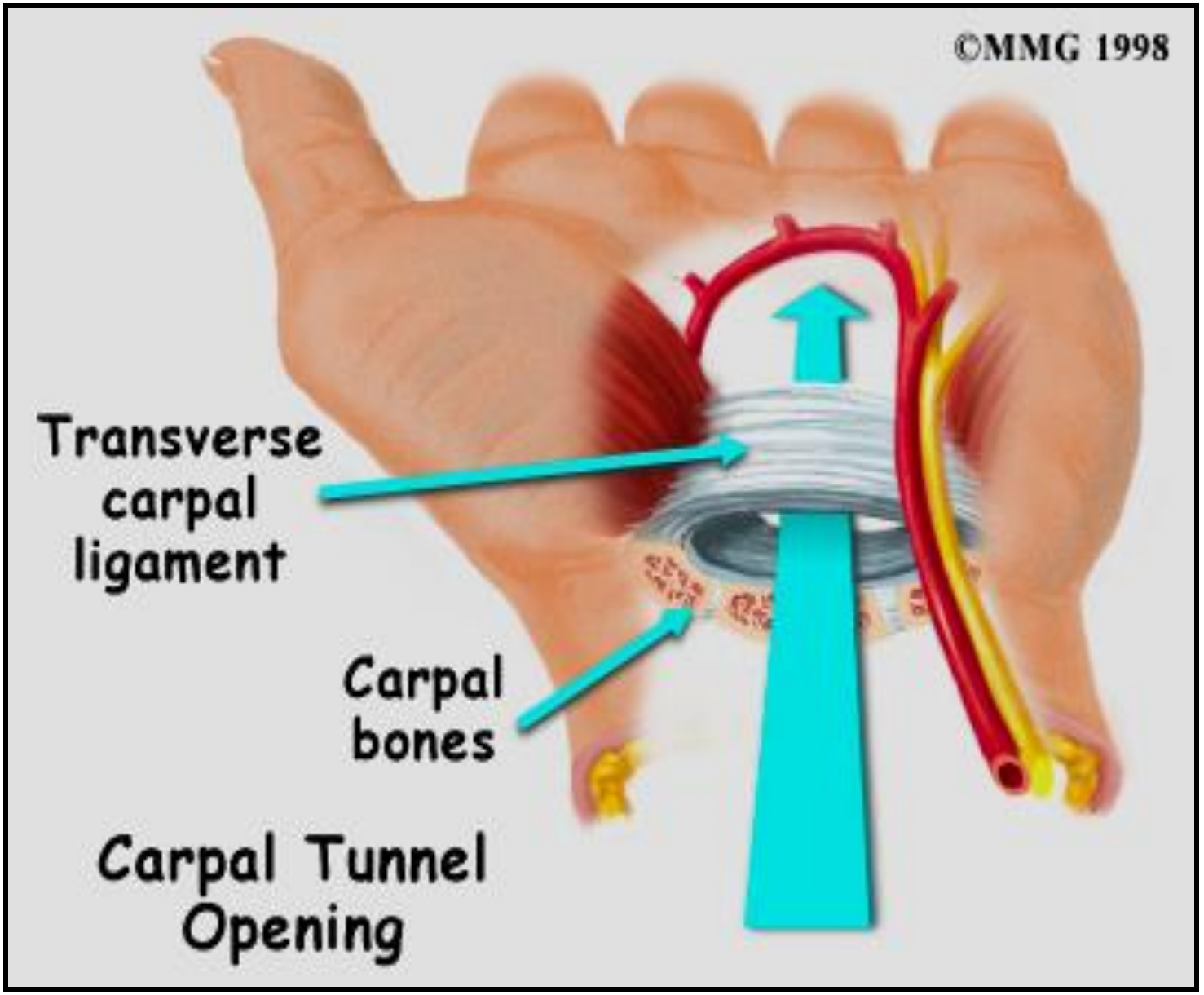
Flexor tendons
Median nerve
Transverse carpal ligament
Thenar muscles
Flexor tendons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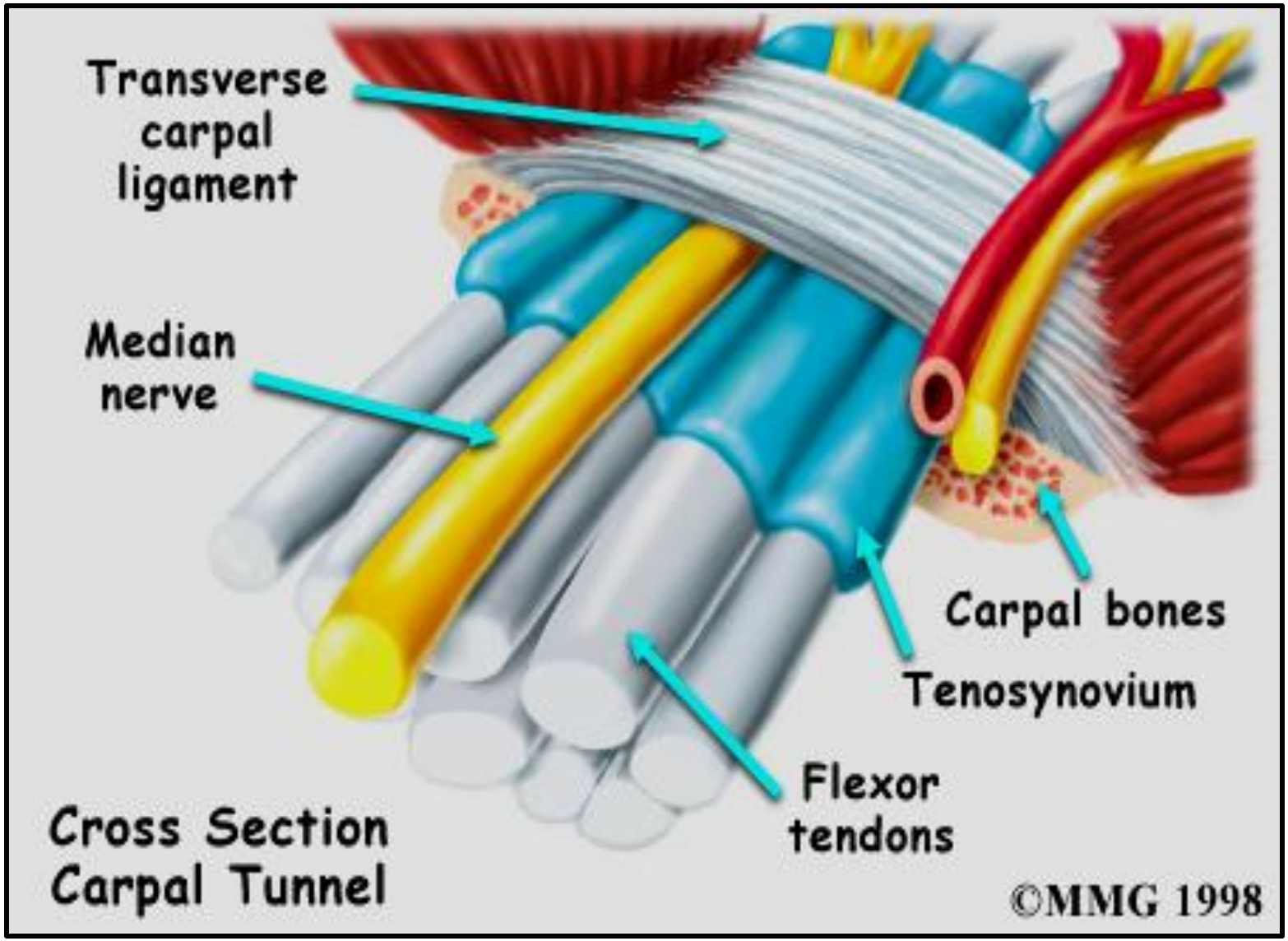
Transverse carpal ligament
Carpal bones
Carpal Tunnel Opening


Transverse carpal ligament
Median nerve
Carpal bones
Tenosynovium
Flexor tendons
Cross Section Carpal Tunnel
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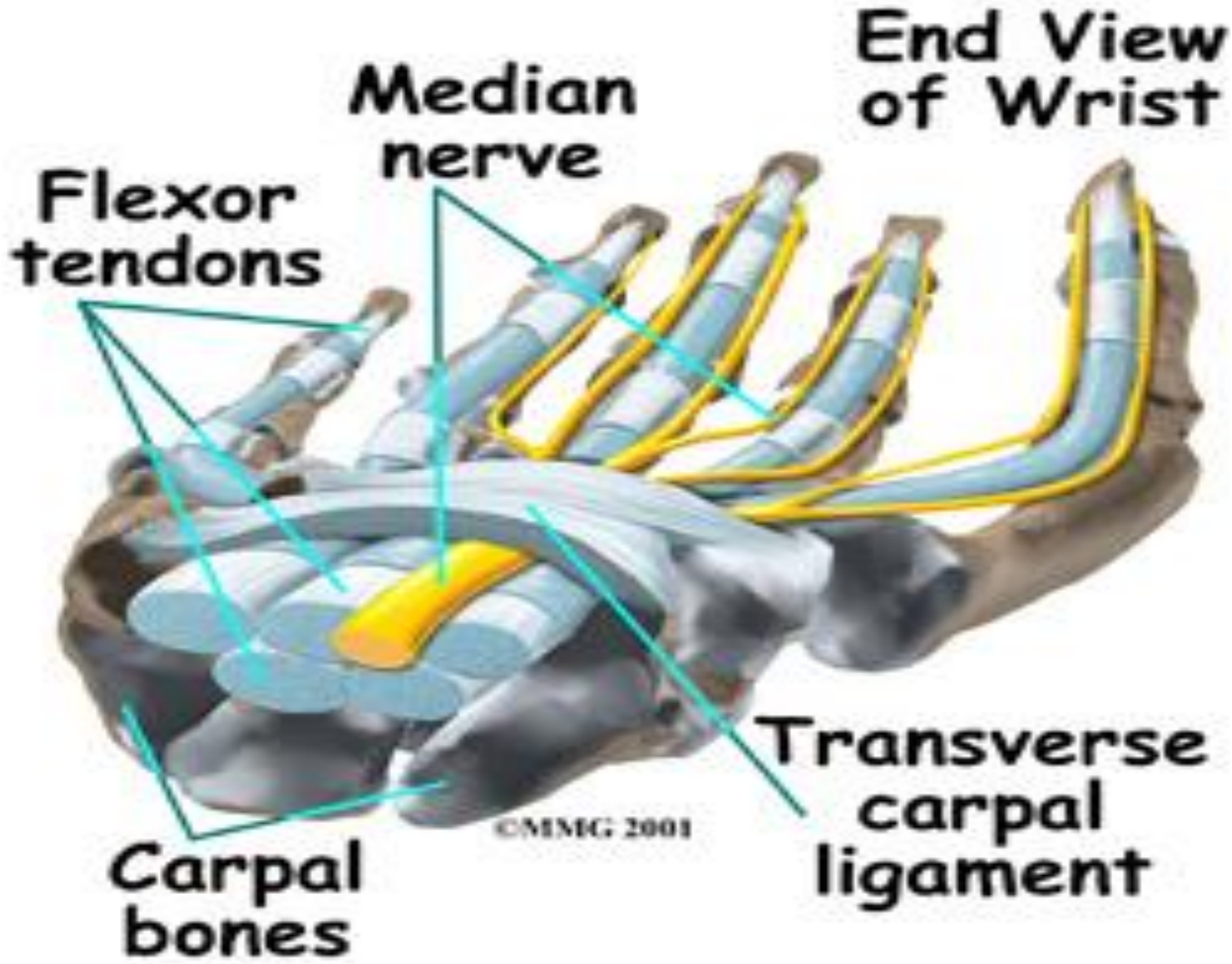
End View of Wrist
Median nerve
Flexor tendons
Transverse carpal ligament
Carpal bones
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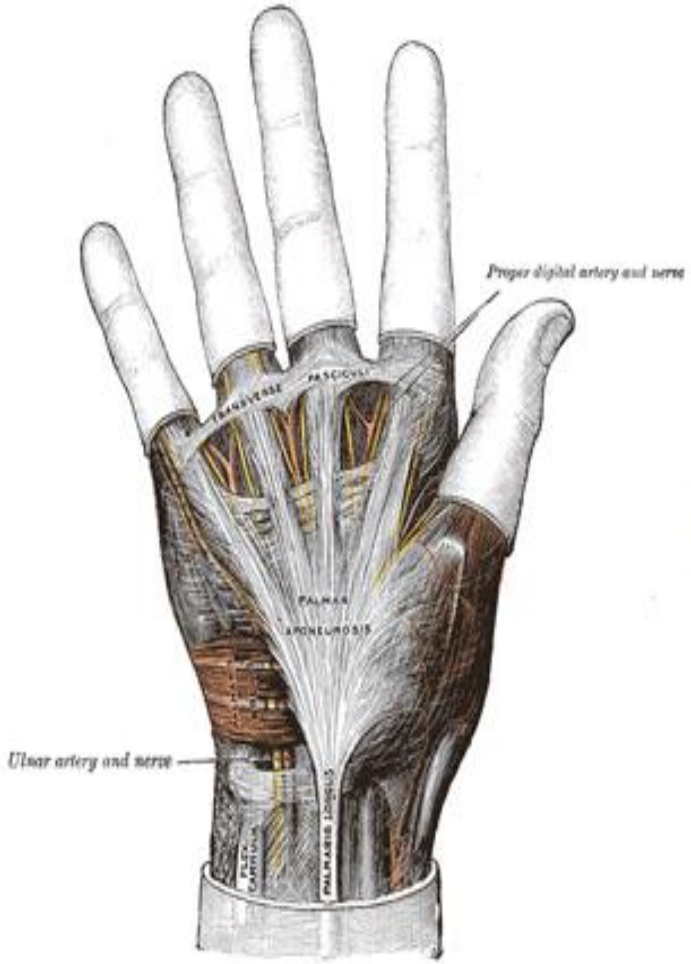
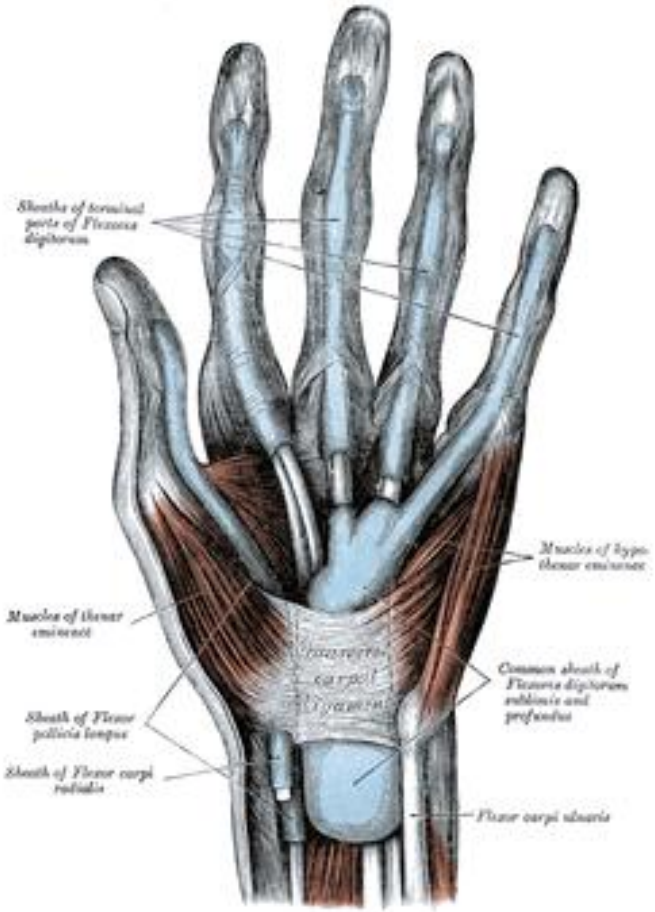
The Flexor Retinaculum

- Extends 1 cm or more proximal to the most distal wrist crease distally at least 3 to 4 cm into the palm.

- Constituted by the fusion of the TCL and deeper transverse fibers of the palmar aponeurosis.


Proper digital artery and nerve
TRANSVERSE
FASCICULI
PALMAR
APONEUROSIS
Ulnar artery and nerve
FLEXOR CARPI ULNARIS
PALMARIS LONGUS

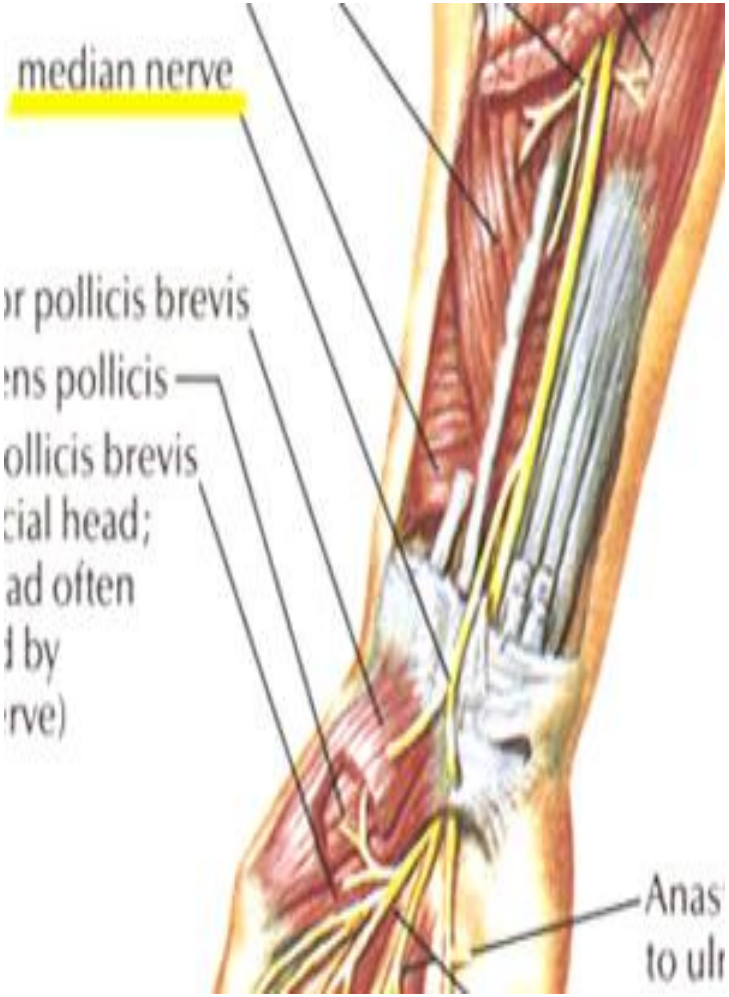

Sheaths of terminal parts of Flexores digitorum
Muscles of hypothenar eminence
Muscles of thenar eminence
Transverse carpal ligament
Common sheath of Flexores digitorum sublimis and profundus
Sheath of Flexor pollicis longus
Sheath of Flexor carpi radialis
Flexor carpi ulnaris

Functions

- Forms the floor of the carpal tunnel.
- Offers attachment for the thenar and hypothenar muscles.
- Helps maintain the transverse carpal arch.
- Prevents bowstringing of the extrinsic flexor tendons.
- Offers protection to the median nerve.

Palmar Cutaneous Branch

- Originates from the median nerve before it enters to the carpal tunnel.
- Exits the median nerve along its antero lateral quadrant about 3 to 4 cm above the distal wrist crease.
- Passes superficial to the TCL.
- Supplies sensation to the proximal surface of the thenar eminence.


median nerve
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ns pollicis
ollicis brevis
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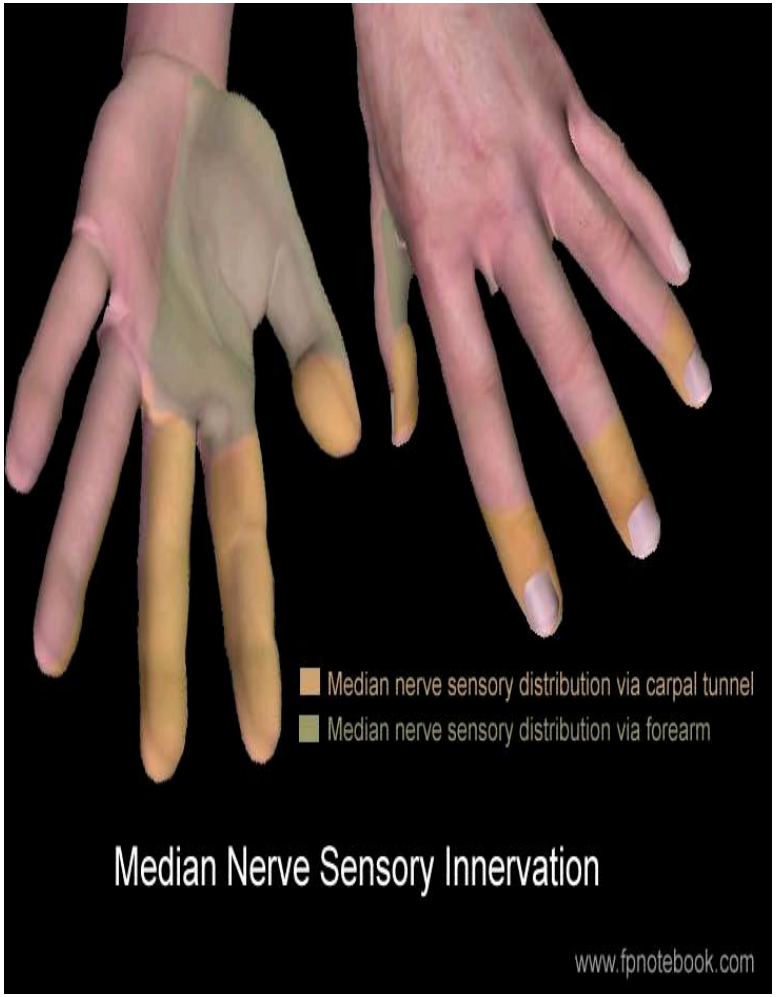
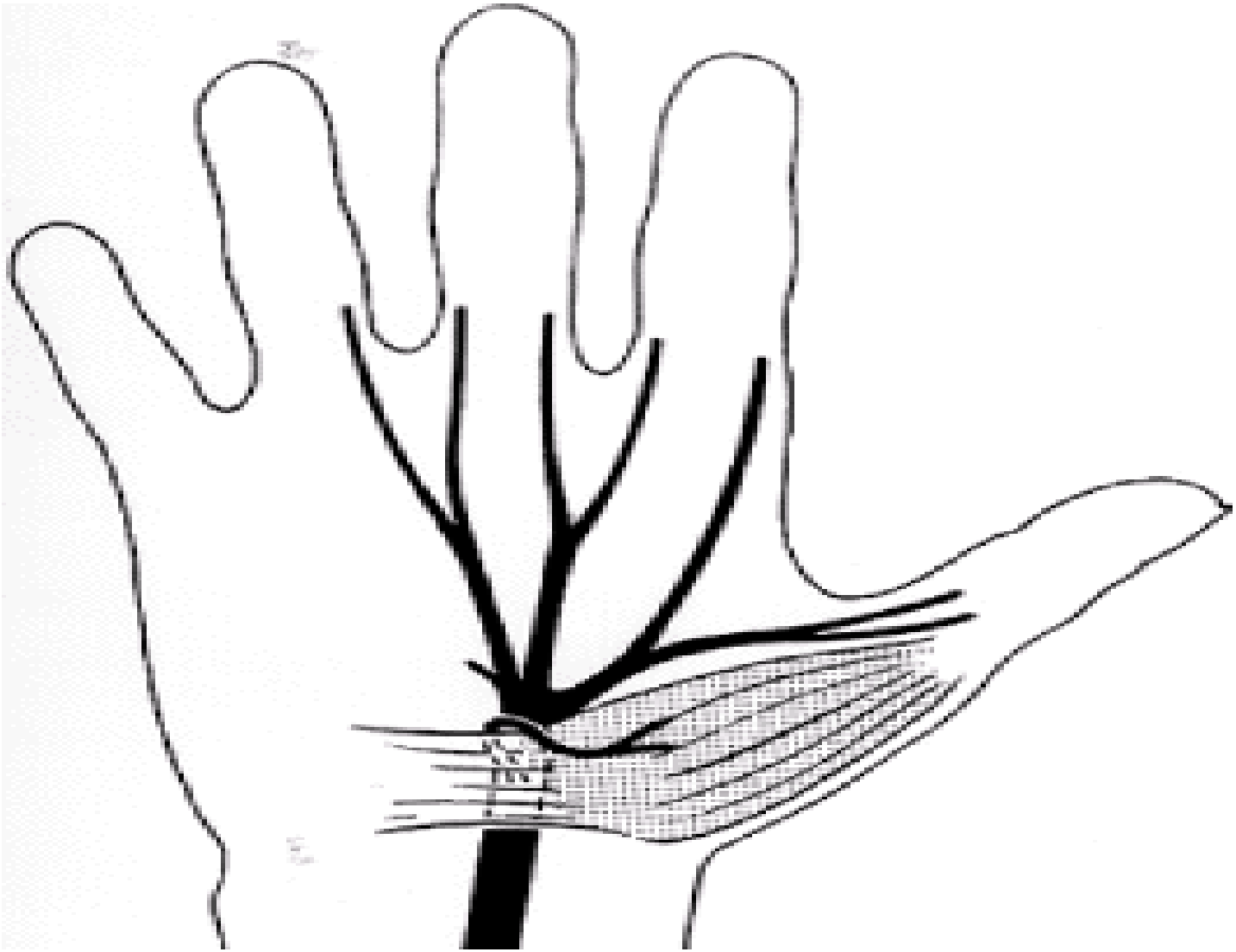

Median nerve sensory distribution via carpal tunnel
Median nerve sensory distribution via forearm
Median Nerve Sensory Innervation
www.fpnotebook.com

Recurrent Motor Branch

- Leaves the radial side of the median nerve distal to the flexor retinaculum.
- Curves back around to enter the thenar muscle mass.
- Multiple anatomical variations.
- 31% of cases: leaves the ulnar side of the median nerve beneath the TCL
- 20 % of cases: transligamentous course.



Median Nerve within the Carpal Tunnel

- Radial Component:
  Sensory branches to the palmar surfaces of the 1st and 2nd fingers.
  Motor branches to the abductor pollicis brevis, opponens pollicis, and superficial head of flexor pollicis brevis.
- Ulnar component:
  Sensory branches to the palmar surface of 2nd , 3rd , and radial side of the 4th finger.
- Additionally, the median nerve can supply the dorsal surfaces of the 2nd , 3rd , and 4th fingers distal to the interphalangeal joint.

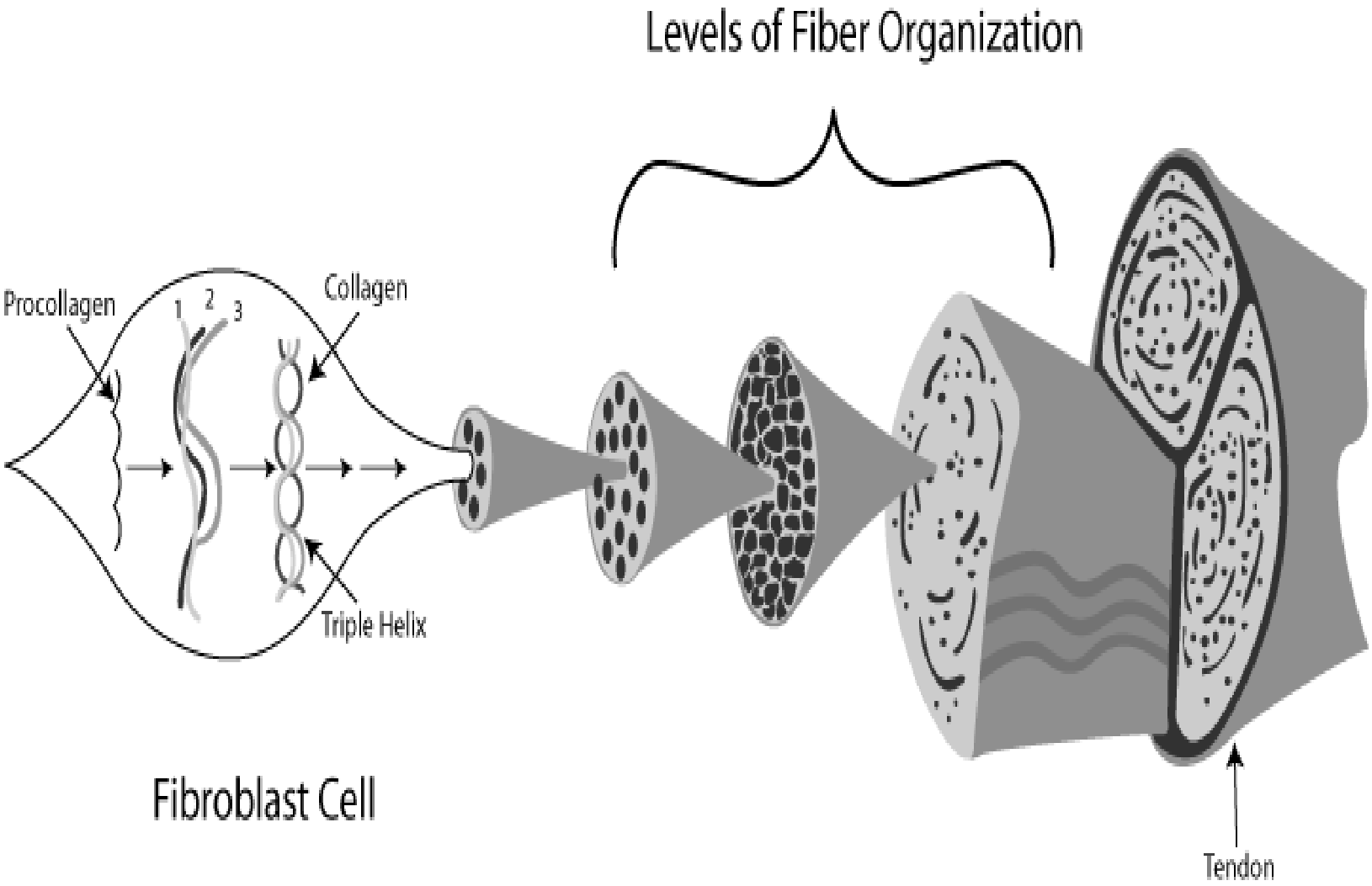
PATHO ANATOMY

Inflammation

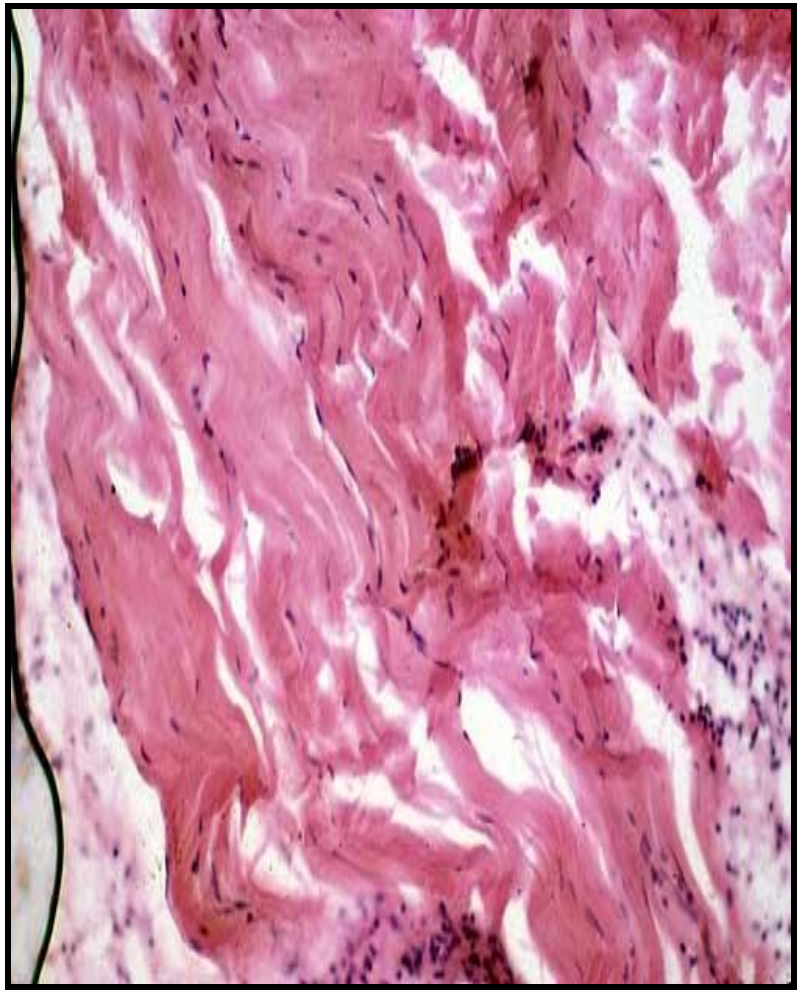
- Body's response to injury: Characterized by blood vessel dilation and increased temperature at site.
- Stage 1, Inflammatory: monocytes, fibroblasts & phagocytes migrate to injury.
- Stage 2, Proliferative: Fibroblasts increase in #; lymphocytes recruited to provide control signals
- Stage 3, Remodeling: Decrease in cellularity and fibronectin production; collagen production

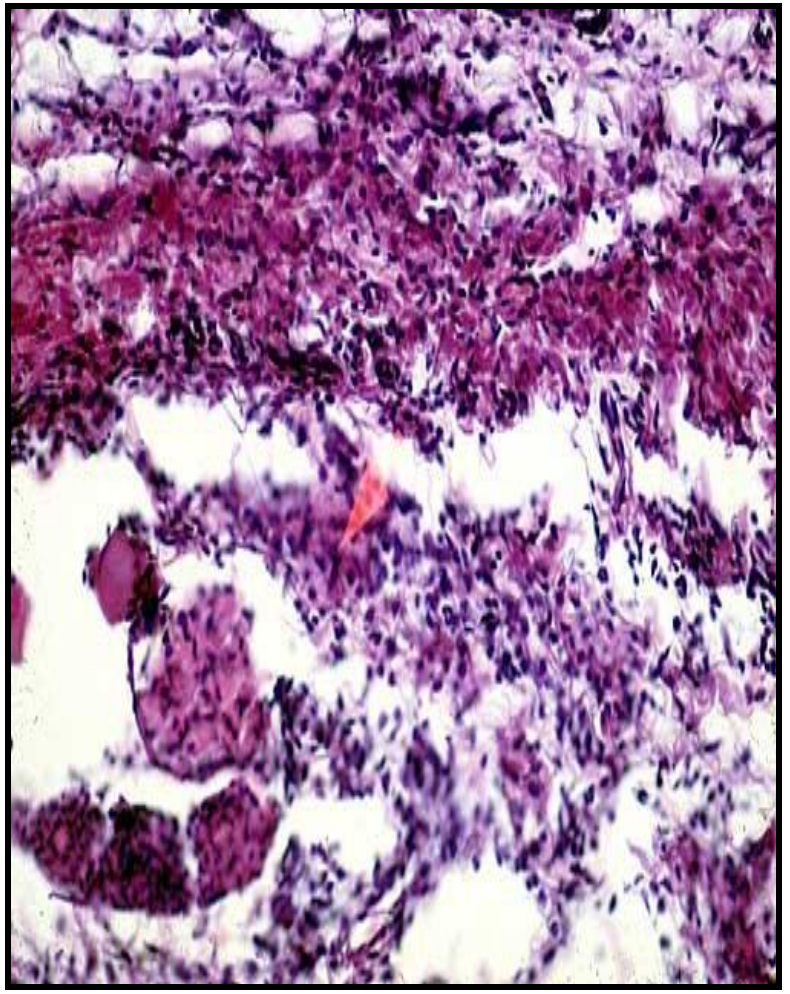
Tendon structure

- Tendon has low cellularity normally
- Consists of highly organized fibrils of collagen
- Wavy appearance in healthy tendon
- Specialized fibroblasts called tenocytes are aligned between the collagen fibers.
- Each tendon is surrounded by a structure known as tenosynovium; a protective sheath - affected area in CTS – inflamed: CTS = compression of median nerve


Levels of Fiber Organization
Procollagen
1
2
3
Collagen
Triple Helix
Fibroblast Cell
Tendon

Healthy vs. Injured Tendon





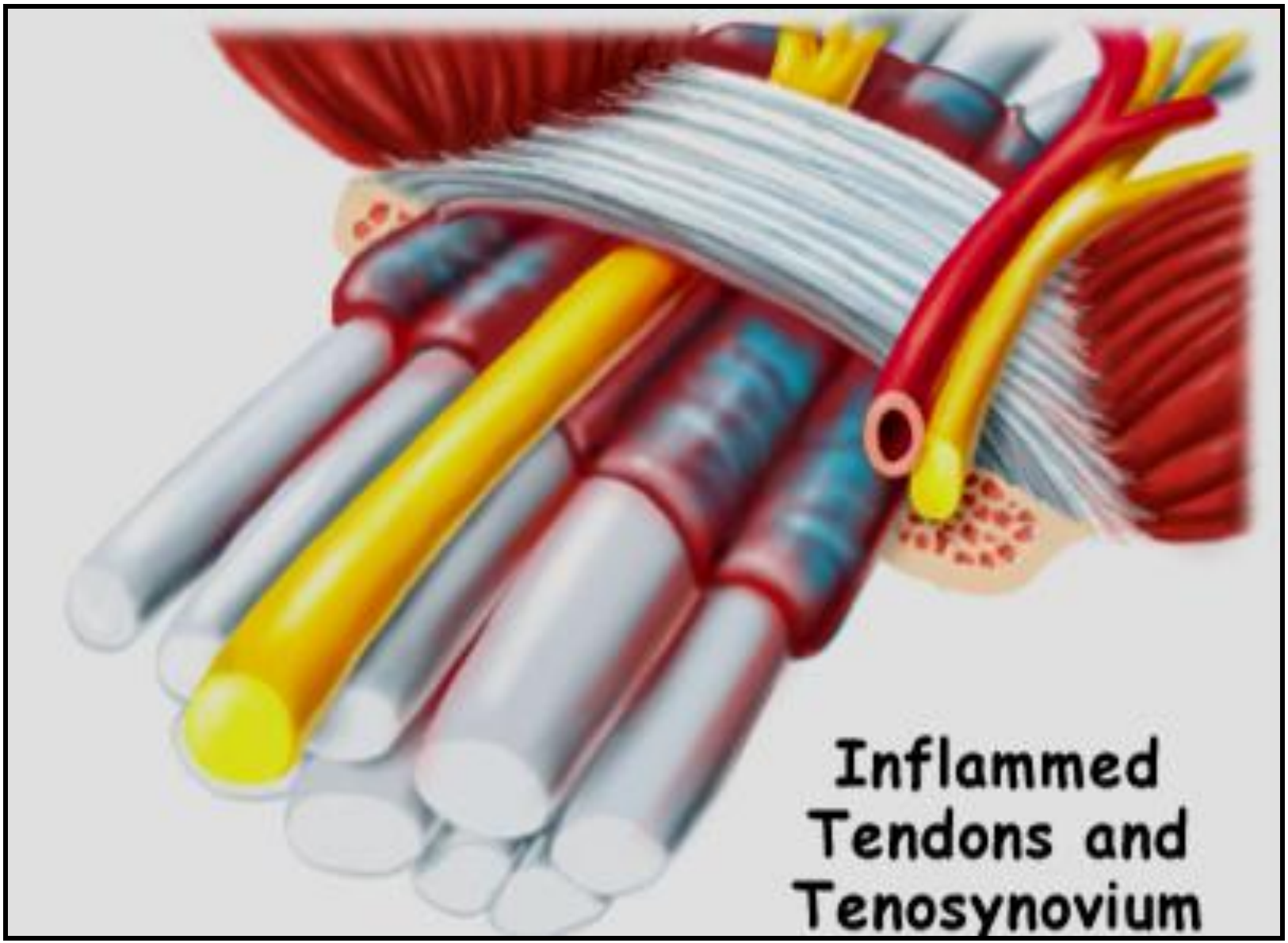
CTS

- Median nerve enters hand through an osseofibrous carpal tunnel, bounded dorsally and laterally by the convex bony carpus and volarly by the thick transverse carpal ligament.
- Corners of this tunnel are the *pisiform, hamate, scaphoid tubercle, and the trapezium tubercle*.
- The transverse carpal ligament spans between the scaphoid tubercle radially and the hamate bone ulnarly.
- Median nerve shares the tunnel with 9 other flexor tendons, each of which is covered by 2layers of synovium.

- The radial and ulnar arteries, the ulnar nerve, and the flexor palmaris longus do not pass through the carpal tunnel and are referred to as extra carpal structures.

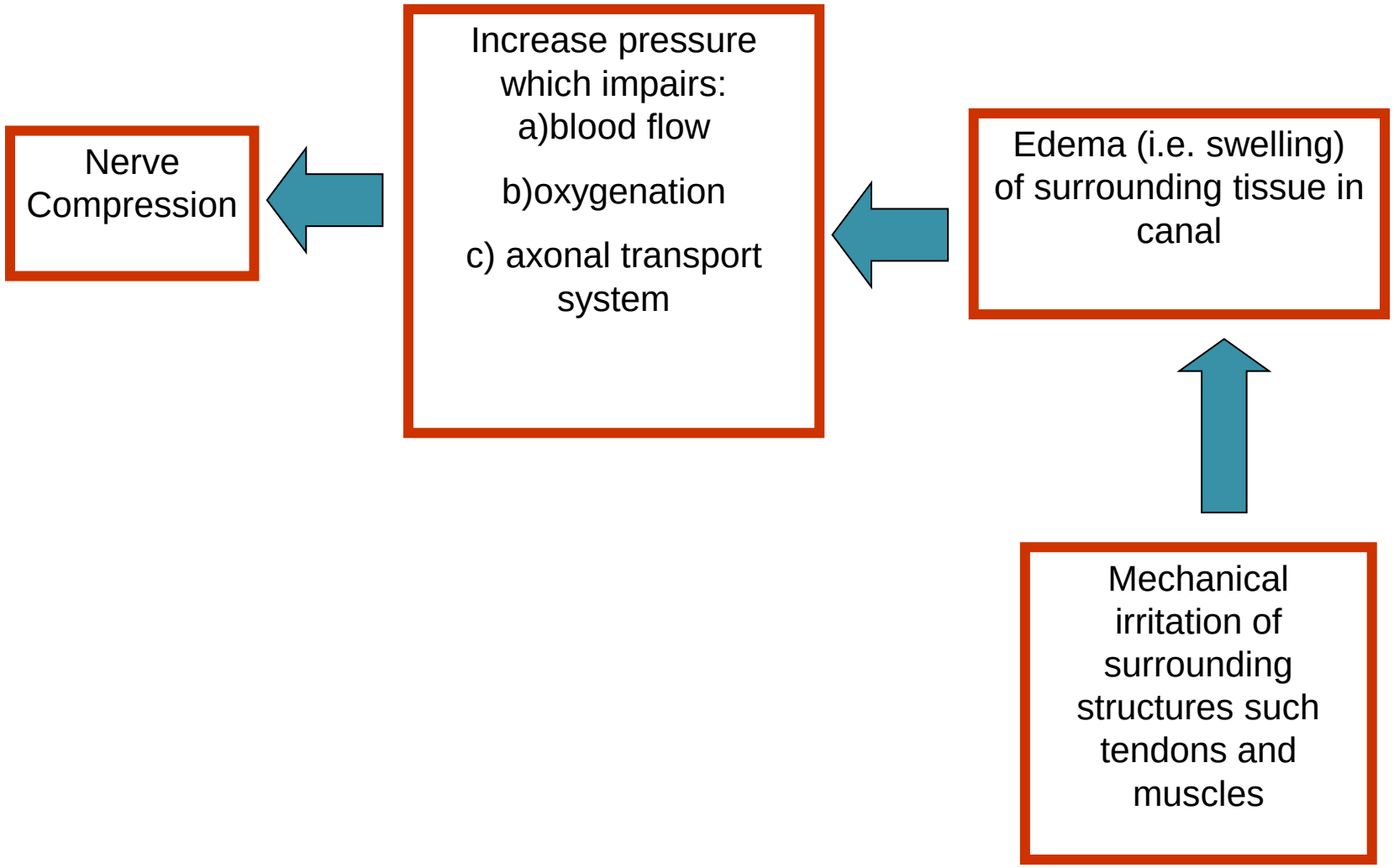
- After its passage through the carpal tunnel, the median nerve divides in to 5 digital branches, the most radial of which supplies the thenar musculature and the latter 2 finger lumbricales; the other branches supply sensation to the palmar aspect of the lateral 3 & ½ digits and their dorsal fingertips.

- The palm itself is spared of sensory loss in CTS because the palmar cutaneous sensory branch takes leave of the median nerve before that nerve enters the carpal tunnel.
- This cutaneous branching occurs approximately 3 cm proximal to the transverse carpal ligament between the tendons of the palmaris longus and flexor carpi radialis muscles, beyond which the nerve travels superficially toward the palm.
- *The essential concept is that there little space within the carpal tunnel, and anything that decreases the volume such as swollen tendons will occupy more space at the expense of median nerve suffering ischemia.*


Inflammed
Tendons and
Tenosynovium

Pathological condition caused by incompatibility between the volume of nerve and the space available to the nerve structure (Lundborg, 1988)

- An increase in volume or tunnel contents secondary to nonspecific tenosynovitis of the flexor tendons within the carpal tunnel. (Dawson et al., 1990)
- Thickening (fibrosis) of the transverse carpal ligament.
- Alteration of the osseous margins of the carpus caused by fractures, dislocations, or arthritic joint changes.
- Tumor or systemic disease.


Mechanical irritation of surrounding structures such tendons and muscles
Edema (i.e. swelling) of surrounding tissue in canal
Increase pressure which impairs:
a)blood flow
b)oxygenation
c) axonal transport system
Nerve Compression

INCIDENCE

Causes and Associated Disorders

- More common in women: ratio of 2.5:1
- Middle age: 40-60 years.
- Occupational factors.
- The dominant hand is most often involved.
- 10% of patients have bilateral compromise.
- Predisposed patients: congenital small carpal tunnel canal.
- Common cause: thickening or fibrosis of the flexor synovialis.
- Conditions that increase the volume of the contents of the carpal tunnel: ganglion cyst, benign mass, amyloid infiltration (multiple myelomo or amyloidosis).
- 15% of patients have DM.
- Rheumatoid arthritis: synovial overgrowth and alterations in carpal bone alignment.
- Acromegaly.
- Hyper and hypothyroidism.
- Pregnancy: 62% of pregnant women report symptoms. Usually resolve following delivery.

Factors studied

- Gender
- Birth control use
- Pregnancy
- Bilateral oophorectomy
- Hysterectomy without oophorectomy
- Height
- Weight
- Varicosis
- Rheumatism
- Diabetes mellitus
- Force
- Repetitive motions
- Awkward postures
- Vibration
- Mechanical Stress
- Force and repetition
- Repetition and cold
- Use of power tools and machinery
- Flexed/Extended wrists activities
- Typing
- Autonomy at work
- Quantitative workload
- Perception of importance of safety and health

Work activities studied

Some work areas/ industries with high incidence of CTS

- Female garment (Punnet, et al 1985)
- Ski Manufacturing (Barnhart, 1991)
- Grocery store (Baron, et al, 1991; Morgenstern,et al, 1991; Osorio, et al, 1994)
- Postal machine operators (CA, Berkeley)
- Frozen food factory workers (Chiang, 1990)
- Oyster, crab and clam packing (Franklin et al 1991; Chiang,et al, 1993)
- Meat workers (Franklin et al 1991 and Schottland et al,
- Pork processing plants (Moore and Garg, 1994)
- Poultry workers (Franklin et al 1991, Schottland, et al, 1991)
- Slaugterhouses and butchers (Falck and Aario, 1983)
- Fish canneries and processing grinders
- Electronic assembly (Feldman, et al, 1987)
- Air craft engine workers (Cannon, et al, 1981)
- Textile workers (McCormack, et al, 1990)
- Clerical
- Bottlers and canners
- Automobile assembly workers

Results of studies

- Show no consensus on what factors are related with the etiology of CTS
- Show no consensus on the degree of influence of factors to CTS.

Why?

- Due to different:
  - Measures (objective vs. subjective)
  - Type of study
  - Confounding factors
  - Biases (e.g. survivor bias)
  - Tools to measure
  - Case definition
  - Approaches (e.g. no comparable)
  - Industries, job descriptions
  - Sample size (e.g. big enough to see difference)
  - Statistical methods and interpretation

Conclusion of studies

- Insufficient evidence
  - Posture and CTS
- Evidence
  - Highly repetitive work and CTS
  - Force and CTS
  - Vibration and CTS
- Strong evidence
  - Combination force and repetition and CTS
  - Combination force and posture and CTS

- *There is an increasing prevalence of CTS signs and symptoms among industrial workers exposed to increasing levels of repetition and forceful exertion.*

  This relationship was not seen when repetition alone was assessed.

  (Silverstein, et al, 1987)

CLINICAL COURSE

Clinical symptoms and signs

- Sensory complaints:
  - 80-100% of patients.
  - Numbness and tingling in any of the sensory areas supplied by Median nerve.
  - Night pain that awakens the patient. (best predictor)
  - Pain go till shoulder.
- Motor complaints:
  - Problems grasping or pinching.
  - Thenar atrophy.
- Acute CTS:
  - severe pain, wrist or hand swelling, cold hand, (changes in sweat functions of hand) or decreased finger motion.


Numbness
Pain
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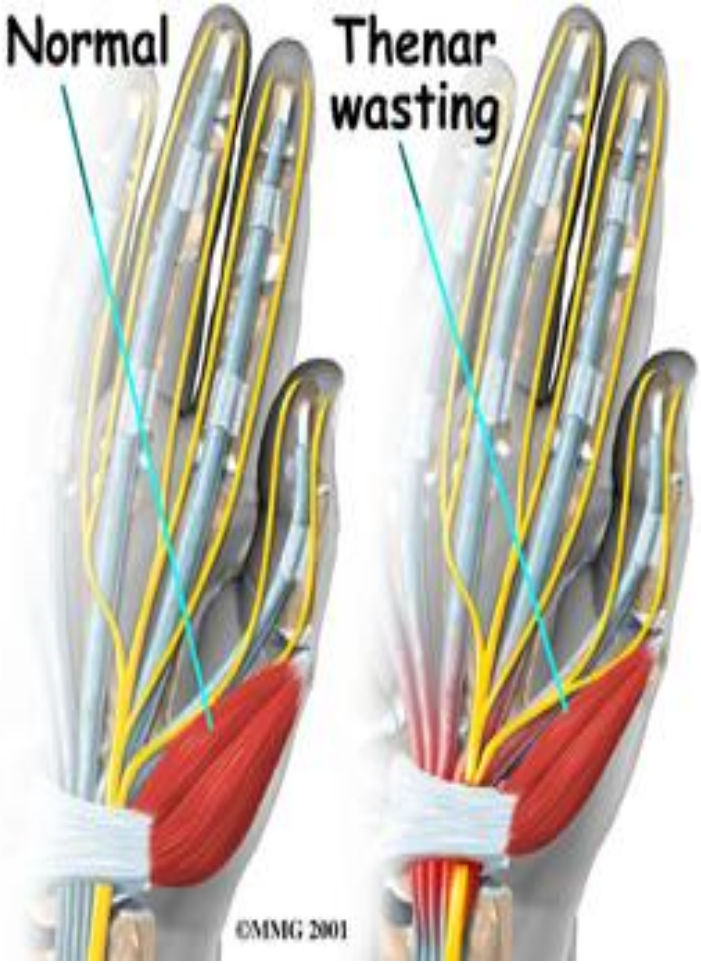
Normal
Thenar wasting
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Signs of CTS

- Great variability in the signs associated with CTS
- Tinel and Phalen signs have had sensitivities reported from 10% to 80%. (Gellman et al., 1986, Kuschner et al., 1992, Heller at al., 1986)
- This great degree of inconsistency due to:
  - Only subjective data were used to diagnose CTS.
  - The provocative maneuvers have been described and performed inconsistently in medical literature.
  - There are significant technical limitations for the signs.

Hoffman-Tinel sign

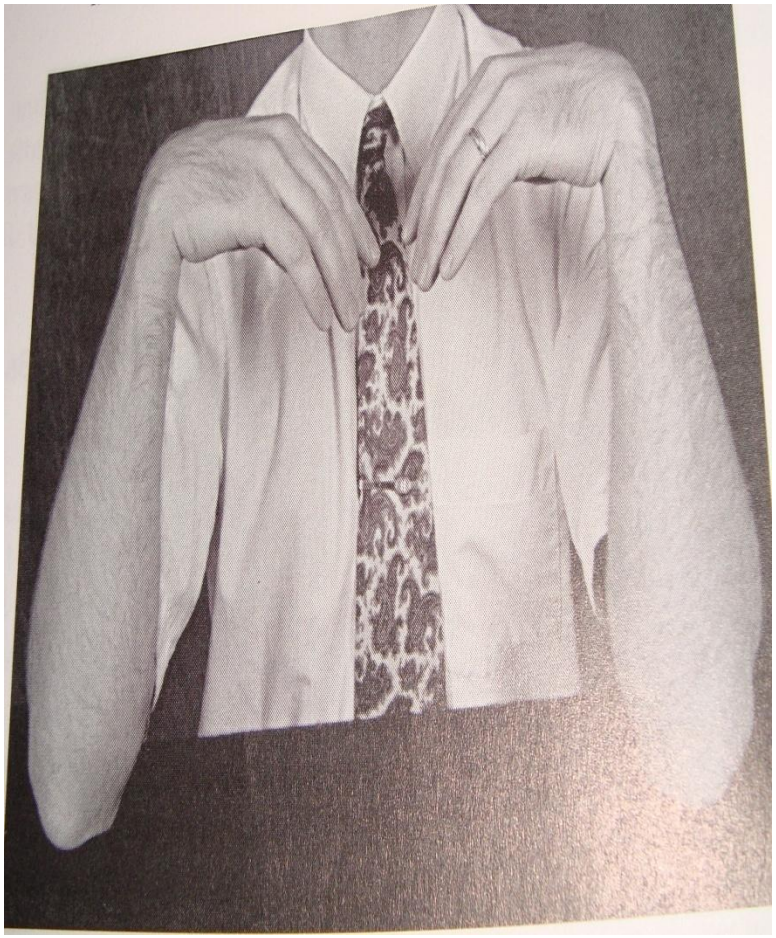
- Hoffman in Mar'1915 & Tinel, Oct'1915.
- Sign associated with successful nerve repair and reinnervation following traumatic nerve injuries.
- A positive sign occurs by gently tapping over the reanastomosed, injured nerve and inducing tingling(not pain) distally in the distribution of the affected nerve.
- "Gentle" has never been defined but avoiding a hard tap that will induce paresthesia distally.
- Location of tingling identifies the point of reinnervation in a nerve that heals properly.
- Sign present only:
  - In nerve injuries with axonal loss of sensory nerve fibers.
  - If tapping is made over the tip of the regenerating sensory axons of the injured nerve.

- Not a single study in medical literature in any language in any year could be identified in the usage of Hoffman –Tinel sign in CTS.
- Low sensitivity and specificity for CTS.
- Not recommended for the evaluaion of CTS.(Golding et al., 1986, Ebramzadeh et al., 1992, Noval GB et al., 1992)
- Very difficult to tap over the median nerve at the level of carpal tunnel because of the degree of soft tissue overlying the nerve.
- Not present in cases of CTS with median nerve conduction slowing and conduction block (neuropraxia) that limits the number of possible positive Hoffman –Tinel sign in patients with CTS.

Phalen sign

- Phalen,1966 ,holding the wrists in complete flexion for 30-60 seconds could induce or exaggerate tingling (not pain) in the median nerve distribution in hand.
- Modified Phalen test , pressing the dorsum of each hand against the other to induce greater pressure within the carpal tunnel.
- In phalen's article, an informal study without control subjects, the sign was present in 73% of 452 hands.(Phalen GS, 1966)
- Kuschner, literature review on Phalen sign and presented 200 cases. (Kuschner SH, Johnson D, 1992). Results showed a sensitivity of 60% and specificity of 80%.
- This is consistent with a sensitivity of 51% and specificity of 76% noted by Hennessey and Kuhlman in 228 cases of suspected cases with CTS , with diagnosis confirmed by nerve conduction studies.

- The Phalen sign induces ischaemia within the entrapped median nerve, which already has compromised blood flow prior to wrist flexion test.
- Phalen test was negative in the presence of advanced sensory loss.
- Cases of CTS with significant sensory loss are common, limiting the clinical utility of the test.

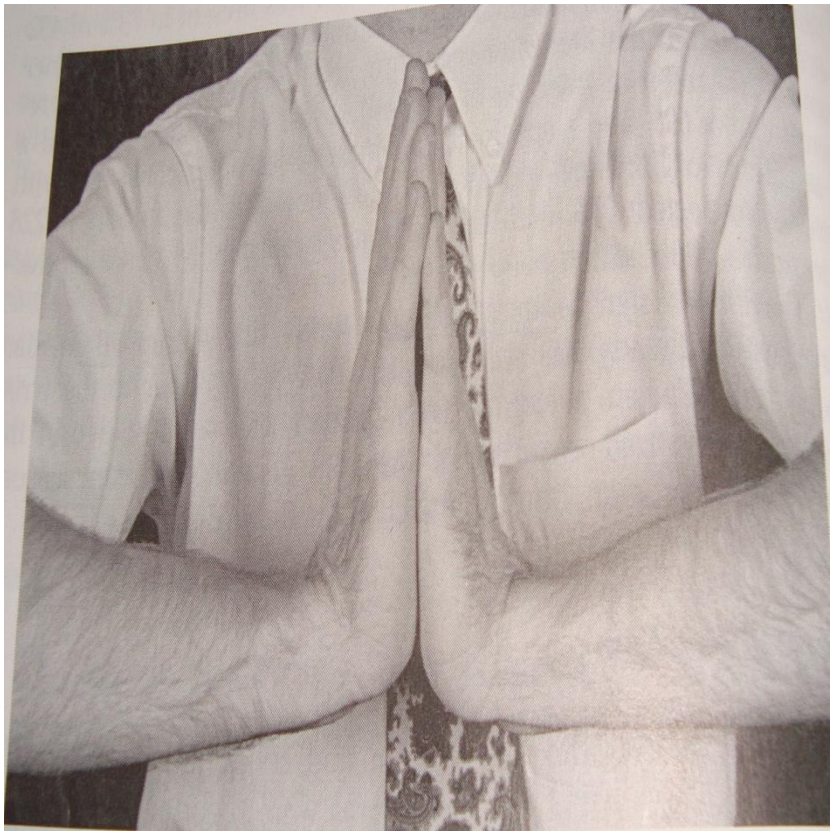


Modified Phalen test

Reverse Phalen sign

- Werner & colleagues, 1994.
- Intracarpal canal pressures were most elevated with the wrist in extension.(Brain WR et al., 1947, Hargerns et al., 1981, TanzerRC 1959)
- Examination of 31 subjects with CTS and 20 control subjects with wrist and fingers in complete extension for 1 minute confirmed electrodiagnostic presence of CTS in all patients.
- Reverse phalen test was positive in 55% of CTS cases and not present in any control subjects.

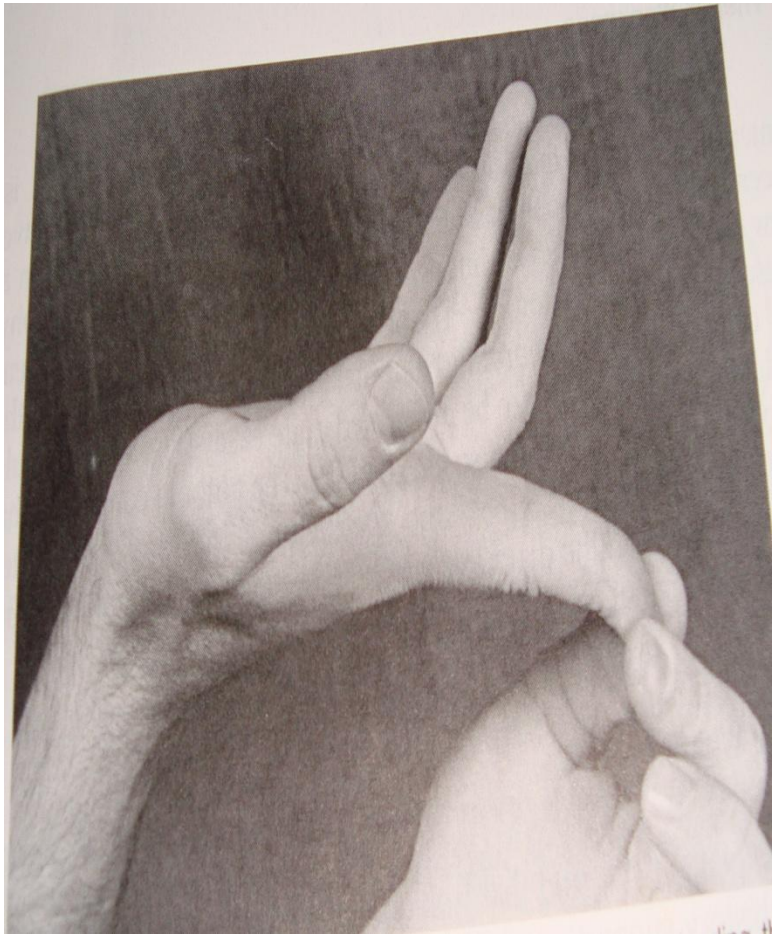
- Reverse Phalen sign demonstrated an excellent specificity in that one study.
- Clinical utility is limited due to its low sensitivity , which is similar to that of Phalen sign.



LaBan sign

- Developed in 1986. Useful in cases of chronic CTS.(LaBan MM et al., 1986).
  - Chronic was not defined in this study but all 20 patients had thumb weakness noted on physical examination.
  - All cases of CTS were confirmed by standard nerve conduction studies.
  - The test was positive in 80% (18 of 20) CTS cases.

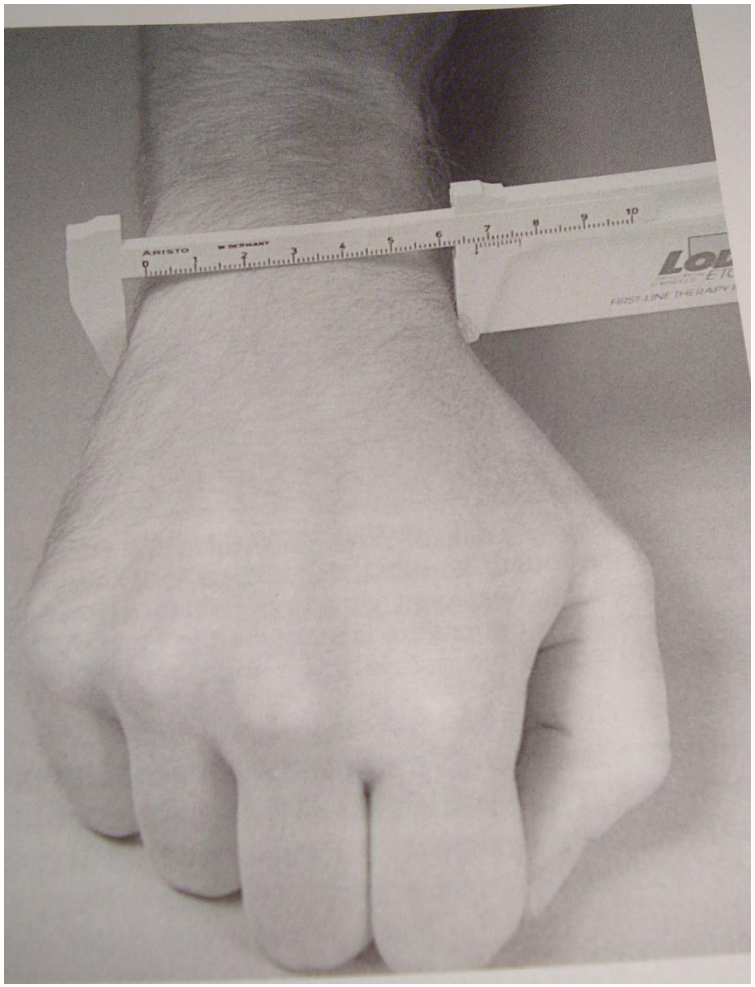
- Performed by supinating the forearm, extending the wrist, and extending the index finger at all joints, with greatest stress placed on the distal interphalangeal joint.
- A positive test referred pain to the proximal anterior forearm.
- The severity of the discomfort was related to the duration of the test.
- The test was not reproducible with the other digits of the hand.

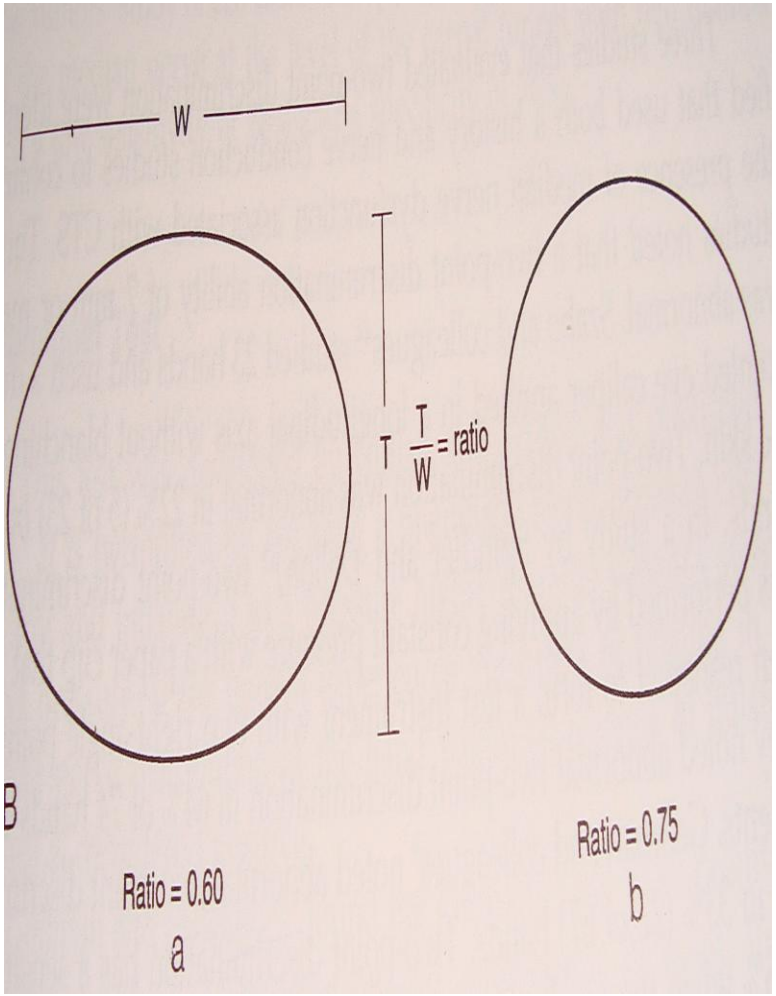


- Adhesions between the median nerve and the transverse carpal ligament contribute to the ischemia during the test.
- Nakamichi and Tachibana, 1995 noted that median nerve slides in the transverse direction beneath the flexor retinaculum with resisted flexion of fingers; confirmed by ultrasonography.
- This phenomenon occurs with a mean value of 1.75 mm, compared with .37 mm in patients with CTS.
- Both the flexor tendons of the index finger are located immediately posterior to the median nerve.

Square Wrist sign

- Johnson and colleagues , 1983.
- A wrist ratio of 0.7 or greater was highly correlated with CTS.
- An abnormal prolonged median sensory nerve response to the long finger, with a distal latency to peak of 3.7msec or greater.
- The wrist is measured at the level of the distal anterior wrist crease and a thickness of (A-P measurement) to width (M-L measurement) ratio is calculated.

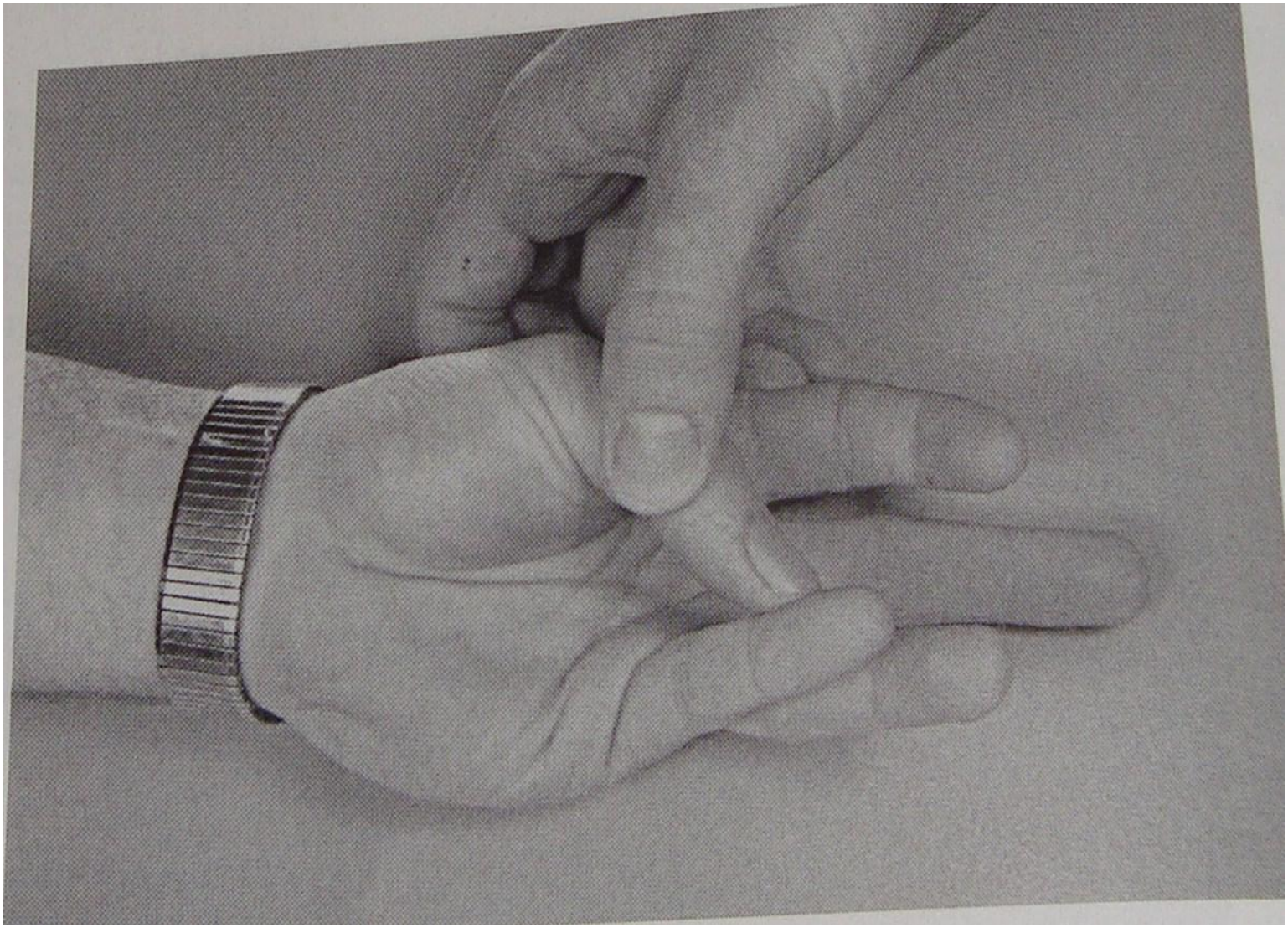



W
T
T/W = ratio
B
Ratio = 0.60
a
Ratio = 0.75
b

- This sign corresponds to a sensitivity of 69% and specificity of 73% in 228 suspected cases of CTS with diagnosis confirmed by nerve conduction studies.
- Gordon and colleagues, 1988 reported a sensitivity of 74% in suspected cases of CTS confirmed by median motor nerve conduction.
- Time efficient sign to perform.
- Presence or absence is useful for the diagnosis of CTS.

Thenar weakness

- No study could be identified regarding this sign.
- Weakness was implied by the observation of thenar atrophy. (Phalen GS, 1966; Selvarajah et al, 1986)
- Assessment of strength is a fundamental component of neuromuscular examination.
- Examination of APB should be performed in all suspected cases of CTS.
- Has a sensitivity of 66% and specificity of 66% with diagnosis confirmed by nerve conduction studies.



Thenar wasting

- Isolated thenar weakness in combination with a history of supportive of CTS, is indicative of a severe chronic case of CTS.
- Not very sensitive – diagnosis before thenar atrophy.
- Studies reporting sensitivities of 3% to 44%. (Phalen GS, 1966; Rose DM et al, 1986)
- Specificity expected to be high. (No studies)

Two-point discrimination

- 3 studies that evaluated 2 –pt. discrimination used both history and nerve conduction studies to confirm presence of CTS.
- A 2-pt. discrimination ability of 7mm or more was abnormal.
- Szabo and colleagues, 1984 used dull pointed eye caliper in a longitudinal axis without blanching of skin. (22% sensitivity in 23 hands)
- Spindler and Dellon, 1982 applied constant pressure with a modified paper clip. (64% +ve of 74 hands)
- Gellman and colleagues, 1986 noted abnormal 2-point discrimination in 33% hands.(22 of 67)
- Two-point discrimination has a sensitivity of 45% when the results of all three studies are combined.

Hypesthesia

- Phalen noted impaired sensation in the median nerve distribution of the hand in 79% of 452 hands, determined by sensation to light touch.
- Sensibility was tested with a pinwheel and median, ulnar and radial sensory portions of hand were studied.
- Test revealed a 51% sensitivity and 85% specificity for CTS.
- Should be used in all cases of CTS.
- Median nerve hypesthesia, if present , is a good indicator of CTS.

Carpal compression test

- Durkan, 1991 and 1994, used history and nerve conduction studies to confirm the presence of median nerve dysfunction associated with CTS.
- He constructed a device that could apply a pressure of 150mm of Hg to carpal tunnel for 30 seconds.
- A positive test was confirmed by the reproduction of symptoms within the median nerve distribution in the hand.
- Test revealed an 87% sensitivity in CTS patients and present in 10% control subjects.
- Test limited by the availability of the device, the 10% false positive rate, and the fact that it indirectly indicates median nerve dysfunction as opposed to direct evaluation via nerve conduction study.

- Durkan also suggested, 2 thumbs to apply pressure over carpal tunnel for 5 seconds.
- Difficult to reproduce on a consistent basis from patient to patient and clinician too clinician.
- Low sensitivity of 28% and a specificity of 74%.

Tourniquet test

- Gilliat and Wilson, 1953.
- Performed by applying a pneumatic blood pressure cuff on the arm and inflating it to a pressure higher than patients systolic blood pressure.
- If the patient experiences numbness or tingling in the median nerve distribution of the hand within 60 seconds of inflation, the test is considered positive.
- Gellman and colleagues, 1986 , test positive in 65% (42 of 67) of electro diagnostically confirmed CTS cases.
- In the control group , tourniquet test was positive in 40% (20 of 50) of the tested hands, indicating significant ischemia within healthy nerves.
- Golding and colleagues, 1986 found the test to be positive in 21% (8 of 39) of electro diagnostically confirmed CTS.
- The tourniquet test was positive in 13% (9 of 71) in the control group.
- Relatively low sensitivity and high false –positive rates.

Electro diagnostic approach

- The recommendations by American association of Electrodiagnostic medicine, American academy of Neurology, American academy of PMR include:

1) Sensory NCS of the median nerve across the wrist, and if the latency is abnormal, compare to one another sensory study in the symptomatic limb.
2) If the initial median sensory NCS across the wrist has a conduction distance > 8 cm and the results are normal, additional studies as follows:

- Median sensory NCS across the wrist over a short (7-8 cm) conduction distance *or*
- Comparison of median sensory NCS across the wrist with radial or ulnar sensory conduction across the wrist in the same limb.

- The practice parameter also recommends motor NCS of the medain nerve with comparison to one other motor nerve in the symptomatic limb and an option for EMG study of the limb.

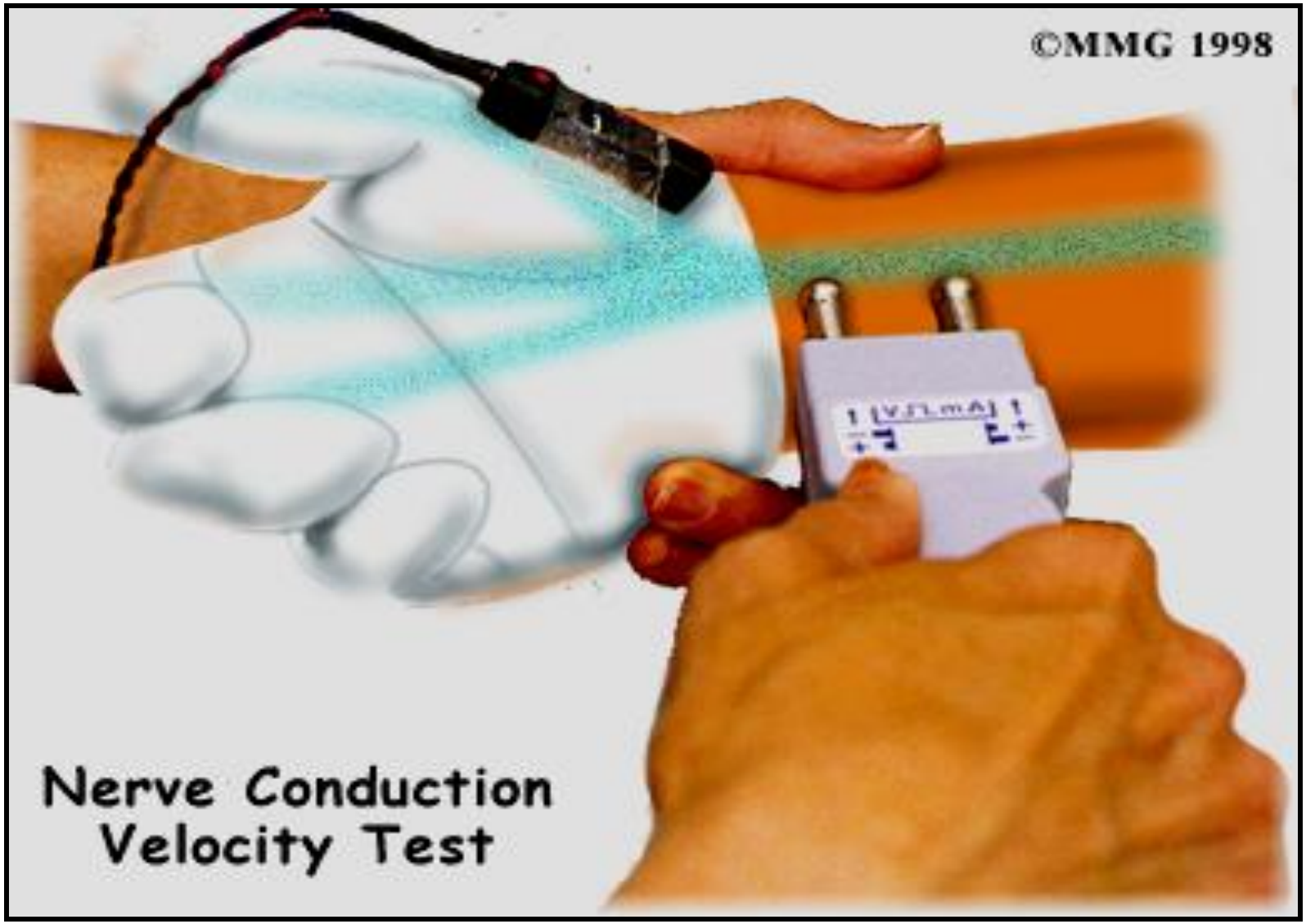
Electrical Studies

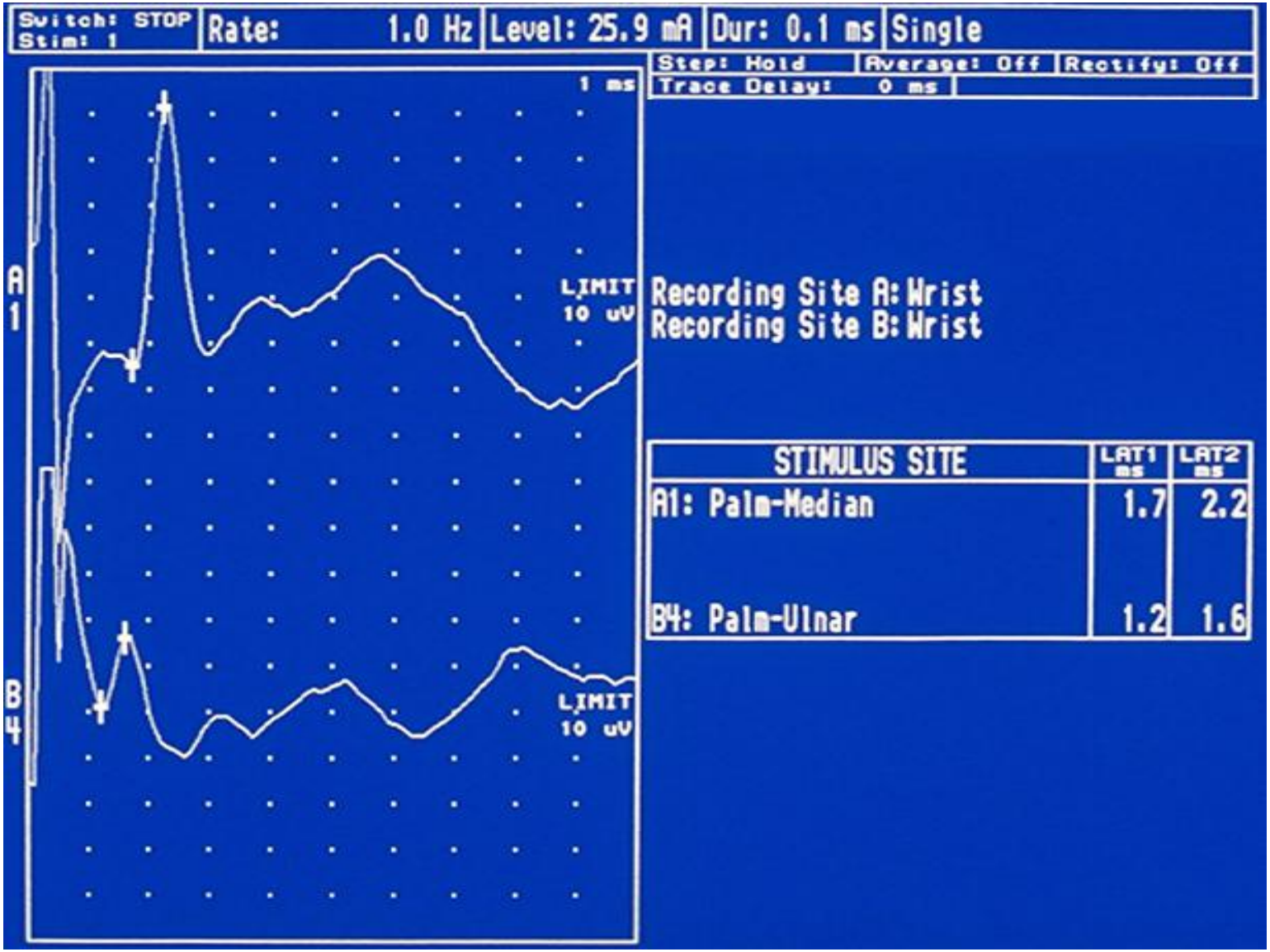
- Important role in the differentiation among the possible affected areas: roots in the cervical spine, brachial plexus, or along the arm.
- Sensory nerve conduction studies are the most sensitive in confirming the diagnosis:

  increase in distal latency due to focal slowing of conduction across the carpal tunnel.
- Sensitivity and specificity: 90%

Nerve Conduction Studies

- Surface electrodes on hand and wrist
- Small elec. shocks applied to nerves in fingers, wrist, and forearm (measure speed of conduction)
- Can detect 84% of people with CTS
- Can eliminate 95% of cases that are not CTS


©MMG 1998
Nerve Conduction
Velocity Test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1 ms
A1
LIMIT
10 uV
B4
LIMIT
10 uV
Recording Site A: Wrist
Recording Site B: Wrist
STIMULUS SITE
LAT1 ms
LAT2 ms
A1: Palm-Median
1.7
2.2
B4: Palm-Ulnar
1.2
1.6

Electromyography (EMG)

- To confirm diagnosis
- Indwelling or surface electrodes; electrical activity is displayed on a screen (benefits vs. disadvantages)
- Conditions such as obesity and anxiety can slow conduction speed and cause skewed results

Differential Diagnosis

- P pregnancy
- R rheumatoid arthritis
- A acromegaly
- G gout
- M myxedema
- A amyloidosis
- T trauma
- I idiopathic
- C calcium pyrophospate dihydrate deposition disease. (and)
- Cervical nerve root pathology
- DJD C-MC joint thumb
- Diabetic neuropathy
- Median nerve compression at elbow
- Ulnar neuropathy (elbow or wrist)
- Thoracic outlet syndrome
- Hypothyroidism

Classification

- Grouped in to 3 categories (outlined by Sunderland); convenient not only for diagnosis but for treatment and prognosis too.
- Groupings correspond to neuropraxia, axonotemesis and neurotemis respectively.
- 2 items to be considered:
  - *Median nerve has both sensory and motor branches. Sensory abnormalities occur first to progress to motor involvement as the pathology evolves.*
  - *Clinical findings are proportional to the degree of nerve damage, which inturn is related to the severity of compression and not to the duration of compression.*

- Group 1:
  - Mildest symptoms of weakness or clumsiness brought on by drawing, holding a newspaper, or performing manual labor.
  - Symptoms are initially sporadic only to increase in frequency over time.
  - No abnormal findings may occur during the initial examination.
  - Physiologic changes include progressive obstruction of venous return resulting in circulatory slowing, hence impaired nutrition to nerve fibers.

- Group 2:
  - Characterized by pain, often of a burning quality, with some thenar weakness or atrophy, skin changes, sensory loss, realization of clumsiness, loss of pinch and dexterity.
  - Patient requires longer periods of hand wringing, rubbing, or placing of the hand under running water so as to help alleviate symptoms.
  - There may be a positive Phalen's test or Tinel's sign.
  - Pain may be referred as proximally as the shoulder.
  - Physiologic changes include slowing of capillary circulation so severely that anoxia damages the endoneuium.

- Group 3:
  - Characterized by pronounced thenar wasting and sensory loss, skin atrophy, and significant loss of dexterity.
  - There is often loss of 2 –pt discrimination and significant functional impairment.
  - Pain may have either subsided or become severe.
  - Prognosis is very poor regardless of treatment because the compressed nerve has become a fibrotic cord.

MANAGEMENT

Factors predicting failure of conservative treatment

- Age > 50 years
- Duration > 10 months
- Constant paresthesias
- Stenosing flexor tenosynovitis
- Positive phalen test in < 30 seconds

less than 10% of persons with 3 of 5 risk factors improve with medical management alone.

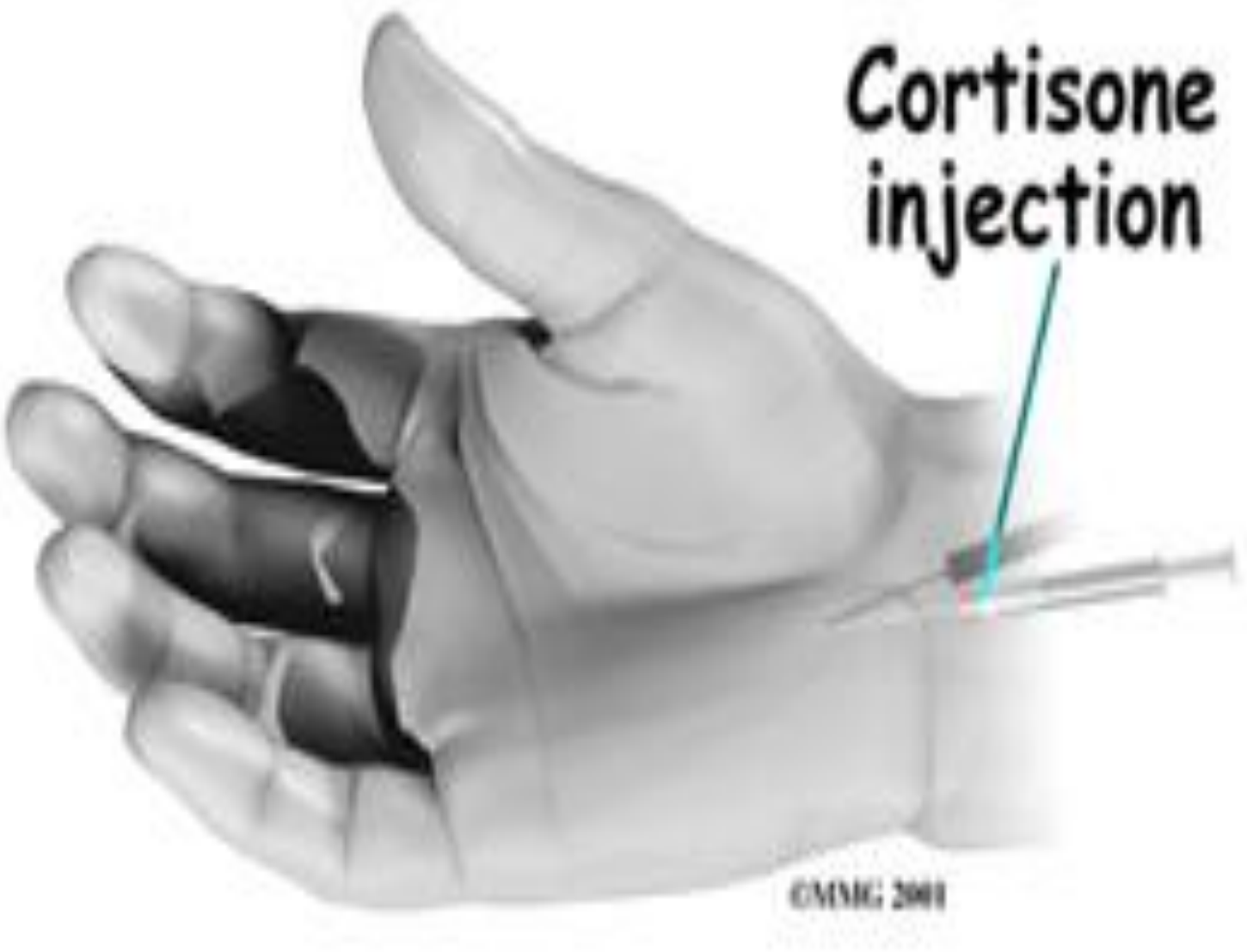
Conservative

- Underlying condition is self-limited: pregnancy.
- Occupational factor that could be modified.
- Wrist splint: Slight wrist extension (10 -30 deg) during sleep.
- Physical therapy. (tendon gliding exercises)
- Drugs
  - NSAIDS (ibuprofen naproxin, aspirin): recommended EARLY in the inflammation cycle
  - Corticosteroids: decrease in tendon strength & mass over time

- **Contrast baths.** Alternating between warm water and cold water soaks helps reduce carpal tunnel symptoms in some people.

- **Ultrasound.** Deep, pulsed ultrasound directed at the carpal tunnel can reduce pain and numbness, and improve hand strength. Continuous superficial ultrasound doesn't help.

- **Traction.** Some people obtain relief from carpal tunnel symptoms by using a hand traction device, called C-Trac. This device might be tried, if other conservative treatment options have failed.


Cortisone
injection

Wrist Immobilization Splint

Evidence:

- A study conducted on the effectiveness of splinting in the conservative treatment of CTS found that use of the wrist immobilization splint caused disappearance of clinical symptoms of CTS in 75% of patients (Papez & Walker, 2004)

Wearing Schedule:

- Research has indicated that most optimal results are seen with both day and night splint wear (Walker, Metzler, Cifu, & Swartz, 2000).

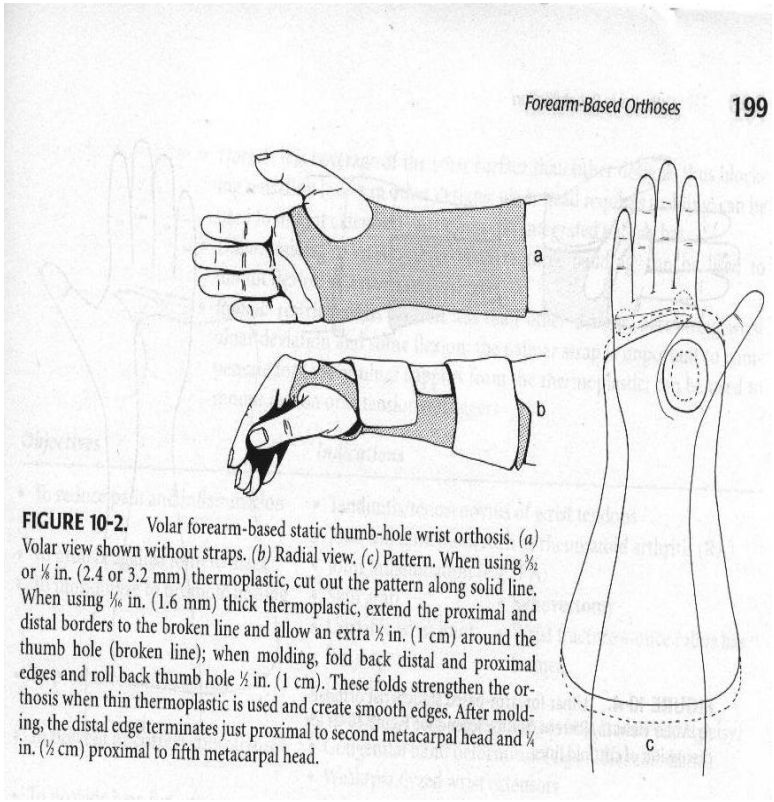
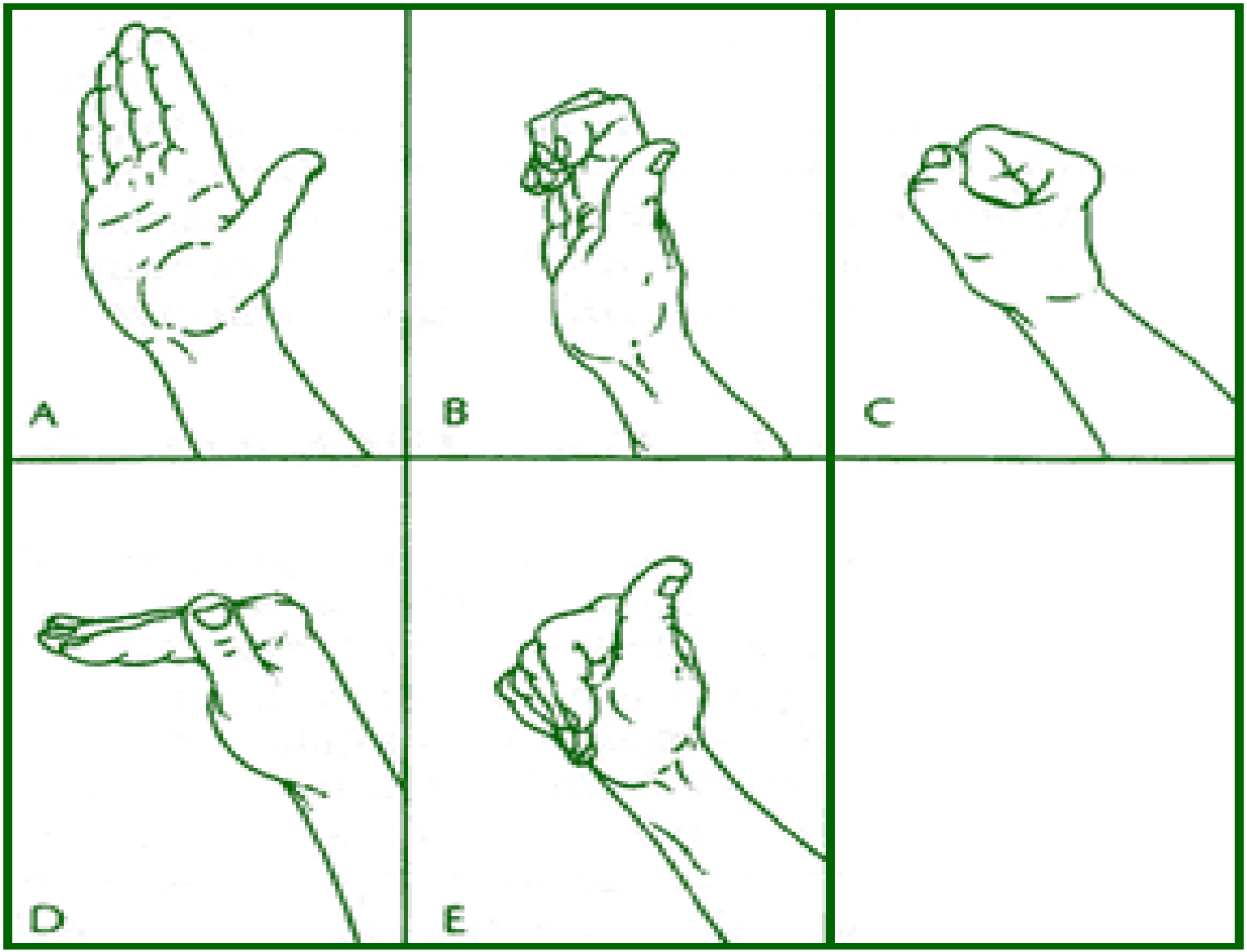


FIGURE 10-2. Volar forearm-based static thumb-hole wrist orthosis. *(a)* Volar view shown without straps. *(b)* Radial view. *(c)* Pattern. When using 1/32 or 1/8 in. (2.4 or 3.2 mm) thermoplastic, cut out the pattern along solid line. When using 1/16 in. (1.6 mm) thick thermoplastic, extend the proximal and distal borders to the broken line and allow an extra 1/2 in. (1 cm) around the thumb hole (broken line); when molding, fold back distal and proximal edges and roll back thumb hole 1/2 in. (1 cm). These folds strengthen the orthosis when thin thermoplastic is used and create smooth edges. After molding, the distal edge terminates just proximal to second metacarpal head and 1/4 in. (1/2 cm) proximal to fifth metacarpal head.

- Author/Association: Walker WC, Metzler M, Cifu DX, Swartz Z Title: Neutral wrist splinting in carpal tunnel syndrome: a comparison of night-only versus full-time wear instructions Source: Archives of Physical Medicine and Rehabilitation 2000 Apr;81(4):424-429 Method: clinical trial Method Score: 3/10 [Eligibility criteria: Yes; Random allocation: No; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To compare the effects of night-only to full-time splint wear instructions on symptoms, function, and impairment in carpal tunnel syndrome (CTS). DESIGN: Randomized clinical trial with 6-week follow-up. SETTING: Veterans Administration Medical Center, outpatient clinic. SUBJECTS: Outpatients with untreated CTS were consecutively recruited from our electrodiagnostics lab. Twenty-one patients (30 hands) were enrolled, and 17 patients (24 hands) completed the study. INTERVENTIONS: Thermoplastic, custom-molded, neutral wrist splints with subjects receiving either full-time or night-only wear instructions. OUTCOME MEASURES: Symptoms and functional deficits were measured by Levine's self-administered questionnaire, and physiologic impairment was measured by median nerve sensory and motor distal latency. Compliance and Crossover: Almost all (92%) of the combined sample reported frequent splint use, but their adherence to specific wearing instructions was limited. A majority (73%) of the full-time group reported splint wear less than one half of waking hours, and some (23%) of the night-only group reported occasional daytime wear. Despite this tendency for treatment crossover, the two treatment groups differed in daytime wear as intended (chi2 analysis, p = 0.004). RESULTS: The combined sample improved in three of four outcome measures: sensory distal latency (mean 0.28msec, standard deviation [SD] 0.37, p = 0.004), symptom severity (mean 0.64, SD 0.46, p = 0.0001), and functional deficits (mean 0.49, SD 0.51, p = 0.0001). Severity of CTS was a factor only in sensory distal latency improvement (more improvement in severe CTS). Subjects receiving full-time wear instructions showed superior distal latency improvement, both motor (0.35 versus -0.07msec, p = 0.04) and sensory (0.46 versus 0.13msec, p = 0.05) when compared with subjects receiving night-only wear instructions. CONCLUSIONS: This study provides added scientific evidence to support the efficacy of neutral wrist splints in CTS and suggests that physiologic improvement is best with full-time splint wear instructions.

Tendon Gliding exercises

- Facilitate isolated excursion of each of the 2 flexor tendons to each finger passing through carpal tunnel.
- Each exercise is initiated from a position of full finger and wrist extension.
- To obtain maximum differential gliding of profundus with respect to superficialis excursion, the patient assumes hooked fist position.
- To obtain maximum FDS excursion, the patient is instructed to flex the MCP & PIP joints while maintaining DIP in extension.
- A full fist exercise completes the series of tendon-gliding exercises and provides maximum profundus tendon excursion.
- *Exercises are performed 5 times each, 5 times daily.*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- Author/Association: Piazzini DB, Aprile I, Ferrara PE, Bertolini C, Tonali P, Maggi L, Rabini A, Piantelli S, Padua L Title: A systematic review of conservative treatment of carpal tunnel syndrome [with consumer summary] Source: Clinical Rehabilitation 2007 Apr;21(4):299-314 Method: systematic review Method Score: This is a systematic review. Systematic reviews are not rated. Consumer Summary: CLINICAL MESSAGES: For people with carpal tunnel syndrome there is strong evidence that steroids are effective by local injection (in the short term) or orally (but with side-effects). There is moderate evidence that vitamin B6 is ineffective and that splints are effective. There is limited or conflicting evidence that NSAIDs, diuretics, yoga, laser and ultrasound are effective. Exercise therapy and botulinum toxin B injection are ineffective. Abstract: OBJECTIVE: To assess the effectiveness of conservative therapy in carpal tunnel syndrome. DATA SOURCES: A computer-aided search of MEDLINE and the Cochrane Collaboration was conducted for randomized controlled trials (RCTs) from January 1985 to May 2006. REVIEW METHODS: RCTs were included if: (1) the patients, with clinically and electrophysiologically confirmed carpal tunnel syndrome, had not previously undergone surgical release, (2) the efficacy of one or more conservative treatment options was evaluated, (3) the study was designed as a randomized controlled trial. Two reviewers independently selected the studies and performed data extraction using a standardized form. In order to assess the methodological quality, the criteria list of the Cochrane Back Review Group for systematic reviews was applied. The different treatment methods were grouped (local injections, oral therapies, physical therapies, therapeutic exercises and splints). RESULTS: Thirty-three RCTs were included in the review. The studies were analysed to determine the strength of the available evidence for the efficacy of the treatment. Our review shows that: (1) locally injected steroids produce a significant but temporary improvement, (2) vitamin B6 is ineffective, (3) steroids are better than non-steroidal anti-inflammatory drugs (NSAIDs) and diuretics, but they can produce side-effects, (4) ultrasound is effective while laser therapy shows variable results, (5) exercise therapy is not effective, (6) splints are effective, especially if used full-time. CONCLUSION: There is: (1) strong evidence (level 1) on efficacy of local and oral steroids; (2) moderate evidence (level 2) that vitamin B6 is ineffective and splints are effective and (3) limited or conflicting evidence (level 3) that NSAIDs, diuretics, yoga, laser and ultrasound are effective whereas exercise therapy and botulinum toxin B injection are ineffective.

- Author/Association: O'Connor D, Marshall S, Massy-Westropp N Title: Non-surgical treatment (other than steroid injection) for carpal tunnel syndrome (Cochrane review) [with consumer summary] Source: Cochrane Database of Systematic Reviews 2003;Issue 1 Method: systematic review Method Score: This is a systematic review. Systematic reviews are not rated. Consumer Summary: PLAIN LANGUAGE SUMMARY: Oral steroids, splinting, ultrasound, yoga and wrist mobilisation provide short-term relief from carpal tunnel syndrome, but other non-surgical methods have not been shown to help. Carpal tunnel syndrome is caused by compression of the median nerve at the wrist, leading to mild to severe pain and pins and needles in the hand. Other Cochrane reviews show benefit from nerve decompression surgery and steroids. This review of other non-surgical treatments found some evidence of short-term benefit from oral steroids, splinting/hand braces, ultrasound, yoga and carpal bone mobilisation (movement of the bones and tissues in the wrist), and insulin and steroid injections for people who also had diabetes. Evidence on ergonomic keyboards and vitamin B6 is unclear, while trials so far have not shown benefit from diuretics, non-steroidal anti-inflammatory drugs, magnets, laser acupuncture, exercise or chiropractic. Abstract: BACKGROUND: Non-surgical treatment for carpal tunnel syndrome is frequently offered to those with mild to moderate symptoms. The effectiveness and duration of benefit from non-surgical treatment for carpal tunnel syndrome remain unknown. OBJECTIVES: To evaluate the effectiveness of non-surgical treatment (other than steroid injection) for carpal tunnel syndrome versus a placebo or other non-surgical, control interventions in improving clinical outcome. SEARCH STRATEGY: We searched the Cochrane Neuromuscular Disease Group specialised register (searched March 2002), MEDLINE (searched January 1966 to February 7 2001), EMBASE (searched January 1980 to March 2002), CINAHL (searched January 1983 to December 2001), AMED (searched 1984 to January 2002), Current Contents (January 1993 to March 2002), PEDro and reference lists of articles. SELECTION CRITERIA: Randomised or quasi-randomised studies in any language of participants with the diagnosis of carpal tunnel syndrome who had not previously undergone surgical release. We considered all non-surgical treatments apart from local steroid injection. The primary outcome measure was improvement in clinical symptoms after at least three months following the end of treatment. DATA COLLECTION AND ANALYSIS: Three reviewers independently selected the trials to be included. Two reviewers independently extracted data. Studies were rated for their overall quality. Relative risks and weighted mean differences with 95% confidence intervals were calculated for the primary and secondary outcomes in each trial. Results of clinically and statistically homogeneous trials were pooled to provide estimates of the efficacy of non-surgical treatments. MAIN RESULTS: Twenty-one trials involving 884 people were included. A hand brace significantly improved symptoms after four weeks (weighted mean difference (WMD) -1.07; 95% confidence interval (CI) -1.29 to -0.85) and function (WMD -0.55; 95% CI -0.82 to -0.28). In an analysis of pooled data from two trials (63 participants) ultrasound treatment for two weeks was not significantly beneficial. However one trial showed significant symptom improvement after seven weeks of ultrasound (WMD -0.99; 95% CI -1.77 to - 0.21) which was maintained at six months (WMD -1.86; 95% CI -2.67 to -1.05). Four trials involving 193 people examined various oral medications (steroids, diuretics, nonsteroidal anti-inflammatory drugs) versus placebo. Compared to placebo, pooled data for two-week oral steroid treatment demonstrated a significant improvement in symptoms (WMD -7.23; 95% CI -10.31 to -4.14). One trial also showed improvement after four weeks (WMD -10.8; 95% CI -15.26 to -6.34). Compared to placebo, diuretics or nonsteroidal anti-inflammatory drugs did not demonstrate significant benefit. In two trials involving 50 people, vitamin B6 did not significantly improve overall symptoms. In one trial involving 51 people yoga significantly reduced pain after eight weeks (WMD -1.40; 95% CI -2.73 to -0.07) compared with wrist splinting. In one trial involving 21 people carpal bone mobilisation significantly improved symptoms after three weeks (WMD -1.43; 95% CI -2.19 to -0.67) compared to no treatment. In one trial involving 50 people with diabetes, steroid and insulin injections significantly improved symptoms over eight weeks compared with steroid and placebo injections. Two trials involving 105 people compared ergonomic keyboards versus control and demonstrated equivocal results for pain and function. Trials of magnet therapy, laser acupuncture, exercise or chiropractic care did not demonstrate symptom benefit when compared to placebo or control. AUTHORS' CONCLUSIONS: Current evidence shows significant short-term benefit from oral steroids, splinting, ultrasound, yoga and carpal bone mobilisation. Other non-surgical treatments do not produce significant benefit. More trials are needed to compare treatments and ascertain the duration of benefit.

- Author/Association: Ebenbichler GR, Resch KL, Nicolakis P, Wiesinger GF, Uhl F, Ghanem AH, Fialka V Title: Ultrasound treatment for treating the carpal tunnel syndrome: randomised "sham" controlled trial [with consumer summary] Source: BMJ 1998 Mar 7;316(7133):731-735 Method: clinical trial Method Score: 8/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: Yes; Blind therapists: Yes; Blind assessors: Yes; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Consumer Summary: KEY MESSAGES: Chronic entrapment of the median nerve at the wrist (the carpal tunnel syndrome) is probably the most common peripheral nerve lesion. No satisfactory conservative treatment is available at present. Twenty sessions of ultrasound treatment show good short and medium term efficacy in patients with bilateral, mild to moderate forms of the carpal tunnel syndrome. Optimal treatment schedules of ultrasound treatment alone or in combination with other non-surgical treatments await elucidation. Abstract: OBJECTIVE: To assess the efficacy of ultrasound treatment for mild to moderate idiopathic carpal tunnel syndrome. DESIGN: Randomised, double blind, "sham" controlled trial with assessments at baseline, after 2 weeks' and 7 weeks' treatment, and at a follow up assessment 6 months later (8 months after baseline evaluation). SETTING: Outpatient clinic of a university department of physical medicine and rehabilitation in Vienna. SUBJECTS: 45 patients with mild to moderate bilateral carpal tunnel syndrome as verified by electroneurography. INTERVENTION: 20 sessions of ultrasound (active) treatment (1 MHz, 1.0 W/cm2, pulsed mode 1:4, 15 minutes per session) applied to the area over the carpal tunnel of one wrist, and indistinguishable sham ultrasound treatment applied to the other. The first 10 treatments were performed daily (5 sessions/week); 10 further treatments were twice weekly for 5 weeks. MAIN OUTCOME MEASURES: Score of subjective symptom ratings assessed by visual analogue scale; electroneurographic measures (for example, motor distal latency and sensory antidromic nerve conduction velocity). RESULTS: Improvement was significantly more pronounced in actively treated than in sham treated wrists for both subjective symptoms ($p < 0.001$, paired t test) and electroneurographic variables (motor distal latency $p < 0.001$, paired t test; sensory antidromic nerve conduction velocity $p < 0.001$, paired t test). Effects were sustained at 6 months' follow up. CONCLUSION: Results suggest there are satisfying short to medium term effects due to ultrasound treatment in patients with mild to moderate idiopathic carpal tunnel syndrome. Findings need to be confirmed, and ultrasound treatment will have to be compared with standard conservative and invasive treatment options.

- Author/Association: Burke J, Buchberger DJ, Carey-Loghmani MT, Dougherty PE, Greco DS, Dishman JD Title: A pilot study comparing two manual therapy interventions for carpal tunnel syndrome [with consumer summary] Source: Journal of Manipulative and Physiological Therapeutics 2007 Jan;30(1):50-61 Method: clinical trial Method Score: 5/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Consumer Summary: PRACTICAL APPLICATIONS: Manual therapy interventions improve signs and symptoms of CTS. Abstract: OBJECTIVE: The purpose of this study was to determine the clinical efficacy of manual therapy interventions for relieving the signs and symptoms of carpal tunnel syndrome (CTS) by comparing 2 forms of manual therapy techniques: Graston Instrument-assisted soft tissue mobilization (GISTM) and STM administered with the clinician hands. METHODS: The study was a prospective comparative research design in the setting of a research laboratory. Volunteers were recruited with symptoms suggestive of CTS based upon a phone interview and confirmed by electrodiagnostic study findings, symptom characteristics, and physical examination findings during an initial screening visit. Eligible patients with CTS were randomly allocated to receive either GISTM or STM. Interventions were, on average, twice a week for 4 weeks and once a week for 2 additional weeks. Outcome measures included (1) sensory and motor nerve conduction evaluations of the median nerve; (2) subjective pain evaluations of the hand using visual analog scales and Katz hand diagrams; (3) self-reported ratings of symptom severity and functional status; and (4) clinical assessments of sensory and motor functions of the hand via physical examination procedures. Parametric and nonparametric statistics compared treated CTS hand and control hand and between the treatment interventions, across time (baseline, immediate post, and at 3 months' follow-up). RESULTS: After both manual therapy interventions, there were improvements to nerve conduction latencies, wrist strength, and wrist motion. The improvements detected by our subjective evaluations of the signs and symptoms of CTS and patient satisfaction with the treatment outcomes provided additional evidence for the clinical efficacy of these 2 manual therapies for CTS. The improvements were maintained at 3 months for both treatment interventions. Data from the control hand did not change across measurement time points. CONCLUSIONS: Although the clinical improvements were not different between the 2 manual therapy techniques, which were compared prospectively, the data substantiated the clinical efficacy of conservative treatment options for mild to moderate CTS.

- **Ergonomic and physiotherapeutic interventions for treating work-related complaints of the arm, neck or shoulder in adults.**
- **Background**

  Conservative interventions such as physiotherapy and ergonomic adjustments (such as keyboard adjustments or ergonomic advice) play a major role in the treatment of most work-related complaints of the arm, neck or shoulder (CANS).
- **Objectives**

  This systematic review aims to determine whether conservative interventions have a significant impact on outcomes for work-related CANS in adults.
- **Search strategy**

  We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (March 2005) and Cochrane Rehabilitation and Related Therapies Field Specialised Register (March 2005), the Cochrane Controlled Trials Register (*The Cochrane Library*, Issue 1, 2005), PubMed, EMBASE, CINAHL, AMED and reference lists of articles. The date of the last search was March 2005. No language restrictions were applied.
- **Selection criteria**

  We included randomised and non-randomised controlled trials studying conservative interventions (e.g. exercises, relaxation, physical applications, biofeedback, myofeedback and work-place adjustments) for adults suffering CANS.
- **Data collection and analysis**

  Two authors independently selected trials from the search yield, assessed the methodological quality using the Delphi list, and extracted relevant data. We pooled data or, in the event of clinical heterogeneity or lack of data, we used a rating system to assess levels of evidence.
- **Main results**
- For this update we included six additional studies; 21 trials in total. Seventeen trials included people with chronic non-specific neck or shoulder complaints, or non-specific upper extremity disorders. Over 25 interventions were evaluated; five main subgroups of interventions could be determined: exercises, manual therapy, massage, ergonomics, and energised splint. Overall, the quality of the studies was poor.
- In 14 studies a form of exercise was evaluated, and contrary to the previous review we now found limited evidence about the effectiveness of exercises when compared to massage and conflicting evidence when exercises are compared to no treatment. In this update there is limited evidence for adding breaks during computer work; massage as add-on treatment on manual therapy, manual therapy as add-on treatment on exercises; and some keyboard designs when compared to other keyboards or placebo in participants with carpal tunnel syndrome.
- **Authors' conclusions**

  There is limited evidence for the effectiveness of keyboards with an alternative force-displacement of the keys or an alternative geometry, and limited evidence for the effectiveness of exercises compared to massage; breaks during computer work compared to no breaks; massage as an add-on treatment to manual therapy; and manual therapy as an add-on treatment to exercises.

- Author/Association: McKeon JMM, Yancosek KE Title: Neural gliding techniques for the treatment of carpal tunnel syndrome: a systematic review Source: Journal of Sport Rehabilitation 2008 Aug;17(3):324-341 Method: systematic review Method Score: This is a systematic review. Systematic reviews are not rated. Abstract: CONTEXT: There are discrepancies regarding the efficacy of neural gliding exercises for the management of carpal tunnel syndrome (CTS). OBJECTIVE: To conduct a systematic review assessing the efficacy of neural gliding in comparison to alternative nonsurgical treatment for the management of CTS. EVIDENCE ACQUISITION: A computerized search was performed in April 2008. Criteria for inclusion required that studies (1) were written in English, (2) examined the efficacy of neural gliding techniques for treatment of CTS, and (3) included at least one of the selected patient-oriented outcomes. Effect sizes, relative risk, and 95% confidence intervals were calculated to compare neural gliding to alternative treatment. EVIDENCE SYNTHESIS: Six studies met inclusion criteria. For all variables, none were consistently favorable toward neural gliding over alternative treatment. However, comparisons across studies revealed a possible trend toward improved outcomes with the use neural gliding. CONCLUSIONS: The efficacy of neural gliding is not clear. More research is necessary to determine the population that may respond optimally to this treatment.

- Author/Association: Naeser MA, Hahn KK, Lieberman BE, Branco KF Title: Carpal tunnel syndrome pain treated with low-level laser and microamperes transcutaneous electric nerve stimulation: a controlled study Source: Archives of Physical Medicine and Rehabilitation 2002 Jul;83(7):978-988 Method: clinical trial Method Score: 7/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: Yes; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: Yes; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To investigate whether real or sham low-level laser therapy (LLLT) plus microamperes transcutaneous electric nerve stimulation (TENS) applied to acupuncture points significantly reduces pain in carpal tunnel syndrome (CTS). DESIGN: Randomized, double-blind, placebo-control, crossover trial. Patients and staff administered outcome measures blinded. SETTING: Outpatient, university-affiliated Department of Veterans Affairs medical center. PARTICIPANTS: Eleven mild to moderate CTS cases (nerve conduction study, clinical examination) who failed standard medical or surgical treatment for 3 to 30 months. INTERVENTION: Patients received real and sham treatment series (each for 3 to 4wk), in a randomized order. Real treatments used red-beam laser (continuous wave, 15mW, 632.8nm) on shallow acupuncture points on the affected hand, infrared laser (pulsed, 9.4W, 904nm) on deeper points on upper extremity and cervical paraspinal areas, and microamps TENS on the affected wrist. Devices were painless, noninvasive, and produced no sensation whether they were real or sham. The hand was treated behind a hanging black curtain without the patient knowing if devices were on (real) or off (sham). MAIN OUTCOME MEASURES: McGill Pain Questionnaire (MPQ) score, sensory and motor latencies, and Phalen and Tinel signs. RESULTS: Significant decreases in MPQ score, median nerve sensory latency, and Phalen and Tinel signs after the real treatment series but not after the sham treatment series. Patients could perform their previous work (computer typist, handyman) and were stable for 1 to 3 years. CONCLUSIONS: This new, conservative treatment was effective in treating CTS pain; larger studies are recommended.

- Author/Association: Garfinkel MS, Singhal A, Katz WA, Allan DA, Reshetar R, Schumacher HR Jr Title: Yoga-based intervention for carpal tunnel syndrome: a randomized trial Source: JAMA 1998 Nov 11;280(18):1601-1603 Method: clinical trial Method Score: 6/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: CONTEXT: Carpal tunnel syndrome is a common complication of repetitive activities and causes significant morbidity. OBJECTIVE: To determine the effectiveness of a yoga-based regimen for relieving symptoms of carpal tunnel syndrome. DESIGN: Randomized, single-blind, controlled trial. SETTING: A geriatric center and an industrial site in 1994 to 1995. PATIENTS: Forty-two employed or retired individuals with carpal tunnel syndrome (median age, 52 years; range, 24 to 77 years). INTERVENTION: Subjects assigned to the yoga group received a yoga-based intervention consisting of 11 yoga postures designed for strengthening, stretching, and balancing each joint in the upper body along with relaxation given twice weekly for 8 weeks. Patients in the control group were offered a wrist splint to supplement their current treatment. MAIN OUTCOME MEASURES: Changes from baseline to 8 weeks in grip strength, pain intensity, sleep disturbance, Phalen sign, and Tinel sign, and in median nerve motor and sensory conduction time. RESULTS: Subjects in the yoga groups had significant improvement in grip strength (increased from 162 to 187 mmHg; p = 0.009) and pain reduction (decreased from 5.0 to 2.9 mm; p = 0.02), but changes in grip strength and pain were not significant for control subjects. The yoga group had significantly more improvement in Phalen sign (12 improved versus 2 in control group; p = 0.008), but no significant differences were found in sleep disturbance, Tinel sign, and median nerve motor and sensory conduction time. CONCLUSION: In this preliminary study, a yoga-based regimen was more effective than wrist splinting or no treatment in relieving some symptoms and signs of carpal tunnel syndrome

- Author/Association: Davis PT, Hulbert JR, Kassak KM, Meyer JJ Title: Comparative efficacy of conservative medical and chiropractic treatments for carpal tunnel syndrome: a randomized clinical trail Source: Journal of Manipulative and Physiological Therapeutics 1998 Jun;21(5):317-326 Method: clinical trial Method Score: 6/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To compare the efficacy of conservative medical care with chiropractic care in the treatment of carpal tunnel syndrome. DESIGN: Two-group, randomized, single-blind trial with 9 wk of treatment and a 1-month follow-up interview. SETTING: Wolfe-Harris Center for Clinical Studies at Northwestern College of Chiropractic in Bloomington, Minnesota. PATIENTS: Ninety-one of 96 eligible subjects who reported symptoms that were confirmed by clinical exam and nerve conduction studies. INTERVENTIONS: Interventions included ibuprofen (800 mg 3 times a day for 1 wk, 800 mg twice a day for 1 wk and 800 mg as needed to a maximum daily dose of 2400 mg for 7 wk) and nocturnal wrist supports for medical treatment. Chiropractic treatment included manipulation of the soft tissues and bony joints of the upper extremities and spine (three treatments/week for 2 wk, two treatments/week for 3 wk and one treatment/week for 4 wk), ultrasound over the carpal tunnel and nocturnal wrist supports. MAIN OUTCOME MEASURES: Outcome measures were pre- and post-assessments of self-reported physical and mental distress, nerve conduction studies and vibrometry. RESULTS: There was significant improvement in perceived comfort and function, nerve conduction and finger sensation overall, but no significant differences between groups in the efficacy of either treatment. CONCLUSIONS: Carpal tunnel syndrome associated with median nerve demyelination but not axonal degeneration may be treated with commonly used components of conservative medical or chiropractic care.

- Author/Association: Brininger TL, Rogers JC, Holm MB, Baker NA, Li Z-M, Goitz RJ Title: Efficacy of a fabricated customized splint and tendon and nerve gliding exercises for the treatment of carpal tunnel syndrome: a randomized controlled trial Source: Archives of Physical Medicine and Rehabilitation 2007 Nov;88(11):1429-1435 Method: clinical trial Method Score: 5/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: No. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To compare the effects of a neutral wrist and metacarpophalangeal (MCP) splint with a wrist cock-up splint, with and without exercises, for the treatment of carpal tunnel syndrome (CTS). DESIGN: A 2x2x3 randomized factorial design with 3 main factors: splint (neutral wrist and MCP and wrist cock-up), exercise (exercises, no exercise), and time (baseline, 4wk, 8wk). SETTING: Subjects were evaluated in an outpatient hand therapy clinic. PARTICIPANTS: Sixty-one subjects with mild to moderate CTS; 51 subjects completed the study. INTERVENTIONS: There were 4 groups: the neutral wrist and MCP group and the neutral wrist and MCP-exercise group received fabricated customized splints that supported the wrist and MCP joints; the wrist cock-up group and the wrist cock-up-exercise group received wrist cock-up splints. The neutral wrist and MCP-exercise and wrist cock-up-exercise groups also received tendon and nerve gliding exercises and were instructed to perform exercises 3 times a day. All subjects were instructed to wear the assigned splint every night for 4 weeks. MAIN OUTCOME MEASURES: We used the CTS Symptom Severity Scale (SSS) and the Functional Status Scale (FSS) to assess CTS symptoms and functional status. RESULTS: Analysis of variance showed a significant main effect for splint and time on the SSS ($p < 0.001$, $p = 0.014$) and FSS ($p < 0.001$, $p = 0.029$), respectively. There were no interaction effects. CONCLUSIONS: Our results validate the use of wrist splints for the treatment of CTS, and suggest that a splint that supports the wrist and MCP joints in neutral may be more effective than a wrist cock-up splint.

- Author/Association: Akalin E, El O, Peker O, Senocak O, Tamci S, Gulbahar S, Cakmur R, Oncel S Title: Treatment of carpal tunnel syndrome with nerve and tendon gliding exercises Source: American Journal of Physical Medicine & Rehabilitation 2002;81(2):108-113 Method: clinical trial Method Score: 5/10 [Eligibility criteria: No; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: Yes; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To assess the effect of nerve and tendon gliding exercises in carpal tunnel syndrome. DESIGN: The study was a prospective, randomized, before-and-after treatment trial. A total of 28 patients with the diagnosis of carpal tunnel syndrome in 36 hands were randomly assigned to two groups. A custom made neutral volar wrist splint was given to group 1 and group 2. The patients were instructed to wear the splints all night and during the day as much as possible for 4 wk. The patients in group 2 were also instructed to perform series of nerve and tendon gliding exercises in addition to the splint treatment. Patients were evaluated with clinical parameters, a functional status scale, and a symptom severity scale. RESULTS: At the end of treatment, statistically significant improvement was obtained in all parameters in both groups. The improvement in group 2 was slightly greater, but the difference between the groups was not significant, except for the lateral pinch strength value. Patient satisfaction was investigated during the follow-up period, ranging from 5 to 11 mo, with a mean of 8 mo. A total of 72% of the patients in group 1 and 93% of the patients in group 2 reported good or excellent results. The difference between the two groups was not statistically significant. CONCLUSION: Although the results in group 2 were better than group 1, the difference was not statistically significant. Further investigations are required to establish the role of nerve and tendon gliding exercises in the treatment of carpal tunnel syndrome.

- Author/Association: Tal-Akabi A, Rushton A Title: An investigation to compare the effectiveness of carpal bone mobilisation and neurodynamic mobilisation as methods of treatment for carpal tunnel syndrome Source: Manual Therapy 2000 Nov;5(4):214-222 Method: clinical trial Method Score: 4/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: Yes; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: No. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: Carpal tunnel syndrome is the most common peripheral entrapment neuropathy. There is little literature available that addresses the management of this condition, which may partly explain why physiotherapy is often overlooked as a treatment approach in its management. This study investigated the effects of two manual therapy techniques in the treatment of patients experiencing carpal tunnel syndrome. An experimental different subject design compared three groups of subjects in three different conditions (two treatment interventions and one control group). Each group consisted of seven patients. The objectives of the study were: (1) to investigate differences between treated and untreated groups; (2) to investigate differences in the effectiveness of treatment I (median nerve mobilization) compared with treatment II (carpal bone mobilization). Measurements were taken applying several measurement tools, including active range of wrist movement (ROM flexion and extension), upper limb tension test with a median nerve bias (ULTT2a), three different scales to evaluate pain perception and function, and lastly numbers of patients continuing to surgery in each group were compared. In visual terms a clear trend was demonstrated between subjects who received treatment compared to those who were not treated, in particular the descriptive analysis of results for ULTT2a and numbers of patients continuing to surgery. When analysed statistically, less could be concluded. Only scores on a Pain Relief Scale ($p < 0.01$) demonstrated highly significant differences between the three groups when analyzed using Kruskal-Wallis Test. In exploring the results of the two intervention groups, no statistically significant difference in effectiveness of treatment was demonstrated between carpal bone mobilization and median nerve mobilization.

- Author/Association: Heebner ML, Roddey TS Title: The effects of neural mobilization in addition to standard care in persons with carpal tunnel syndrome from a community hospital Source: Journal of Hand Therapy 2008 Jul-Sep;21(3):229-241 Method: clinical trial Method Score: 4/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: The purpose of this study was to determine whether neural mobilization in addition to standard care is more effective than standard care alone in the treatment of Carpal Tunnel Syndrome (CTS). Sixty participants were randomly assigned to one of two groups. Group 1 received standard care, and Group 2 performed a neurodynamic mobilization exercise in addition to standard care. Outcomes were assessed at baseline and at one and six months using the Disabilities of the Arm, Shoulder, and Hand Questionnaire, the Brigham and Woman's Hospital Carpal Tunnel Specific Questionnaire (CTSQ), and elbow extension range of motion during an upper limb median nerve tension test. There were no significant differences in the outcome measures between groups, except Group 1 had improved scores on the function status scale of the CTSQ compared to Group 2 at six months. The addition of neural mobilization to standard care did not result in improved outcomes in patients with CTS.

- Author/Association: Werner R, Franzblau A, Gell N Title: Randomized controlled trial of nocturnal splinting for active workers with symptoms of carpal tunnel syndrome Source: Archives of Physical Medicine and Rehabilitation 2005 Jan;86(1):1-7 Method: clinical trial Method Score: 4/10 [Eligibility criteria: Yes; Random allocation: No; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVES: To determine whether nocturnal splinting of workers identified through active surveillance with symptoms consistent with carpal tunnel syndrome (CTS) would improve symptoms and median nerve function as well as impact medical care. DESIGN: Randomized controlled trial. SETTING: A Midwestern auto assembly plant. PARTICIPANTS: Active workers with symptoms suggestive of CTS based on a hand diagram. INTERVENTION: The treatment group received customized wrist splints, which were worn at night for 6 weeks; the control group received ergonomic education alone. MAIN OUTCOME MEASURES: Change in wrist, hand, and/or finger discomfort, carpal tunnel symptom severity index, median sensory nerve function, and the percentage of subjects who had carpal tunnel release surgery. RESULTS: The splinted group, unlike the controls, had a significant reduction in wrist, hand, and/or finger discomfort and a similar trend in the Levine carpal tunnel symptom severity index, which was maintained at 12 months. A secondary analysis showed that more median nerve impairment at baseline was associated with less clinical improvement among controls but not among the splinted group. CONCLUSIONS: Workers identified with CTS symptoms in an active symptom surveillance tended to benefit from a 6-week nocturnal splinting trial, and the benefits were still evident at the 1-year follow-up. The splinted group improved in terms of hand discomfort regardless of the degree of median nerve impairment, whereas the controls showed improvement only among subjects with normal median nerve function. Results suggest that a short course of nocturnal splinting may reduce wrist, hand, and/or finger discomfort among active workers with symptoms consistent with CTS

- Author/Association: Pinar L, Enhos A, Ada S, Gungor N Title: Can we use nerve gliding exercises in women with carpal tunnel syndrome? Source: Advances in Therapy 2005 Sep-Oct;22(5):467-475 Method: clinical trial Method Score: 4/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: This study investigated the effectiveness of nerve gliding exercises used in combination with conservative treatment approaches in patients with carpal tunnel syndrome. A total of 35 hands of 26 patients with carpal tunnel syndrome were divided into 2 groups. Static volar wrist splints were applied to 16 hands in the control group, and these patients were trained to modify their functional activities in accordance with conservative treatment. In the experimental group, nerve gliding exercises were applied to 19 hands that were also treated conservatively. A day-and-night splint, together with the conservative training program, was applied for 6 weeks to both groups. Subsequently, a night splint only was used in both groups, and nerve gliding exercises were continued in the experimental group for the remaining 4 weeks. Pretreatment and posttreatment assessments of pain, sensation, muscle strength, and grip and pinch strength, along with Tinel and Phalen tests, were performed in all cases; electrophysiologic measurements were recorded. Significant progress was detected in both control and experimental groups during the posttreatment phase compared with the initial phase ($p < 0.05$). However, when the 2 groups were compared, the experimental group in which nerve gliding exercises were added to conservative therapy approaches demonstrated more rapid pain reduction; these patients also showed greater functional improvement, especially in grip strength ($p < 0.05$).

- Author/Association: Oztas O, Turan B, Bora I, Karakaya MK Title: Ultrasound therapy effect in carpal tunnel syndrome Source: Archives of Physical Medicine and Rehabilitation 1998 Dec;79(12):1540-1544 Method: clinical trial Method Score: 4/10 [Eligibility criteria: No; Random allocation: Yes; Concealed allocation: No; Baseline comparability: No; Blind subjects: Yes; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: No; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: OBJECTIVE: To investigate the overall effect of repeated ultrasound treatment in carpal tunnel syndrome (CTS). DESIGN: Patient-blinded, placebo-controlled, before-after treatment trial. SETTING: University hospital PM&R department outpatient clinic and neurology department electromyography laboratory. PATIENTS: Eighteen women with diagnosis of CTS in 30 hands. INTERVENTIONS: Three groups, each with 10 cases of CTS, were randomly established. Continuous ultrasound therapy, with intensities of 1.5W/cm2 (group A), 0.8W/cm2 (group B), and 0.0W/cm2 (group C), was applied to palmar carpal tunnel area for 5 minutes, 5 days a week, for 2 weeks. OUTCOME MEASURES: Patients were evaluated clinically and electrophysiologically before and after the treatment. RESULTS: At the end of treatment, statistically significant improvement was obtained in clinical parameters in all groups: pain ($p < 0.05$), pain/paresthesia at night/day ($p < 0.05$), and frequency of awakening at night ($p < 0.05$). Although there was no statistically significant before-after difference in electrophysiologic studies, slightly decreased motor nerve conduction velocity and increased motor distal latency were noted in groups A and B, but not in group C. CONCLUSION: Ultrasound therapy in CTS was comparable to placebo ultrasound in providing symptomatic relief, and the probability of a negative effect on motor nerve conduction needs to be considered.

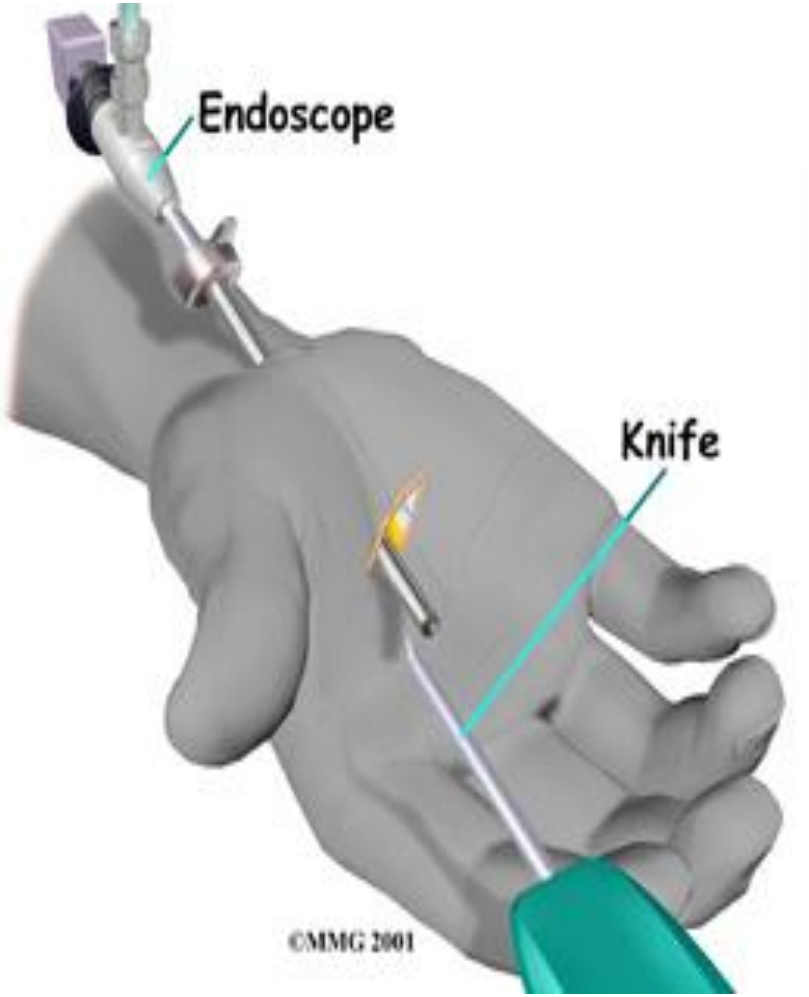
Conventional Carpal Tunnel Release

- Indications: Continued or disabling symptoms with abnormal electrical studies, evidence of muscle weakness or atrophy, and increased two point discrimination.
- Local anaesthesia: 50%-50% combination of lidocaine and marcaine without epinephrine.
- Incision: ulnar to the palmaris longus at the distal wrist crease extended distally in a line trajectory between 3rd and 4th fingers until the base of the thumb (length: 4 cm).
- Avoid injury of any banches of the palmar cutaneous nerve.
- Sectioning of the palmar aponeurosis.
- Identification and sectioning of the transverse carpal ligament.
- Identify anomalous position of the motor branch.
- Avoid injury of the vascular arch while sectioning the distal segment of the transverse carpal ligament.
- Motor branch decompression if significant motor weakness and atrophy are present.
- Neurolysis if it is a reintervention and fibrosis is the presumable cause of failure.


Transverse
carpal
ligament cut

Endoscopic Carpal Tunnel Release

- Similar indications but more limited.
- NOT indicated in: rheumatoid arthritis, significant tenosynovitis, recurrent CTS, concurrent ulnar tunnel syndrome, or space occupying lesion.
- Pain seems to be less.
- Strength improves earlier but overall, no significant benefit over the open release.
- Most common complication: incomplete release.
- Other complications: median nerve injuries, superficial vascular arch injuries, and tendon injuries.


Endoscope
Knife
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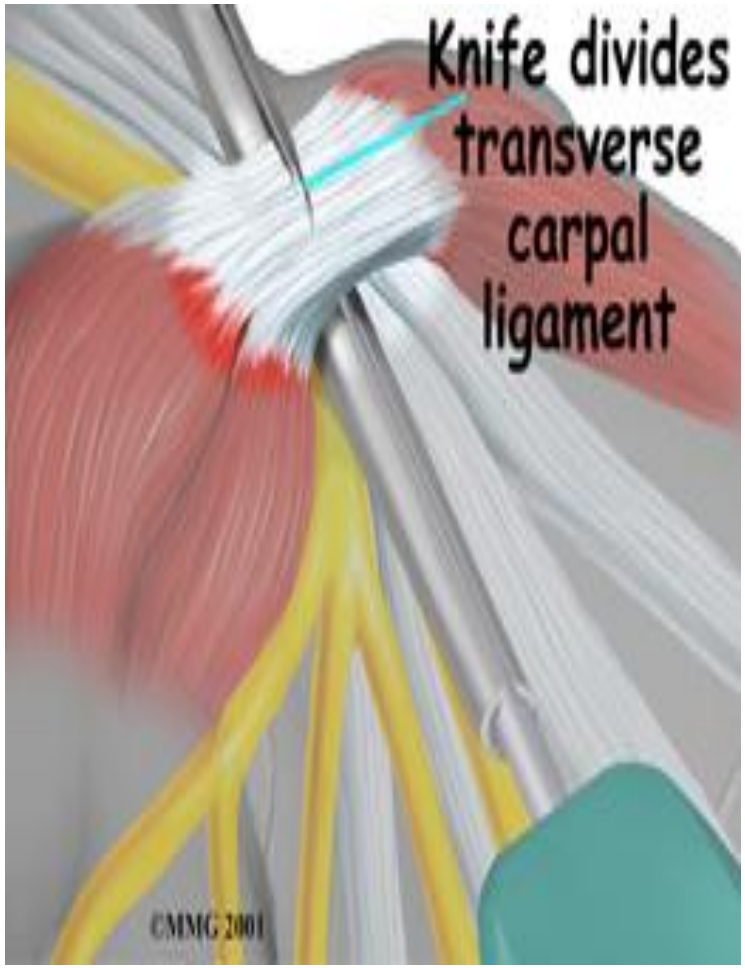
Knife divides transverse carpal ligament
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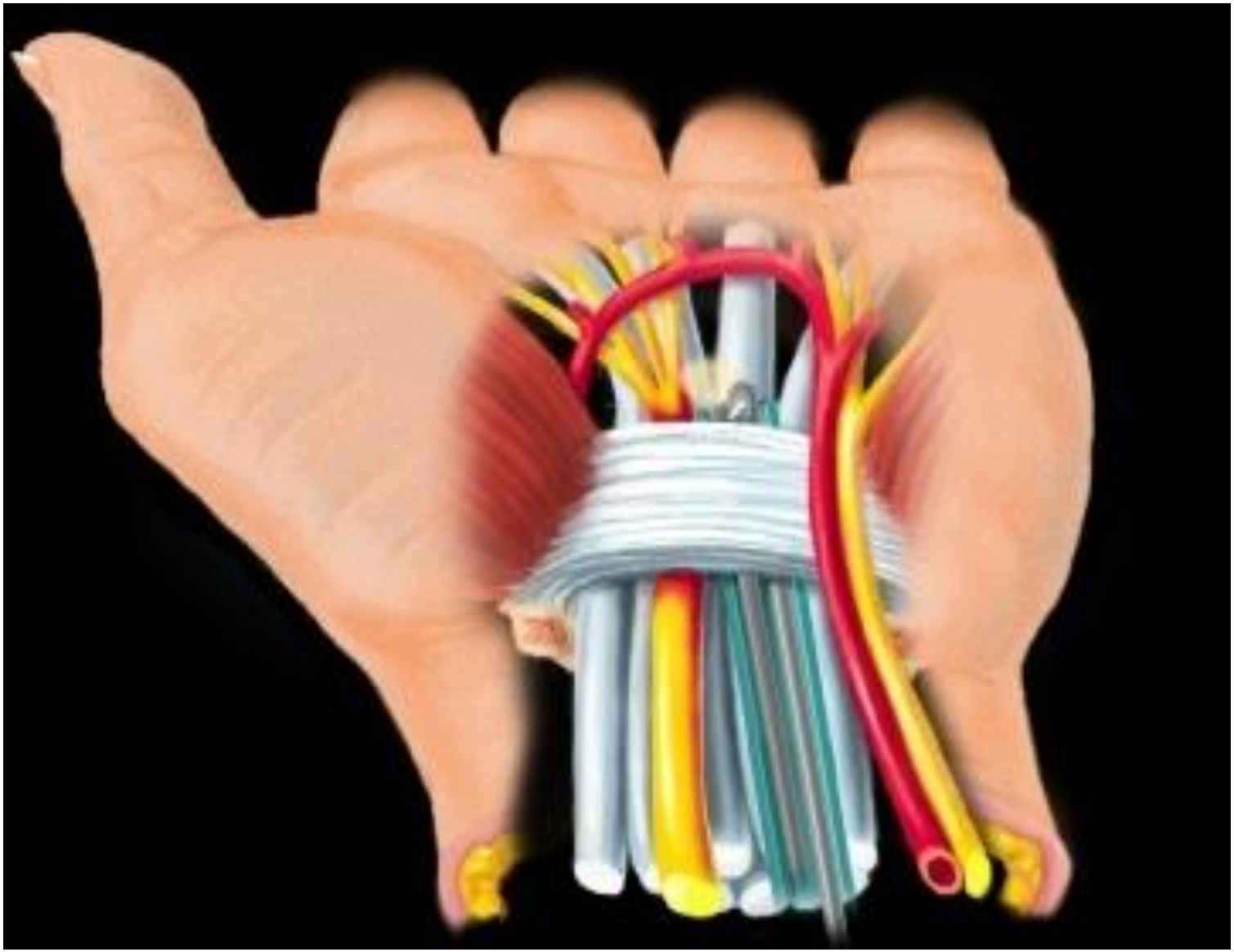


Follow-up after CTS surgery

- Wrist is splinted in extension for 1-3 weeks and fingers are gently exercised.
- Splint is worn at night and during strenuous exercises. (Dawson DM et al, 1990)
- Depending upon the severity of preoperative symptoms , patients may require few or no therapy sessions, moderate interventions (3-8 weeks) or a comprehensive rehabilitation program (8 to 16 weeks).

First 3 weeks

- Goals:
  - Edema control
  - Maintaining ROM
  - Preventing adhesion formation
  - Protected hand use
- Interventions:
  - Elevation of hand
  - Retrograde massage
  - 3 sets of 10 repetitions of tendon –gliding exercises and thumb flexion, extension and opposition exercises, as well as shoulder and elbow exercises.

3 -8 weeks

- Goals:
  - Edema reduction
  - Scar modeling
  - Reduction of hyper sensitivity
  - Increase strength and functional use
- Interventions
  - Elastometer
  - Active and passive exercises are initiated for digits and wrist, if patient lacks full motion.
  - If edema persists – overhead bilateral fisting exercises, 1 set of 20 repetitions per hour.
  - String wrapping & overhead Prehension activities. (Macrame)
  - Nerve gliding exercises & passive thumb stretching of thumb. 3 sets of 10 repetitions daily.(Baxter – Petralia, 1990)
  - 8th week – graded isometric and isotonic strengthening.
  - Avoid over exercising. (Tenosynovitis)
  - Work hardening 8 -12 weeks.

premature return to heavy work can cause local pain, tenosynovitis, painful scarring, and local arthritis.

Nerve Gliding Exercises

- Purpose: prevent scar adhesion, maintain ROM, & muscle strength
- Median nerve slides during movement instead of continually being stretched
- Clenching of digits causes median nerve to slide backwards into the forearm
  - Fingers straight = median nerve out towards hand
  - Backward extension = Out further
- Sliding of median nerve during flexion of wrist & fingers is 2 to 4 times greater at wrist than in upper arm.
- Adhesion between median nerve & flexor tendons result in stretching of the nerve
- Place hand in warm water for 4 mins. & then cold for 1 min. (3-5 times/day)
- Hold stretch for 7 secs. & repeat 5 times each session

Procedure

A: wrist in neutral, fingers & thumb bent in toward palm

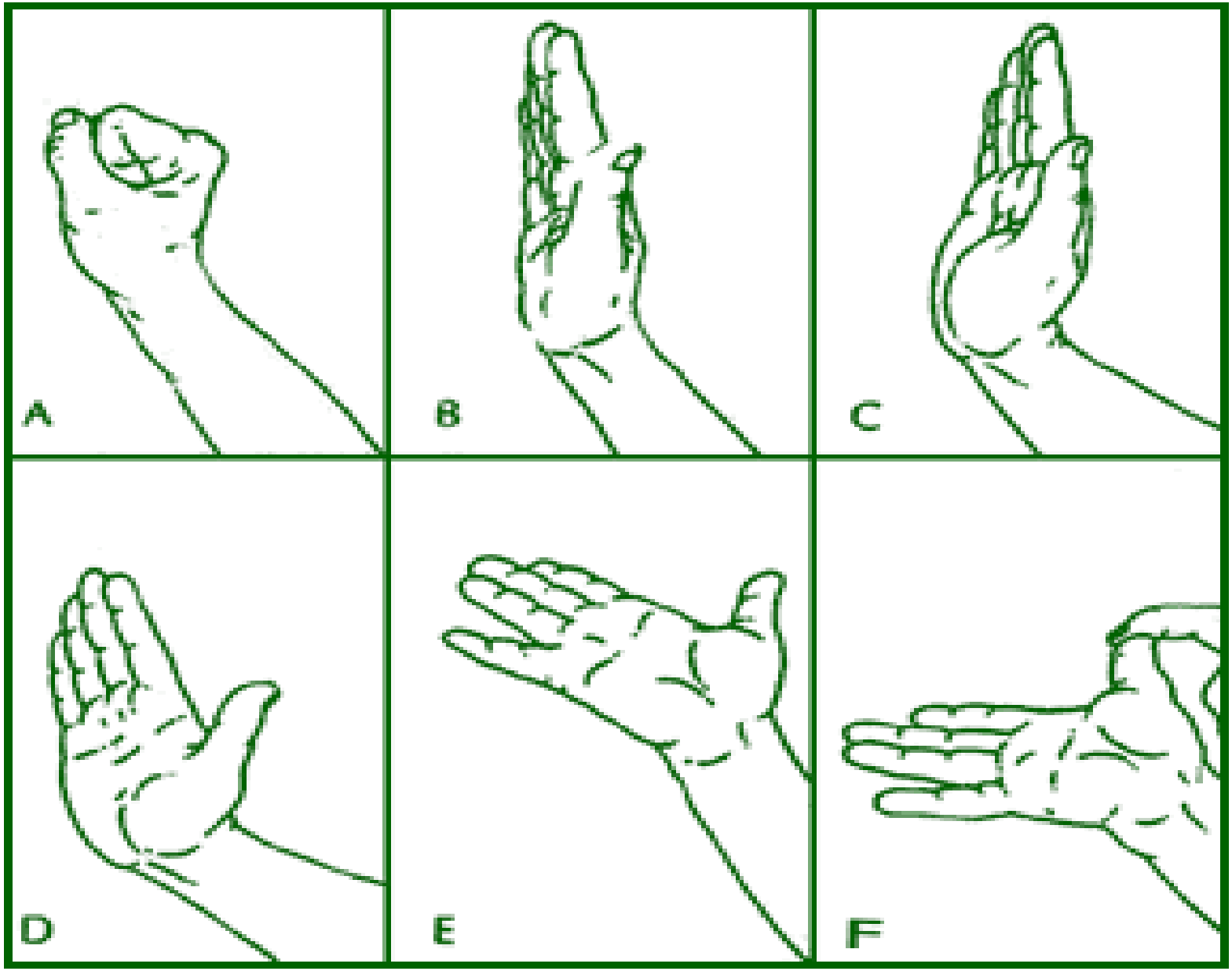
B: wrist in neutral, fingers & thumb straightened

C: wrist & fingers bent backwards, thumb neutral

D: wrist, fingers, & thumb stretched backwards

E: wrist, fingers, & thumb extended & spread, With palm facing ceiling

F: wrist, fingers, & thumb bent backwards, palm facing ceiling & other hand gently stretches thumb outwards


A
B
C
D
E
F

- Pain and paresthesias usually improve in the first several weeks, while weakness and numbness may require 6-9 months for optimal recovery.
- Patients with preoperative thenar involvement are less likely to have resolution of paresthesias after surgery.
- With a median follow-up of 5.5 years, 86% of patients with decompression showed at least partial improvement of NCS.
- Pain is the most significantly improved symptom.
- Poorer outcome has been observed in the heavy labor population, suggesting a need for ergonomic or vocational adjustments if CTS to be relieved.
- Following surgery, NCS abnormalities typically improve, although complete normalization does not always occur.
- Return to work: open surgery – 1-6 weeks; endoscopic repair- 1-3 weeks.

Splinting After Surgery

- **Wrist Immobilization Splint**
  - A volar splint with the wrist in a neutral or *slightly extended position*
- **Goal:** minimize pressure on median nerve, provide support during activities, maintain gains from exercise, and rest the extremity during the healing phase.
- "There is no consistent protocol… some physicians do not prescribe splints at all. Others may recommend a wrist immobilization splint 1 week after surgery with the therapist providing instructions for splint-wearing schedule..." (Coppard & Lohman, 2001)

- **Mixed Evidence:**
- Patients randomized to 2 weeks of wrist splinting or bulky dressing only.
  - No differences between groups on patient satisfaction, strength, complication rates, range of motion (Bury, Akelman, & Weiss, 1995).
- Patients randomized to splinting of the wrist or range-of-motion exercises (wrist and fingers are exercised separately to avoid bowstringing) for 2 weeks
  - Patient that had splinting had delays in return to ADLs and work, delayed recovery of strength, and increased pain and scar tenderness in the first month (Cook, Szabo, Birkhotz, & King, 1995).

- Author/Association: Verdugo RJ, Salinas RA, Castillo JL, Cea JG Title: Surgical versus non-surgical treatment for carpal tunnel syndrome (Cochrane review) [with consumer summary] Source: Cochrane Database of Systematic Reviews 2008;Issue 4 Method: systematic review Method Score: This is a systematic review. Systematic reviews are not rated. Consumer Summary: PLAIN LANGUAGE SUMMARY: Surgical versus non-surgical treatment for carpal tunnel syndrome. Carpal tunnel syndrome is caused by compression of the median nerve which goes through the carpal tunnel in the wrist. It causes tingling, numbness and pain, mostly in the hand. Treatment is controversial. This review aimed to compare surgical decompression with non-surgical treatments such as splinting or corticosteroid injections. Four trials were found and included, while three are awaiting assessment. The results suggest that surgical treatment is probably better than splinting but it is unclear whether it is better than steroid injection. Further research is needed for those with mild symptoms. Abstract: BACKGROUND: Carpal tunnel syndrome results from entrapment of the median nerve in the wrist. Common symptoms are tingling, numbness, and pain in the hand that may radiate to the forearm or shoulder. Most symptomatic cases are treated non-surgically. OBJECTIVES: The objective is to compare the efficacy of surgical treatment of carpal tunnel syndrome with non-surgical treatment. SEARCH STRATEGY: We searched the Cochrane Neuromuscular Disease Group Trials Register (January 2008), MEDLINE (January 1966 to January 2008), EMBASE (January 1980 to January 2008) and LILACS (January 1982 to January 2008). We checked bibliographies in papers and contacted authors for information about other published or unpublished studies. SELECTION CRITERIA: We included all randomised and quasi-randomised controlled trials comparing any surgical and any non-surgical therapies. DATA COLLECTION AND ANALYSIS: Two authors independently assessed the eligibility of the trials. MAIN RESULTS: In this update we found four randomised controlled trials involving 317 participants in total. Three of them including 295 participants, 148 allocated to surgery and 147 to non-surgical treatment reported information on our primary outcome (improvement at three months of follow-up). The pooled estimate favoured surgery (RR 1.23, 95% CI 1.04 to 1.46). Two trials including 245 participants described outcome at six month follow-up, also favouring surgery (RR 1.19, 95% CI 1.02 to 1.39). Two trials reported clinical improvement at one year follow-up. They included 198 patients favouring surgery (RR 1.27, 95% CI 1.05 to 1.53). The only trial describing changes in neurophysiological parameters in both groups also favoured surgery (RR 1.44, 95% CI 1.05 to 1.97). Two trials described need for surgery during follow-up, including 198 patients. The pooled estimate for this outcome indicates that a significant proportion of people treated medically will require surgery while the risk of re-operation in surgically treated people is low (RR 0.04 favouring surgery, 95% CI 0.01 to 0.17). Complications of surgery and medical treatment were described by two trials with 226 participants. Although the incidence of complications was high in both groups, they were significantly more common in the surgical arm (RR 1.38, 95% CI 1.08 to 1.76). AUTHORS' CONCLUSIONS: Surgical treatment of carpal tunnel syndrome relieves symptoms significantly better than splinting. Further research is needed to discover whether this conclusion applies to people with mild symptoms and whether surgical treatment is better than steroid injection.

- Author/Association: Gerritsen AA, de Vet HC, Scholten RJ, Bertelsmann FW, de Krom MC, Bouter LM Title: Splinting versus surgery in the treatment of carpal tunnel syndrome: a randomized controlled trial Source: JAMA 2002 Sep 11;288(10):1245-1251 Method: clinical trial Method Score: 8/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: Yes; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: CONTEXT: Carpal tunnel syndrome (CTS) can be treated with nonsurgical or surgical options. However, there is no consensus on the most effective method of treatment. OBJECTIVE: To compare the short-term and long-term efficacy of splinting and surgery for relieving the symptoms of CTS. DESIGN, SETTING, AND PATIENTS: A randomized controlled trial conducted from October 1998 to April 2000 at 13 neurological outpatient clinics in the Netherlands. A total of 176 patients with clinically and electrophysiologically confirmed idiopathic CTS were assigned to wrist splinting during the night for at least 6 weeks (89 patients) or open carpal tunnel release (87 patients); 147 patients (84%) completed the final follow-up assessment 18 months after randomization. MAIN OUTCOME MEASURES: General improvement, number of nights waking up due to symptoms, and severity of symptoms. RESULTS: In the intention-to-treat analyses, surgery was more effective than splinting on all outcome measures. The success rates (based on general improvement) after 3 months were 80% for the surgery group (62/78 patients) versus 54% for the splinting group (46/86 patients), which is a difference of 26% (95% confidence interval [CI] 12% to 40%; $p < 0.001$). After 18 months, the success rates increased to 90% for the surgery group (61/68 patients) versus 75% for the splinting group (59/79 patients), which is a difference of 15% (95% CI 3% to 27%; $p = 0.02$). However, by that time 41% of patients (32/79) in the splint group had also received the surgery treatment. CONCLUSION: Treatment with open carpal tunnel release surgery resulted in better outcomes than treatment with wrist splinting for patients with CTS.

- Author/Association: Hochberg J Title: A randomized prospective study to assess the efficacy of two cold-therapy treatments following carpal tunnel release Source: Journal of Hand Therapy 2001;14(3):208-215 Method: clinical trial Method Score: 5/10 [Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: No; Adequate follow-up: No; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: Yes. Note: Eligibility criteria item does not contribute to total score] *This score has been confirmed* Abstract: A prospective randomized study was performed comparing the efficacy of controlled cold therapy (CCT) with the efficacy of ice therapy in the postoperative treatment of 72 patients with carpal tunnel syndrome. Immediately after surgery, patients applied either a temperature-controlled cooling blanket (CCT) or a standard ice pack over their surgical dressings. Pain was assessed by visual analog scale and swelling by wrist circumference preoperatively, immediately after surgery, and on postoperative day 3. Patients kept log books of daily treatment times. Narcotic use (of Vicodin ES) was determined by pill count at day 3 and by daily log book recordings. Patients who used CCT showed significantly greater reduction in pain, edema (wrist circumference), and narcotic use at postoperative day 3 than did those using ice therapy. This study indicates that after carpal tunnel surgery, the use of CCT, compared with traditional ice therapy, provides patients with greater comfort and lessens the need for narcotics.