RESEARCH PAPERS FOR NATIONAL ACADEMY OF OESTEOPATHY ON CARPAL TUNNEL SYNDROME BY JASBIR KAUR JAURA
CARPAL TUNNEL SYNDROME

INTRODUCTION

Carpal tunnel syndrome (CTS) is a medical condition in which the median nerve is compressed as it travels through the wrist at the carpal tunnel and causes pain, numbness and tingling, in the part of the hand that receives sensation from the median nerve. Pain may extend up the arm leading to discomfort extending to the shoulder and forearm. The mechanism of injury is compression; there are a variety of contributing factors. Some of the individual predisposing factors include: diabetes, obesity, pregnancy, hypothyroidism, and a narrow-diameter carpal tunnel. CTS may also result from an injury that causes internal scarring or mis-aligned wrist bones. Occupational causes involve use of the hand and arm, such as heavy manual work, work with vibrating tools, and highly repetitive tasks even if they involve low force motions.
The main symptom of CTS is intermittent numbness of the thumb, index, and middle (long) fingers and the radial (thumb) side of the ring finger. The numbness often occurs at night, with hypothesized reasons related to sleep position, such as the wrists being held flexed during sleep or sleeping on one's side. It can be relieved by wearing a wrist splint that prevents flexion. Long-standing CTS leads to permanent nerve damage with constant numbness, atrophy of some of the muscles of the thenar eminence, and weakness of palmar abduction.

Pain in carpal tunnel syndrome is primarily numbness that is so intense that it wakes one from sleep. Conservative treatments include use of night splints and corticosteroids injection. The only scientifically established disease modifying treatment is surgery to cut the transverse carpal ligament.

CAUSES

Most cases of CTS are of unknown cases. Carpal tunnel syndrome can be associated with any condition that causes pressure on the median nerve at the wrist. Some common conditions that can lead to CTS include obesity, oral contraceptives, hypothyroidism, arthritis, diabetes, prediabetes (impaired glucose tolerance), and trauma.
Causes of carpal tunnel syndrome can be divided into three types.

1. Work related
2. Genetic causes
3. Associated or other causes

WORK RELATED CAUSES;

The international debate regarding the relationship between CTS and repetitive motion in work is ongoing. The occupational safety and health administration (OSHA) has adopted rules and regulations regarding cumulative trauma disorders. Occupational risk factors of repetitive tasks, force, posture, and vibration have been cited. The relationship between work and CTS is controversial; in many locations, workers diagnosed with carpal tunnel syndrome are entitled to time off and compensation.

Some speculate that carpal tunnel syndrome is provoked by repetitive movement and manipulating activities and that the exposure can be cumulative. It has also been stated that symptoms are commonly exacerbated by forceful and repetitive use
of the hand and wrists in industrial occupations, but it is unclear as to whether this refers to pain (which may not be due to carpal tunnel syndrome) or the more typical numbness symptoms.

A review of available scientific data by the National Institute for occupational safety and health (NIOSH) indicated that job tasks that involve highly repetitive manual acts or specific wrist postures were associated with incidents of CTS, but causation was not established, and the distinction from work-related arm pains that are not carpal tunnel syndrome was not clear. It has been proposed that repetitive use of the arm can affect the biomechanics of the upper limb or cause damage to tissues. It has also been proposed that postural and spinal assessment along with ergonomic assessments should be included in the overall determination of the condition. Addressing these factors has been found to improve comfort in some studies. A 2010 survey by NIOSH showed that 2/3 of the 5 million carpal tunnel cases in the US that year were related to work. Women have more work-related carpal tunnel syndrome than men.

Speculation that CTS is work-related is based on claims such as CTS being found mostly in the working adult population, though evidence is lacking for this. For instance, in one recent representative
series of a consecutive experience, most patients were older and not working. Asked on the claimed increased incidence in the workplace, arm use is implicated, but the weight of evidence suggests that this is an inherent, genetic, slowly but inevitably progressive idiopathic peripheral mononeuropathy.

GENETIC CAUSES;

Genetics plays a major role in any disease.

ASSOCIATED CAUSES;

A variety of patient factors can lead to CTS, including heredity, size of the carpal tunnel, associated local and systematic diseases, and certain habits. Non-traumatic causes generally happen over a period of time, and are not triggered by one certain event. Many of these factors are manifestations of physiologic aging.

Examples include:

- Rheumatoid arthritis and other diseases that cause inflammation of the flexor tendons.
- With hypothyroidism generalized myxedema causes deposition of mucopolysaccharides within both the perineurium of the median nerve, as
well as the tendons passing through the carpal tunnel.

- During pregnancy women experience CTS due to hormonal changes (high progesterone levels) and water retention (which swells the synovium), which are common during pregnancy.
- Previous injuries including fractures of the wrist.
- Medical disorders that lead to fluid retention or are associated with inflammation such as: inflammatory arthritis, fracture, amyloidosis, hypothyroidism, diabetes mellitus, acromegaly, and use of corticosteroids and estrogens.
- Carpal tunnel syndrome is also associated with repetitive activities of the hand and wrist, in particular with a combination of forceful and repetitive activities.
- Acromegaly causes excessive growth hormones. This causes the soft tissues and bones around the carpal tunnel to grow and compress the median nerve.
- Tumors (usually benign), such as aganglion or a lipoma, can protrude into the carpal tunnel, reducing the amount of space. This is exceedingly rare (less than 1%).
- Obesity also increases the risk of CTS: individuals classified as obese (BMI > 29) are 2.5 times more likely than slender individuals (BMI < 20) to be diagnosed with CTS.
• *Double-crush syndrome* is a debated hypothesis that compression or irritation of nerve branches contributing to the median nerve in the neck, or anywhere above the wrist, increases sensitivity of the nerve to compression in the wrist. There is little evidence, however, that this syndrome really exists.

• Heterozygous mutations in the gene SH3TC2, associated with Charcot-Marie-Tooth, confer susceptibility to neuropathy, including the carpal tunnel syndrome.

**SIGN AND SYMPTOMS;**

• Difficulty making a fist.
• Difficulty gripping objects with the hand(s).
• Pain and/or numbness in the hand(s).
• "Pins and needles" feeling in the fingers.
• Swollen feeling in the fingers.
• Burning or tingling in the fingers, especially the thumb and the index and middle fingers.
• Pain and/or numbness that is worse at night, interrupting sleep.

The symptoms of carpal tunnel syndrome may resemble other medical conditions or problems. Always consult your physician for a diagnosis.
PATHOPHYSIOLOGY;

The carpal tunnel is an anatomical compartment located at the base of the palm. Nine flexor tendons and the median nerve pass through the carpal tunnel that is surrounded on three sides by the carpal bones that form an arch. The median nerve provides feeling or sensation to the thumb, index finger, long finger, and half of the ring finger. At the level of the wrist, the median nerve supplies the muscles at the base of the thumb that allow it to abduct, move away from the other four fingers, as well as move out of the plane of the palm. The carpal tunnel is located at the middle third of the base of the palm, bounded by the bony prominence of the scaphoid tubercle and trapezium at the base of the thumb, and the hamate hook that can be palpated along the axis of the ring finger. From the anatomical position, the carpal tunnel is bordered on the anterior surface by the transverse carpal ligament, also known as the flexor retinaculum. The flexor retinaculum is a strong, fibrous band that attaches to the pisiform and the hamulus of the hamate. The proximal boundary is the distal wrist skin crease, and the distal boundary is approximated by a line known as Kaplan’s cardinal line. This line uses surface landmarks, and is drawn between the apex of the skin fold between the thumb and index finger to the palpated hamate hook. The
median nerve can be compressed by a decrease in the size of the canal, an increase in the size of the contents (such as the swelling of lubrication tissue around the flexor tendons), or both. Since the carpal tunnel is bordered by carpal bones on one side and a ligament on the other, when the pressure builds up inside the tunnel, there is nowhere for it to escape and thus it ends up pressing up against and damaging the median nerve. Simply flexing the wrist to 90 degrees will decrease the size of the canal.

Compression of the median nerve as it runs deep to the transverse carpal ligament (TCL) causes atrophy of the thenar eminence, weakness of the flexor pollicis brevis, abductor pollicis brevis, as well as sensory loss in the digits supplied by the median nerve. The superficial sensory branch of the median nerve, which provides sensation to the base of the palm, branches proximal to the TCL and travels superficial to it. Thus, this branch spared in carpal tunnel syndrome, and there is no loss of palmar sensation.

**DIAGNOSIS**

- **History of symptoms.** Doctor will review symptoms with history of patient. The pattern of
your signs and symptoms may offer clues to their cause. For example, because the median nerve doesn't provide sensation to your little finger, symptoms in that finger may indicate a problem other than carpal tunnel syndrome.

Another clue is the timing of the symptoms. Usual times when you experience symptoms due to carpal tunnel syndrome include while holding a phone or a newspaper, gripping a steering wheel, or waking up during the night.

- **Physical examination.** Doctor will conduct a physical examination. He or she will test the feeling in your fingers and the strength of the muscles in your hand.
- Pressure on the median nerve at the wrist, produced by bending the wrist, tapping on the nerve or simply pressing on the nerve, can bring on the symptoms in many people.
- **Phalen’s maneuver** - is performed by flexing the wrist gently as far as possible, then holding this position and awaiting symptoms. A positive test is one that results in numbness in the median nerve distribution when holding the wrist in acute flexion position within 60 seconds. The quicker the numbness starts, the more advanced the condition. Phalen's sign is defined as pain
and/or paresthesias in the median-innervated fingers with one minute of wrist flexion. Only this test has been shown to correlate with CTS severity when studied prospectively.

- **Tinel’s Sign** - a classic though less sensitive - test is a way to detect irritated nerves. Tinell's is performed by lightly tapping the skin over the flexor retinaculum to elicit a sensation of tingling or "pins and needles" in the nerve distribution. Tinell's sign (pain and/or paresthesias of the median-innervated fingers with percussion over the median nerve) is less sensitive, but slightly more specific than Phalen's sign.

- **Durkan test** - *carpal compression test*, or applying firm pressure to the palm over the nerve for up to 30 seconds to elicit symptoms has also been proposed.

- **Hand elevation test** - The hand elevation test has higher sensitivity and specificity than Tinell's test, Phalen's test, and carpal compression test. Chi-square statistical analysis confirms the hand elevation test is not ineffective compared with Tinell's test, Phalen's test, and carpal compression test.
**X-ray.** Some doctors recommend an X-ray of the affected wrist to exclude other causes of wrist pain, such as arthritis or a fracture.

- **Electromyogram.** Electromyography measures the tiny electrical discharges produced in muscles. During this test, your doctor inserts a thin-needle electrode into specific muscles. The test evaluates the electrical activity of your muscles when they contract and when they're at rest. This test can determine if muscle damage has occurred and also may be used to rule out other conditions.

- **Nerve conduction study.** In a variation of electromyography, two electrodes are taped to your skin. A small shock is passed through the median nerve to see if electrical impulses are slowed in the carpal tunnel. This test may be used to diagnose your condition and rule out other conditions.

**PREVENTION;**

Suggested healthy habits such as avoiding repetitive stress, work modification through use of ergonomic equipment (wrist rest, mouse pad), taking proper breaks, using keyboard alternatives (digital pen, voice, and dictation), and have been proposed as
methods to help prevent carpal tunnel syndrome. The potential role of B-vitamins in preventing or treating carpal tunnel syndrome has not been proven.

**TREATMENT;**

Generally accepted treatments include: physiotherapy, steroids either orally or injected locally, splinting, and surgical release of the transverse carpal ligament. There is no or insufficient evidence for ultrasound, yoga, lasers, B6, and exercise therapy. Change in activity may include avoiding activities that worsen symptoms which may require changing work.

The American Academy of Orthopedic Surgeons recommends proceeding conservatively with a course of nonsurgical therapies tried before release surgery is considered. Early surgery with carpal tunnel release is indicated where there is evidence of median nerve denervation or a person elects to proceed directly to surgical treatment. The treatment should be switched when the current treatment fails to resolve the symptoms within 2 to 7 weeks.

**SPLINTS**

A rigid splint can keep the wrist straight.
A different type of rigid splint used in carpal tunnel syndrome.

The importance of wrist braces and splints in the carpal tunnel syndrome therapy is known, but many people are unwilling to use braces. In 1993, The American Academy of Neurology recommends a non-invasive treatment for the CTS at the beginning (except for sensitive or motor deficit or grave report at EMG/ENG): a therapy using splints was indicated for light and moderate pathology. Current recommendations generally don't suggest immobilizing braces, but instead activity modification and non-steroidal anti inflammatory drugs as initial therapy, followed by more aggressive options or specialist referral if symptoms do not improve.

Many health professionals suggest that, for the best results, one should wear braces at night and, if possible, during the activity primarily causing stress on the wrists.

**CORTICOSTEROIDS**

Corticosteroids injections can be effective for temporary relief from symptoms while a person develops a long-term strategy that fits their lifestyle. The injections are done under local anesthesia. This
treatment is not appropriate for extended periods, however. In general, local steroid injections are only used until other treatment options can be identified.

SURGERY

Carpal Tunnel Syndrome Operation

Release of the transverse carpal ligament is known as "carpal tunnel release" surgery. It is recommended when there is static (constant, not just intermittent) numbness, muscle weakness, or atrophy, and when night-splinting or other conservative interventions no longer control intermittent symptoms. The surgery may be done with local or regional anesthesia with or without sedation, or under general anesthesia. In general, milder cases can be controlled for months to years, but severe cases are unrelenting symptomatically and are likely to result in surgical treatment.

PHYSICAL THERAPY

A recent evidence based guideline produced by the American Academy of Orthopedic Surgeons assigned various grades of recommendation to osteopathy (also called physical therapy) and other nonsurgical treatments. One of the primary issues with osteopathy is that it attempts to reverse (often) years of
pathology inside the carpal tunnel. Practitioners caution that any physiotherapy such as myofacial release may take weeks of persistent application to effectively manage carpal tunnel syndrome.

Again, some claim that pro-active ways to reduce stress on the wrists, which alleviates wrist pain and strain, involve adopting a more ergonomic work and life environment. For example, some have claimed that switching from a QWERTY computer keyboard layout to a more optimized ergonomic layout such as Dvorak was commonly cited as beneficial in early CTS studies.

**OESTEOPATHIC MANIPULATIVE TECHNIQUES**;

When osteopathic structural examination reveals somatic dysfunction associated with CTS, osteopathic manipulative treatment may be used to manage the somatic dysfunction. Specifically, OMT may be used to stretch soft tissues, release tissue adhesions, eliminate restricted motion of carpal and metacarpal bones, increase the length of the TCL to enlarge the carpal tunnel and lower intratunnel pressure transmitted to the median nerve, increase range of motion, strengthen muscles, and reduce edema. Resultant improvements in circulation and joint function will allow for normalization of nerve
function. As described the following, several techniques can be used to manage somatic dysfunction in various parts of the wrist and hand that are associated with CTS.

**Wrist Retinaculum**  
**Myofascial release technique**

Thenar and Carpal Lig **Opponens roll maneuver**  
Carpal Bone- **High-velocity, low-amplitude technique**  
Metacarpophalangeal Joint- **High-velocity, low-amplitude technique** (mobilization with impulse)

Carpometacarpal Joint- **High-velocity, low-amplitude technique.**

**Muscle energy technique for pronation and supination dysfunctions**—to manage pronation dysfunction, the physician holds the patient's hand in a handshake position while the palm of the free hand contacts the posterolateral aspect of the radial head to be treated. Supination is applied to the patient's forearm until a restrictive barrier is reached. The patient then attempts to pronate his or her forearm while the physician applies a counterforce for 3 to 5 seconds. The contraction is then relaxed and the patient is supinated to a new restrictive barrier, and again the patient pronates his or her forearm while
the physician applies a similar counterforce. These steps are repeated 3 to 5 times.

**For supination dysfunction**, the physician holds the patient's hand in a handshake position while the palm of the free hand contacts the posterolateral aspect of the radial head. Pronation is applied to the patient's forearm until a restrictive barrier is reached. The patient then attempts to supinate his or her forearm while the physician applies a counterforce for 3 to 5 seconds. The contraction is then relaxed, the patient is pronated to a new restrictive barrier, and again the patient supinates his or her forearm while the physician applies a counterforce. It should be repeated 3-5 times.

**Clinical Efficacy of OMM on CTS**
Multiple published studies have outlined the clinical effectiveness of OMT on patients diagnosed with CTS. Sucher demonstrated that osteopathic palpatory diagnosis in 20 patients with carpal tunnel syndrome revealed at least moderate restriction (grade 2), compared to 20 healthy, symptom-free patients with no to mild restriction (grade 0-1). In the same study, 16 patients with CTS who had at least a grade 2 restriction and who were treated with OMT experienced improved range of motion and decreased symptoms of CTS. Results of nerve conduction studies improved within 1 to 3 months.
CONCLUSION
Although there are multiple causes of CTS, using, osteopathic structural examination and OMT in the diagnosis and management of CTS may ultimately prevent or delay surgical intervention in patients with this condition.

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