Carpal tunnel syndrome – an occupational hazard facing dentistry

Sagar Abichandani, Saquib Shaikh and Ramesh Nadiger

Prosthodontics, SDM college of dental sciences, Dharwad, India.

Background: The authors wished to evaluate the comprehensive literature on carpal tunnel syndrome to discover work specific to carpal tunnel syndrome among dentists in order to determine whether there is any correlation with dentists having a higher prevalence of its occurrence. Methods: A review of dental literature involving carpal tunnel syndrome was undertaken. Details appearing in the literature before 1995 was reviewed in a comprehensive manner and the literature after 1995 was reviewed electronically. Results: The prevalence of carpal tunnel syndrome is higher in dental professionals involved in various aspects of dental specialties. Conclusions: Abnormal postures, including muscle imbalances, muscle necrosis, trigger points, hypomobile joints, nerve compression and spinal disk herniation or degeneration may result in serious detrimental physiological changes in the body. These changes often result in pain, injury or possible neuroskeletal disorders. Clinical implications: Dentists have an increased risk of carpal tunnel syndrome and precautions and care should be exercised to prevent detrimental irreversible changes occurring.

Key words: Carpal tunnel syndrome, musculoskeletal disorders

INTRODUCTION

The formation of a deep arch anteriorly at the wrist by the carpal bones and the flexor retinaculum is called the carpal tunnel. Medially, the pisiform and the hook of the hamate form the base of the carpal arch, while laterally it is formed by the tubercles of the scaphoid and trapezium. The carpal arch becomes the carpal tunnel when the flexor retinaculum, which is a thick connective tissue ligament, bridges the space between the medial and lateral sides of the base of the arch. The four tendons of the flexor digitorum profundus, the four tendons of flexor digitorum superficialis and the tendon of flexor pollicis longus pass through the carpal tunnel, as does the median nerve. The tendons of the bone plane at the wrist are held by the flexor retinaculum, preventing them from ‘bowing’. Synovial sheaths facilitate free movement of the tendons in the carpal, which surrounds the tendons. Carpal tunnel syndrome (CTS) is an entrapment syndrome caused by the pressure on the median nerve within the carpal tunnel.

MATERIALS AND METHODS

A review of the dental literature pertaining to carpal tunnel syndrome was undertaken. Details appearing in the literature before 1995 were reviewed in a comprehensive manner and the material after 1995 was reviewed electronically. Electronic searches of the literature were performed.

Various combinations of key words (carpal tunnel syndrome, musculoskeletal disorders, tenosynovitis) were used in MEDLINE, in various combinations, to obtain potential references for review. A total of 245 English language titles were obtained, many of which were duplicates because of multiple searches. The titles were reviewed and selected for closer examination. If the article under review was a study of any type, hand-searching of the MEDLINE reference list was performed to identify any articles missed in the original search.

AETIOLOGY

Complications in symptoms and increased healing time can result from any previous neck injury or injury to the upper body. A systemic or a biochemical factor could be an additional component, which, even without any repetitive movement, can bring on an inflammatory condition. The risk of a narrow tunnel can be increased by genetic or anatomical factors, such as race or gender. Hamann et al. stated that repetitiveness of work, forceful exertions, mechanical
stress, posture, temperature and vibration are ergonomic risk factors associated with CTS. These risk factors are present for dentists as contact stress over the carpal tunnel may be caused by dental instruments, and wrists may be held in awkward positions for prolonged periods.

PREDISPOSING FACTORS

- Genetic predisposition: the carpal tunnel is smaller in some people than in others
- Repetitive movements: Franklin et al.\(^4\) stated that people who repeatedly do the same movements with their wrists and hands may be more likely to develop CTS. Thus, people with certain types of jobs are more likely to have CTS, including dentists, manufacturing and assembly line workers, grocery store checkers, violinists and carpenters. In addition, CTS can be caused by some hobbies and sports that use repetitive hand movements, such as golfing, knitting and gardening
- Injury or trauma: Sesto et al.\(^5\) stated that swelling and pressure on the nerve can be caused by a sprain or a fracture of the wrist, increasing the risk of CTS. Strong vibrations caused by heavy machinery or power tools, along with forceful and stressful movements of the hand and wrist, can also cause trauma
- Pregnancy: Atroshi I et al.\(^6\) stated that pregnant women, especially during the last few months, are at greater risk of getting CTS because of hormonal changes during pregnancy and the build-up of fluid. Most doctors treat CTS in pregnant women with wrist splits or rest rather than surgery, as CTS almost always goes away following childbirth
- Menopause: during menopause, hormonal changes can put women at greater risk of getting CTS. In addition, the wrist structures become enlarged in some postmenopausal women, which can press on the wrist nerve
- Breast cancer: some women who have a mastectomy may get lymph oedema, where the build-up of fluids goes beyond the lymphatic system’s ability to drain it. This causes pain and swelling of the arm
- Other medical conditions: people suffering from diabetes, hypothyroidism, lupus, obesity and rheumatoid arthritis are more likely to get CTS. In some of these patients, the normal structures in the wrist can become enlarged and lead to CTS.

In addition, smokers with CTS usually have worse symptoms and recover more slowly than non-smokers.

- Repetitive hand motion
- Awkward hand position
- Strong gripping
- Mechanical stress on the palm
- Vibration.

Patients typically report pain and pin-and-needles in the distribution of the median nerve. According to Stockstill & Harn SD\(^8\) stated symptoms of carpal tunnel syndrome may include:

- Loss of sense of touch
- Tingling and numbness in hand and fingers
- Pain in shoulder at night, pain in elbow, or swelling in wrist area
- Loss of grip strength in hand
- Pain in wrist when stretched in an extreme position, such as bending wrist, pointing the fingers to the floor
- Dropping objects more often than usual
- A burning sensation in the wrist and hand area
- Being unable to unscrew a jar lid
- Tenderness in the wrist area
- More difficult to do tasks such as brushing hair.

Stevens et al.\(^9\) showed that the findings on physical examination (signs) are frequently absent or non-specific. Tinel’s sign (tapping on the wrist or over the median nerve) and Phelan’s signs (forced flexion of the wrist) are frequently described. An electromyogram can also be used to check for muscle damage, where a needle is inserted into the muscle to record electrical activity in that muscle at rest and when contracted. Generally, symptoms can be better examined when the patient is not working or holidays when the worker has avoided workplace exposure. On examination, there is wasting of the muscles of the thenar eminence, absence of abduction of thumb at metacarpophalangeal joint and absence of opposition of the thumb. In severe cases, sensation may be permanently lost and the muscles at the base of the thumb slowly shrink (thenaratrophy), causing difficulty with pinch. Relatively large number of dentists have a prolonged median–ulnar latency.

Lam & Thurston\(^10\) stated that higher rate of hand and finger pain symptoms are seen among dentists than in the general population. This higher rate of pain is associated with dentists who reportedly work longer hours.

Examination

Physical examination of the patient’s hands, arms, shoulders, and neck can help determine if the complaints are related to daily activities or to an underlying disorder, and can rule out other painful conditions that mimic carpal tunnel syndrome. The wrist is examined for:

- Tenderness
• Swelling
• Warmth
• Discoloration.

The muscles at the base of the hand should be examined for strength and signs of atrophy; each finger should be being tested for sensation. Routine laboratory tests and X-rays can reveal:
• Diabetes
• Arthritis
• Fractures.

The presence of CTS is suggested if one or more symptoms, such as tingling or increasing numbness is felt in the fingers within 1 minute. Doctors may also ask patients to try to repeat the movements that bring on symptoms.

Tests

Electrodiagnostic tests are often used to confirm the diagnosis. In a nerve conduction study, electrodes are placed on the hand and wrist. Small electric shocks are applied to measure the speed with which nerves transmit impulses.

In electromyography, a fine needle is inserted into a muscle, the severity of damage to the median nerve can be determined by electrical activity viewed on a screen. Impaired movement of the median nerve can be seen by ultrasound imaging. Magnetic resonance imaging can show the anatomy of the wrist, but until now has not been especially useful in diagnosing carpal tunnel syndrome.

DENTAL IMPLICATIONS AND CLINICAL FEATURES

Valachi stated that procedures carried out certain dental specialties have increased incidence of carpal tunnel syndrome.

Endodontics

Biomechanical shaping of the root canals over long hours requires repeated usage of hand-files that can predispose a dentist to CTS.

Periodontics

Constant use of ultrasonic scalers can predispose a dentist to CTS not only because of increased vibrations and repetitive movements but also because of awkward positioning over prolonged periods.

Prosthodontics

A constant prolonged static position during tooth preparation using an aerator handpiece can predispose to CTS.

ORAL SURGERY

Working on maxillary premolars involves jerky, repetitive movements with awkward positioning of the musculoskeletal system for prolonged periods; this can predispose dentists to CTS during tooth extraction.

Muscles, tendons, ligaments and nerves in the hands and forearms are repeatedly overworked and stress owing to the use of older, low-speed handpieces. These were designed with very heavy motors at one end and thus require unnecessary leverage just to control the unbalanced weight during each dental procedure.

Modern handpieces are better to handle and use as they are shorter, made with lighter-weight durable materials, and often weigh about 85 g–two-thirds less than older models. In modern designs the weight is evenly distributed over the entire length of the handpiece rather than concentrated at the hose-end connection, making it easier to handle. They also come with a variety of swivel mechanisms that reduce unnecessary torque on the hand, wrist, forearm and elbow.

Different types of handpiece profile such as straight, cylindrical or tapered (wider at the hose-end connection) are available. Overall pinch/grip can be reduced by flared or tapered handpieces. The back end of the handpiece is supported and balanced by the soft tissue between the thumb and index finger. Pinch/grip is affected by the texture on the handpiece shaft. Texture improves traction and the clinician’s ability to grasp the handpiece lightly while still maintaining control, especially in a moisture-laden environment is improved by any texture or ribbing. To stabilize the prophy angle, one should ensure that the current handpiece is in good running order, maintained regularly and has a proper locking mechanism. However, one should also regularly check the availability of more ergonomically sound handpieces.

Conrad & Conrad stated that a design that necessitates more wrist flexion and extension for reaching tooth surfaces, also where majority both metal and single-use prophy angles are right-angled. Similar to the bend of a high-speed handpiece, contra-angled prophy angles have a small 4 mm bend in the shaft. The clinician can keep his or her wrist in a neutral position as this reduces stress on the wrist and forearm. An adjustable contra-angled DPA is ideal for use with a non-swivelling handpiece.

Osborn & Newell stated that hand comfort is directly affected by cup stability. Spinning screw- or latch-mounted cups remain concentrically stable during polishing, in contrast to the wobble created by snap-on cups, which create unnecessary hand stress for the clinician.

Advancements in rotary instruments for endodontics have not only resulted in decreased perception of
vibrations but also increased durability by reducing
the need for hand-filing for biomechanical shaping of
root canals.

Often, dentists assume static postures, which
require more than 50% of the body’s muscles to con-
tract to hold the body motionless while resisting grav-
ity. The static forces resulting from these postures
have been shown to be much more taxing than
dynamic (moving) forces.

A series of events that may result in pain, injury or
a career-ending MSD can be initiated when the
human body is subjected repeatedly to PSPs. Some
of the physiological consequences of PSPs are muscle
imbalances, ischaemia, trigger points, joint hypomo-
ibility and spinal disk degeneration.

To recover from even very low-level exertion,
human muscles require rest periods as they are not
adapted for continuous long-lasting contractions. Dur-
ing a sustained, static muscle contraction, the tender
stretches and compresses the vascular supply to the
muscle and surrounding tissues, thereby depleting the
nutrient and oxygen supply. Lactic acid and other
metabolites then accumulate in the muscle tissues,
which can result in damaged muscle tissue and a pain-
ful sensation.

Under normal conditions, damaged tissue is
repaired during rest periods. However, in dentistry,
because of insufficient rest periods the damage often
exceeds the rate of repair and can result in muscle
tissue death. If this occurs the body uses another part of
the damaged muscle to maintain the body position in
order to protect the stressed area from further injury.

As the body recruits different muscle groups to per-
form the needed task long periods, entire muscles
become compromised. This is known as muscle substi-
tution and muscles are required to perform a task for
which they are not ideally designed. An abnormal
“compensatory” motion then develops and predisposes
the person to joint hypomobility (stiffness) and nerve
compression.

Early intervention could be important for people
who have symptoms of CTS or are at an increased
risk of developing the condition. When recognized
early, CTS can be managed effectively with conserva-
tive and non-invasive treatment, as suggested by
Corks.

The highest risk of injury occurs at the median
erve because of the extremes of wrist flexion and
extension position; thus the most common inter-
vention is the use of a night-time wrist splint. This device
helps the patient avoid extremes of wrist flexion and
extension during sleep, decreasing the pressure on the
median nerve. As extended wrist flexion or extension
can place the median nerve at risk, pacing of work
activity can be helpful to reduce the pressure on the
nerve and prevent injury.

Bramson & Smith stated that management of
ergonomic stressors could include the use of fitted
gloves that reduce hand tension and Avoidance of
awkward wrist posture during procedures reduces the
stress on the median nerve. Early recognition of
symptoms and education regarding ergonomic risk
factors is important in the successful management of
CTS.

TREATMENT

Fish & Morris-Allen stated that symptoms may
often be relieved without surgery. Some ways to
reduce pressure on the nerve are identifying and treat-
ning medical conditions, changing the patterns of hand
use, or keeping the wrist splinted in a straight posi-
tion. Wearing wrist splints at night may relieve the
symptoms that can interfere with sleep. Swelling
around the nerve can be relieved by a steroid injection
into the carpal tunnel. However, surgery may be
needed to make more room for the nerve when symp-
toms are severe or do not improve. Pressure on the
nerve is decreased by cutting the ligament that forms
the roof (top) of the tunnel on the palmar side of the
hand. Incisions for this surgery may vary, although
the goal is the same: to enlarge the tunnel and
decrease pressure on the nerve. Soreness around the
incision may last for several weeks or months, follow-
ing surgery. The numbness and tingling may disappear
quickly or slowly and it may take several months for
strength in the hand and wrist to return to normal.

However, the symptoms of CTS may not resolve after
surgery, especially in severe cases.

According to Guay some precautions would be:
keep the wrist at relaxed, middle position without
bending it completely up or down; use a relaxed grip;
and use less hand and finger force when performing
tasks. It is important to strive for good posture so that
neck and shoulder muscles do not compress nerves in
the neck, which affects the wrist and hands.

- **Wrist Splint**: Field et al. recommend that the
  wrist be supported and braced by wearing a splint
  in a neutral position so that the nerves and tendons
can recover. A splint can be worn 24 hours a day
  or only at night. Wearing a splint at night some-
times helps to reduce the pain. Splinting can work
the best when done within 3 months of having any
symptoms of CTS.

- **Rest**: stopping or doing less of a repetitive move-
  ment may be all that is needed, for people with
mild CTS. Your doctor will advice you about the
steps that should be taken to prevent CTS from coming
recurring. These steps will include rest, stretching
and bending the hand and wrists at intervals of
20 minutes, alternating tasks and changing work
position frequently. It is important to be aware of
any onset of headaches, fatigue or muscle pain during activities.

Other assistance
Stress and pain can be reduced by relaxation techniques such as those found in yoga. Water therapy, heat and massage might be useful in relieving symptoms.

Ergonomics
Valachi & Valachi\textsuperscript{11,12} indicated that effective and efficient design of the workplace is key. A huge variety of equipment, such as wrist and forearm supports, sprints and braces, work surfaces, chairs and other innovative devices, is available to ensure correct posture and good wrist position. Werner & Armstrong\textsuperscript{21} stated that it is imperative to take care to adjust equipment to avoid stress from awkward body positioning and wrist angles.

Medication
Patient leaflets from the BMJ group states that for controlling CTS pain, the short-term use of nonsteroidal anti-inflammatory drugs (NSAIDs) may be helpful. These include aspirin, ibuprofen and other nonprescription pain relievers. In severe cases, swelling may be reduced with the help of an injection of cortisone or with corticosteroids in pill form. However, these treatments only relieve symptoms temporarily. If CTS is caused by another health problem, this will probably be treated first. If diabetes is present, it is important to be aware that long-term corticosteroid use can make it harder to control insulin levels.

Physical therapy
Ashworth\textsuperscript{22} advised that physical therapists can help with special exercises to make wrists and hands stronger. Massage, yoga, ultrasound, chiropractic manipulation, and acupunture are just a few such options that have been found to be helpful to improve CTS and relieve symptoms.

Massage treatment consists of moderate stroking techniques from the fingertip to elbow region. The technique is described as ‘stroking the wrist up to the elbow and back down on both sides of the forearm’, after which another technique, described as ‘a wringing motion applied to the same area.’ is applied. These appear to be petrissage-type techniques. Two more techniques are described as part of the massage process. The first is stroking using the thumb and forefinger in a circular back-and-forth motion covering the entire forearm and hand. The final technique described is rolling the skin between the thumb and forefinger across the hand and up both sides of the forearm. It is advisable to first consult a doctor before trying these alternative treatments.

Surgery
Surgery for CTS is one of the most common procedures done in the USA. Generally, surgery is only an option for severe cases of CTS and/or after other treatments has failed for a period of at least 6 months. A common surgical approach to CTS is an open release technique, which involves making a small incision in the wrist or palm and cutting the ligament to enlarge the carpal tunnel. This surgery is done as an outpatient procedure under local anaesthetic to numb the wrist and hand area.

OVERVIEW OF THE TREATMENT MODALITIES
An overview of medical treatment modalities, as provided by the Washington State Department of Labor and Industries\textsuperscript{23} guidelines, are given below.

Conservative
- Corticosteroids (local injection/systemic)
- Diuretics
- NSAIDS
- Pyridoxine
- Large doses of vitamin B\textsubscript{6}
- Acupuncture
- Massage
- Nerve and/or tendon exercise
- Therapeutic ultrasound
- Wrist splints.

Hamann et al.\textsuperscript{3} stated that whether the patient can remain at work is primarily dependent on the duration of conservative treatment. Regardless of whether specific treatment is rendered, most patients will improve when they are off work. In some cases, worsening of OCTS can be prevented and symptoms may be improved by modification of the job, along with conservative treatment. If modification is not possible, or if the claimant cannot continue working with conservative treatment, then surgery should be considered as a treatment option.

Surgery
Surgical options, as suggested by The American Society for the Surgery of Hand\textsuperscript{24}, are:
- Endoscopic carpal tunnel release and open carpal tunnel release
- Internal neurolysis in conjunction with open carpal tunnel release.
Abichandani et al.

For OCTS the surgical procedure of choice is decompression of the transverse carpal ligament. In general, the following criteria should have been met for authorization of surgery to occur:

1. The clinical history should be consistent with OCTS
2. Nerve conduction testing (NCV) should have demonstrated a conduction slowing of the median motor or sensory fibres across the carpal tunnel
3. A course of conservative management must have been tried.

According to various studies, it is suggested that 60–90% of the post-surgical cases, the burning pain associated with OCTS will be alleviated. The patient’s ability to return to the same job is not clear. If pain persists or recurs, NCVs can help sort out whether nerve entrapment continues to be a problem.

**Acupressure**

Acupressure is based on the same principles as acupuncture. Pressure is applied instead of needles to acupuncture points, which is thought to stimulate blood flow to the wrists and hands and ease numbness and swelling in the area.

Acupressure points for carpal tunnel syndrome are typically on the wrists, forearms and hands.

Kiernan & Mogvoros described that with the thumb or middle finger at a 90 degree angle to the skin, apply gradually increasing pressure. Hold for 2–3 minutes. Each point will feel different; it may be achy, sore or tense. The pressure should not be painful or uncomfortable (don’t try to bore a hole into your arm!). The points do not have to be used together to be effective, so choose the most tense points if you do not have time for the whole routine.

**Post surgery**

Guidelines after surgery, as provided by the University of Pittsburgh Medical Center information for patients section¹⁰, include:

- **Medicine**: take the prescribed pain medication and an antibiotic as directed by your doctor
- **Elevation**: it is important to keep the hand raised above the level of the heart as much as possible for the first 48 hours following surgery as this helps to reduce swelling and pain
- **Dressing**: keep the dressing over the incision clean and dry until the follow-up appointment with your doctor, unless instructed otherwise. The stitches under the dressing will be removed by a doctor
- **Activity**: do not lift anything with the hand you had surgery on until your doctor says it can be used. Move the fingers regularly as this will keep them from getting stiff and help lessen the swelling.

**Prognosis**

By changing the way they do repetitive movements, the frequency of these movements and the amount of time rest between periods of performing these movements, the majority of patients recover completely and can avoid re-injury.

**CONCLUSION**

Abnormal postures, including muscle imbalances, muscle necrosis, trigger points, hypomobile joints, nerve compression and spinal disk herniation or degeneration may result in serious detrimental physiological changes in the body. These changes often result in pain, injury or MSDs.

Clinical work habits, including proper use of ergonomic equipment, frequent short stretch breaks and regular strengthening exercise may require a paradigm shift within the dentistry profession to prevent chronic pain.

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**Conflict of interest**

None declared.

**REFERENCES**


26. University of Pittsburgh Medical Center Information for Patients. Carpal tunnel syndrome.

Correspondence to:
Dr Sagar Abichandani,
Prosthodontics,
SDM college of dental sciences,
Dharwad, India.
Email: sagar.abichandani@gmail.com
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