



Review Paper

A Systematic Review on Carpal Tunnel Syndrome

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ABSTRACT

Carpal tunnel syndrome is a painful ailment caused by the compression of a major nerve where it crosses the carpal bones through a tunnel at the front of the wrist. It could be brought on by fluid retention or by repetitive motions that are done repeatedly. In clinical practice, Tinel's sign and Phalen's maneuver are commonly used to identify CTS. Tinel's sign is to create a feeling of tingling or "pins and needles" throughout the nerve's distribution, it is done by lightly tapping (percussion) over the nerve. Typically, percussion is done by advancing from distal to proximal. Phalen's maneuver, on the other hand, is a test that increases the pressure on the median nerve usually performed by flexing the wrist for 30-60 seconds. First-line treatments include corticosteroid injections, therapeutic ultrasound, and splinting.

INTRODUCTION

The painful ailment known as carpal tunnel syndrome is brought on by compression of the median nerve in the wrist. A person with carpal tunnel syndrome may experience discomfort, tingling. Carpal tunnel syndrome (CTS), sometimes called median nerve entrapment or median nerve compression, can occur when a nerve swells, the tendons become inflamed, or anything causes the carpal tunnel to swell. Numbness in the palm of the hand and fingers,

particularly the thumb and index finger, as well as tingling, burning, or itching are symptoms. The majority of persons are diagnosed with CTS between the ages of 40 and 60, and the frequency rises with age. The condition may manifest in one or both wrists. Additionally, women are more prone to having it. CTS can negatively affect a person's quality of life if treatment is not received. The median nerve may eventually sustain significant injury. As a result, the muscles innervated by the median nerve may become

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permanently weak and the fingers may become permanently numb.

CTS is frequently associated with computer use since it is frequently caused by repetitive wrist movements. However, orthopedic physicians were aware of the condition prior to the widespread use of computers, with accounts going back to the 1800s.[2]

ETIOLOGY:

compression of the median nerve is responsible for carpal tunnel syndrome. Through the carpal tunnel, a passageway in the wrist, the median nerve passes from the forearm to the hand. The median nerve senses every digit except the palm side of the thumb and the little finger. Additionally, this nerve sends signals to the muscles surrounding the thumb's base. We call this movement motor function. Carpal tunnel syndrome can result from anything that compresses or irritates the median nerve in the carpal tunnel area. A fractured wrist may cause the carpal tunnel to constrict, leading to nerve irritation. Even though CTS is an idiopathic syndrome, the occurrence of this illness is nevertheless linked to certain risk factors. Prolonged postures involving excessive wrist flexion or extension, repetitive flexor muscle usage, and vibration exposure are noteworthy ecological risk factors [1-2]. Medical risk factors for CTS are divided into four groups, in contrast to environmental influences. These consist of neuropathic factors, extrinsic factors that increase the volume of the tunnel on either side of the nerve, intrinsic factors that increase the volume of the tunnel, and extrinsic factors that change the tunnel's shape [1-2]. The longer life expectancy of workers and the rise in risk factors like diabetes and pregnancy are also linked to rising rates of CTS occurrences. Situations that alter the body's fluid balance are examples of extrinsic factors that raise the tunnel's volume. Pregnancy, menopause, obesity, kidney disease, hypothyroidism, oral

contraceptive use, and congestive heart failure are a few examples of these variables. Tumor-like strains and lumps are examples of intrinsic components in the nerve that increase the occupied volume inside the tunnel. These may result immediately from distal radius fractures or indirectly from posttraumatic arthritis. Conditions including diabetes, alcoholism, vitamin toxicity or insufficiency, and exposure to pollutants are examples of neuropathic causes. These are significant factors because they affect the median nerve without necessarily increasing the interstitial pressure in the carpal tunnel. Due to their delayed start of nerve damage, diabetic persons are more likely to develop CTS. While the prevalence rate during pregnancy is estimated to be 2%, the extent of occurrence in diabetic patients is 14% for those without diabetes and 30% for those with diabetic neuropathy [1].

EPIDEMIOLOGY:

Carpal Tunnel Syndrome (CTS), the most common entrapment condition, impacts one or more peripheral nerves, resulting in numbness or weakness in the affected organ. CTS affects at least 3.8% of people who report having painful, unresponsive, and itching hands on average [2]. Medical evaluations and electrophysiological testing are used to diagnose CTS, albeit idiopathic CTS is the most common diagnosis for people exhibiting these symptoms. Furthermore, the incidence rates of CTS are 9.2% for women and 6% for males, with 276 occurrences per 100,000 annual reports [2]. Despite being ubiquitous in all age groups, CTS is more common in people between the ages of 40 and 60. Compared to the 5% incidence rates in the US, the prevalence of CTS is comparatively higher in places like the UK, where it ranges from 7% to 16% [3]. There is an increase in work-related musculoskeletal disorders (WMSDs) in the majority of western countries. Increased strain and repetitive motions by people are linked to this. For example, over 60% of upper



limb musculoskeletal diseases identified as work-related in Europe in 1998 were reported to be CTS occurrences [2]. Additionally, the prevalence rates may range among various professions and sectors; for example, the fish processing industry reports that 73% of its employees have CTS [2]. These opinions regarding CTS occurrence rates highlight the severity of the problem and make it a major topic of concern that calls for efficient management techniques.

PATHOPHYSIOLOGY:

A combination of ischemia injury to the median nerve within the carpal tunnel, elevated pressure, and mechanical stress make up the pathogenesis of CTS. As far as elevated pressure is concerned, normal pressure is measured to range from 2 mmHg to 10 mmHg. Changes in wrist position can cause significant changes in fluid pressure in the carpal tunnel. As a result, the pressure increases more than ten times during extension and eight times during wrist flexion—as stated in reference[6]. The increased stress on the tendon sheaths causes fibrocartilage to develop, which thickens the sheaths. The tendon sheaths exhibit neovascularization. Myxoid degeneration is also seen in the tendons in this case. The first dorsal compartment between the two tendons frequently has a septum, which restricts the capacity of the first compartment and has significant implications for both nonoperative and surgical treatment.[5]

As a result, wrist motions that are repeated are important risk factors for cases of CTS. Conversely, demyelination, which happens when the nerve is regularly subjected to automatic stresses, is a significant stage in damage to the median nerve in nerve injury [6]. The nerve's demyelination begins where the compression occurs and extends to the intermodal section, where the axons remain intact. The development of endoneurial edema and changes to the blood-nerve barrier result from persistent compression that stops blood flow to the endoneurial capillary

system. A strong cycle that includes ischemia, venous congestion, and local metabolic changes therefore starts [6].

DIAGNOSIS:

The corresponding medical practitioner must create a case history linked to the distinctive symptoms of CTS in order to diagnose the patient. It is important to ask the patient how often these symptoms occur, whether they occur during the day or at night, and whether they are triggered by specific postures or repetitive motions [4]. The doctor may also inquire as to whether the patient has predisposing variables for the incidence of CTS, whether the patient uses vibratory objects for their tasks, or which portions of the arm are experiencing the feelings. In this situation, they might check the patients for diseases such as diabetes, inflammatory arthritis, hypothyroidism, or pregnancy that are linked to CTS [5]. Since certain findings may point to the presence of other causes, physical examination of the patient's hand is a fundamental method of diagnosing CTS. For example, ecchymosis or abrasions on the hands and wrist may be signs of tissue damage, which may also involve damage to the median nerve [4]. The initial diagnostic procedures for carpal tunnel syndrome are Tinel's sign and Phalen's maneuver. When tapping along the carpal tunnel causes symptoms in the median nerve distribution, Tinel's sign is positive. In contrast, a patient performs Phalen's technique, which involves flexing the wrist to 90 degrees. If the flexing results in symptoms and the distribution of the median nerve, the test is considered successful. Furthermore, two-point discrimination, vibration, and monofilament testing may produce sensory effects in carpal tunnel syndrome [4]. There may be fewer precise locations of symptom manifestation and limited outcomes when using the patient's medical history and physiological assessment. For this reason, patients could be asked to fill out a self-diagnosis form known as the

Katz Hand Diagram. This allows the patient to categorize sensations such as tingling, discomfort, hypoesthesia, or numbness and to identify which areas of their hand are affected [4].

Differential diagnosis:

It is crucial to remember that other illnesses can present with symptoms identical to those of CTS, necessitating a thorough diagnosis in order to confirm the patient's health. When dealing with scenarios, such as diagnosing CTS in patients, the differential diagnosis is crucial since it compares the likelihood of one disease to other conditions that the patient may be experiencing. A comprehensive physiological evaluation is a crucial diagnostic technique to distinguish CTS from other medical issues. Excruciating thumb movement, a positive grind evaluation, and radiographic results are some of the signs of carpometacarpal arthritis of the thumb, which is differentiated from CTS by the differential diagnostic [8]. Other disorders include de Quervain tendinopathy, which causes soreness at the distal radial styloid, and cervical radiculopathy, which manifests as neck pain, numbness in the thumb and index finger, and positive Spurling test results [8]. Other conditions include pronator syndrome, which causes forearm pain, sensory loss over the thenar eminence, and weakness with thumb flexion and wrist extension; Raynaud syndrome, which causes patients to exhibit symptoms related to exposure to cold and typical color changes; and peripheral neuropathy, which is characterized by a history of diabetes mellitus [7].

TREATMENT:

The severity of the condition determines how patients with CTS are managed. It is advised that patients in minor and modest circumstances attempt conventional treatment. Yoga, physical therapy, corticosteroids, splinting, and therapeutic ultrasonography are all included in this [8]. With the greatest improvement observed at three

months, these types of therapy promote better symptoms in two to six weeks. Due to its ease of usage, affordability, and acceptability, the use of splints is an important responsive action for minimal to moderate CTS [7]. Additionally, it can be used to support other therapy modalities and is recommended for usage in more reversible risk factors, such as pregnancy. Compared to a placebo, oral prednisone at a dose of 20 mg per day improves a person's symptoms and functions, and these improvements endure for an average of eight weeks [8]. Involving patients in physical therapy, which includes nerve gliding exercises, ultrasounds, and carpal bone mobilization, is an additional therapeutic option [8]. These, however, are typically less successful and necessitate the involvement of skilled therapists. On the other hand, surgical decompression is necessary as a CTS therapeutic technique for individuals with severe CTS or nerve damage based on electrodiagnostic data [8]. Patients who experience persistent symptoms, no improvement in their health, or a developing motor or sensory deficiency should be referred for surgical therapy [8]. Surgery should only be considered by doctors if conservative treatments are ineffective for the illness. Treating and, ideally, relieving the patient of the agonizing symptoms of carpal tunnel syndrome is the main goal of carpal tunnel release. In the past, doctors believed that carpal tunnel syndrome was solely caused by repeated hand and wrist motions, particularly in people who used computers frequently. However, because some people have larger carpal tunnels than others, experts now recognize that the disease is most likely a congenital propensity. Notably, carpal tunnel syndrome can also be brought on by frequent use of vibrating devices and accidents such as fractures or sprains. Doctors sometimes associate the syndrome with thyroid disorders, diabetes, rheumatoid arthritis, and pregnancy. Carpal tunnel syndrome can be described as a multifactorial



disorder. Several areas of the wrist are impacted by carpal tunnel syndrome. The carpal tunnel creates a canal through which the median nerve and tendons pass. Finger mobility is facilitated by the median nerve and muscles. The carpal tunnel is composed of the wrist bones and the transverse carpal ligaments at the top and bottom of the wrist [7]. The tissues in the tunnel swell and compress the median nerve when this area of the body is injured or becomes constricted. Unrelenting pain, loss of function, and tingling and numbness in the hand are all symptoms of untreated median nerve pressing. The discomfort normally gets worse when the thumb end of the wrist is compressed, however the symptoms start out mildly and get worse over time. In order to make incisions on the swollen areas, a surgeon frequently makes cuts through the pressing nerve during surgery. This frequently reduces discomfort and enhances function by making more space for the tendons and median nerve to pass through the carpal tunnel. The diagnosis of carpal tunnel syndrome is the sole justification for surgery. However, even in these cases, physicians typically begin with the non-surgical treatments that are currently accessible. Physical therapy, wrist splints, medication, using other equipment at work, and applying steroids to the affected areas to reduce discomfort and swelling are among non-surgical treatment options. Following the failure of non-surgical treatments, doctors frequently prescribe surgery for the reasons listed below. First, discomfort and swelling from carpal tunnel syndrome are frequently not reduced by non-surgical therapy. Second, the surgeon determines whether the patient has carpal tunnel syndrome by doing an electrophysiological assessment of the median nerve. Third, significant compression of the median nerve typically results in weak and shrinking wrist and hand muscles. Finally, when symptoms of the illness persist for more than six months without improvement, physicians advise

surgery [9]. In summary, when someone suspects they have carpal tunnel syndrome, non-surgical treatments would be the best course of action. For the reasons listed above, doctors do not advocate surgery initially since it may have additional contraindications. Like other operations, the release of the carpal tunnel carries a number of hazards. During the surgical operation, the patient's wrist becomes numb, and the surgeon may use local anesthesia to induce drowsiness. In certain cases, general anesthesia is used by the doctors to induce deep sleep in the patient. For certain patients, anesthesia is contraindicated. Infections, sensitive scars, bleeding, damage to the nerves that branch off from the median nerve, and damage to nearby blood vessels are additional likely concerns connected to carpal tunnel surgery. Recovery after surgery might take anywhere from a few weeks to many months. Essentially, the length of time and severity of the compression on the median nerve determines the recovery. Two healing methods for strengthening and repairing the hand and wrist include physical therapy and wrist splinting. Doctors need to prepare a patient before surgery. Additional hazards could arise during and after the procedure due to other medical issues. Patients should therefore talk about these pre-existing medical issues. Additionally, the patient should disclose to the physician all drugs, including vitamins, supplements, over-the-counter medications, and botanicals [9]. In certain situations, the doctor suggests that the patient cease taking drugs such as ibuprofen, aspirin, and naproxen that could make the blood clotting process more difficult [9]. Because smoking slows down the healing process, it is also advised that smokers stop smoking prior to the carpal tunnel release. Prior to surgery, blood tests and an ECG are also necessary. Finally, for up to 12 hours before to the carpal tunnel surgery, the patient is advised by the doctor to abstain from any food and liquids. Depending on the patient's health, the



doctor may need to make further arrangements. Addressing carpal tunnel syndrome requires an understanding of the releasing process. The patient can go home the same day because the surgery is usually done as an outpatient procedure. The conventional method and endoscopic carpal tunnel release are the two types of carpal tunnel release surgery [8,9]. Conventional medicine, on the one hand, refers to the open release technique, in which the doctor makes a cut on the wrist during the process. The endoscopic carpal tunnel release, on the other hand, uses a camera inside a thin, flexible tube. Through a tiny incision, the surgeon places the tube into the wrist. Under the camera's guidance, the surgeon makes another incision through which tiny instruments are placed, and the procedure continues. Depending on the patient's condition, doctors may perform one of the carpal tunnel release surgery kinds.

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