

Managing Carpal Tunnel Syndrome: Insights into Symptoms and Relief

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Abstract

Carpal tunnel syndrome (CTS) is a prevalent and concerning issue affecting the wrist and hand, arising from the compression of the median nerve within the carpal tunnel. This compression results in a spectrum of distressing symptoms, including numbness, tingling, weakness, and discomfort, particularly in the thumb, index, and middle fingers. Despite its frequent association with repetitive hand movements and prolonged use of computers or handheld devices, CTS can stem from various factors, encompassing genetic predisposition, underlying health conditions, and occupational risks. The abstract aims to delve into the management of CTS, offering insights into its symptoms and potential relief strategies. Prompt recognition and comprehension of symptoms are crucial for effectively managing this syndrome. Diagnostic measures, including clinical assessments and nerve conduction studies, aid in confirming the diagnosis and initiating appropriate interventions. Therapeutic approaches for managing CTS span a spectrum from conservative to surgical measures, depending on the severity of symptoms and the patient's condition. Non-invasive methods such as wrist splinting, ergonomic adjustments, and lifestyle modifications often provide initial relief. Additionally, physical therapy and targeted exercises aim to alleviate discomfort and enhance wrist flexibility and strength. In cases refractory to conservative treatments, surgical interventions like carpal tunnel release may be considered to alleviate pressure on the median nerve, thereby mitigating symptoms and restoring hand function. This abstract strives to provide a comprehensive understanding of CTS management, emphasizing the importance of early recognition, lifestyle modifications, and a multi-disciplinary approach involving healthcare professionals. Educating individuals about preventive measures and ergonomic practices is paramount in minimizing the impact of CTS on daily activities and improving the overall quality of life.

Keywords: Carpal tunnel syndrome, lifestyle modifications, healthcare professionals, quality of life

INTRODUCTION

Carpal tunnel syndrome (CTS) is a frequent and frequently discomforting issue that impacts the hand and wrist. It arises when the median nerve, traveling from the forearm to the palm faces pressure or constriction at the wrist. Enclosed within the carpal tunnel, this narrow pathway accommodates both the median nerve and the tendons regulating finger movements. If this area becomes constrained, it can cause various symptoms and disrupt everyday tasks. The carpal tunnel plays a pivotal role in hand function, serving as a vital anatomical structure that facilitates the intricate movements and sensations essential for various daily activities through the coordinated functioning of the hand. Carpal tunnel syndrome commonly induces discomfort, numbness, tingling, and weakness in the hand and wrist. It results from heightened pressure exerted on the median nerve within the wrist. This nerve supplies feeling to the thumb, index, and middle

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fingers, as well as half of the ring finger, while the little finger (also known as the “pinky”) is usually unaffected [1, 2].

REVIEW OF LITERATURE

“*Managing Carpal Tunnel Syndrome: Insights into Symptoms and Relief*” encompasses a critical analysis of strategies and insights for handling carpal tunnel syndrome. This literature review delves into the comprehensive understanding of CTS symptoms, exploring various approaches to mitigate its impact and offer relief to affected individuals. The review systematically examines a plethora of studies, encompassing both clinical observations and empirical research findings. It elucidates the multifaceted nature of CTS symptoms, shedding light on the spectrum of discomfort experienced by individuals afflicted with this condition. Additionally, it delves into the effectiveness of diverse management approaches, ranging from conservative treatments like splinting, physical therapy, and lifestyle modifications to surgical interventions when necessary.

By synthesizing current research, the review highlights emerging trends and innovations in CTS management, addressing not only symptomatic relief but also preventive measures aimed at reducing its incidence. It critically evaluates the efficacy of different interventions, weighing their benefits and potential drawbacks to provide a comprehensive understanding for healthcare practitioners and individuals dealing with CTS. Overall, “*Managing Carpal Tunnel Syndrome: Insights into Symptoms and Relief*” offers an informative and insightful review of the existing literature, presenting a nuanced perspective on the complexities of CTS management, thus serving as a valuable resource for both clinicians and individuals seeking effective strategies to address this debilitating condition [3–5].

History

Orthopedic surgeons have acknowledged carpal tunnel syndrome for more than four decades, with its initial description dating back to the mid-1800s and the first surgical intervention to release the carpal tunnel occurring in the 1930s.

Carpal tunnel syndrome arises from the compression of the space in the wrist that houses tendons and the median nerve. Among its symptoms, individuals may experience hand numbness extending throughout the affected area (Figure 1) [6].

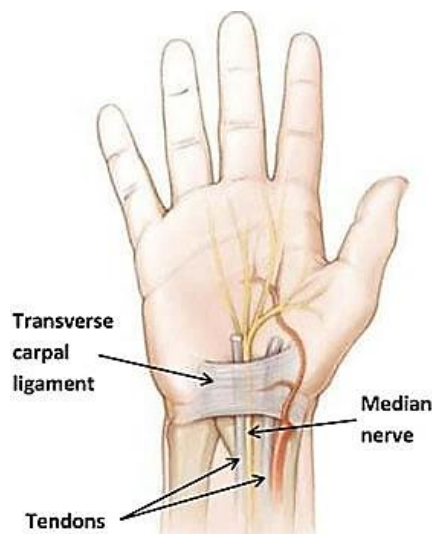


Figure 1. Carpal tunnel syndrome.

Functions of Carpel Tunnel

1. Passageway for the Median Nerve
 - The carpal tunnel resides as a slender pathway situated within the wrist.

- Its primary function is to house the median nerve, one of the major nerves responsible for transmitting signals between the brain and the hand.
2. Sensory and Motor Function:
 - The median nerve serves dual functions, providing both sensation and motor control to the hand.
 - Sensory fibers relay information about touch, temperature, and pain from the hand to the brain.
 - Motor fibers control the muscles of the thumb and fingers, enabling precise movements and dexterity.
 3. Fine Motor Skills:
 - The carpal tunnel supports fine motor skills, allowing for intricate movements of the fingers and thumb.
 - Activities such as typing, writing, and grasping small objects heavily rely on the coordination facilitated by the median nerve.
 4. Grip Strength and Stability:
 - The carpal tunnel is instrumental in maintaining grip strength and stability in the hand.
 - The muscles and tendons within the carpal tunnel work synergistically to ensure a firm and controlled grip during various tasks.
 5. Facilitation of Wrist Movements:
 - The carpal tunnel is intricately connected to the movement of the wrist joint.
 - It enables smooth flexion, extension, and lateral movement of the wrist, contributing to the versatility of hand motions.
 6. Precision and Coordination:
 - Precise movements, such as picking up small objects, typing on a keyboard, or playing a musical instrument, heavily rely on the coordination orchestrated within the carpal tunnel.
 7. Daily Activities and Work Performance:
 - Nearly all daily activities, from buttoning a shirt to cooking a meal, involve the intricate functioning of the hand facilitated by the carpal tunnel. In occupational settings, optimal hand function is crucial for productivity and performance [7].

Prevalence of Carpal Tunnel Syndrome

Carpal tunnel syndrome is a prevalent medical condition that impacts a considerable segment of the worldwide population. While the prevalence may vary across different regions and demographic groups, studies have consistently demonstrated its common occurrence.

1. Global Burden
 - CTS is recognized as one of the most prevalent nerve compression disorders globally.
 - Epidemiological research has showcased fluctuating occurrence rates, frequently impacted by elements like age, profession, and pre-existing health conditions.
2. Occupational Influence
 - Certain occupations are associated with a higher risk of developing CTS.
 - Jobs that involve repetitive hand movements, prolonged use of vibrating tools, or forceful gripping increase the likelihood of CTS development.
3. Gender Disparities
 - CTS is typically identified more frequently in women than in men.
 - Hormonal factors, such as those related to pregnancy and menopause, may contribute to the higher prevalence observed in women.
4. Age-Related Patterns
 - The likelihood of experiencing CTS tends to rise with advancing age.
 - Older individuals may be more susceptible to degenerative changes in the structures of the wrist and hand [8].

Impact on Daily Life

Carpal tunnel syndrome can have a considerable effect on an individual's everyday activities, affecting multiple facets of functionality, productivity, and general welfare. The consequences of CTS on daily life include:

1. Work Limitations
 - Individuals with CTS, especially those in occupations requiring repetitive hand movements, may face challenges in performing job-related tasks.
 - Decreased productivity and increased absenteeism can occur due to CTS-related symptoms.
2. Impaired Fine Motor Skills
 - CTS may impair delicate motor abilities crucial for activities like writing, typing, and fastening buttons on clothing. Delicate activities that demand precision and coordination may become challenging and painful.
3. Disruption of Sleep
 - Numerous people diagnosed with CTS encounter sensations like numbness and tingling, notably during nighttime.
 - Sleep disturbances can lead to fatigue and diminished overall quality of life.
4. Decreased Grip Strength
 - Grip strength is often compromised in individuals with CTS.
 - Activities requiring a strong and stable grip, such as lifting and carrying objects, may be affected.
5. Pain and Discomfort
 - Pain and discomfort in the hand, wrist, and forearm are hallmark symptoms of CTS.
 - Persistent pain can affect mood, focus, and participation in leisure activities.
6. Functional Limitations
 - Functional limitations can extend to routine tasks like cooking, driving, and using handheld devices.
 - The impact may vary, but individuals may find their overall independence affected.
7. Quality of Life
 - CTS can significantly influence a person's quality of life, impacting their physical, emotional, and social well-being.
 - Addressing CTS symptoms and seeking appropriate treatment is crucial for improving overall life satisfaction [9]

Causes

1. Repetitive Motion and Overuse
 - *Occupational Activities:* Repetitive hand and wrist movements, especially those associated with certain occupations, contribute significantly to CTS. Jobs that involve continuous typing, assembly line work, and prolonged use of vibrating tools can lead to overuse of the hand and wrist.
 - *Repetitive Stress:* Continuous and repetitive strain placed on the tendons and median nerve in the carpal tunnel may result in irritation and inflammation, eventually giving rise to the onset of CTS.
2. Health Conditions
 - *Diabetes:* People diagnosed with diabetes are more prone to experiencing nerve-related ailments, such as CTS. High levels of blood sugar can influence nerve performance and play a role in nerve compression.
 - *Rheumatoid Arthritis:* Inflammatory conditions, such as rheumatoid arthritis, can lead to joint and tissue inflammation, affecting the structures within the carpal tunnel.
 - *Thyroid Disorders:* Conditions like hypothyroidism can contribute to fluid retention and tissue swelling, increasing pressure within the carpal tunnel.

3. Repetitive Trauma and Vibrations

- *Trauma to the Wrist:* Injuring or traumatizing the wrist, such as through fractures or sprains, can change the carpal tunnel's composition, heightening the likelihood of nerve compression.
- *Vibrations:* Extended use of vibrating tools or machinery can contribute to CTS emergence. The persistent vibration can cause micro-injuries and inflammation within the carpal tunnel.

4. Genetic and Anatomical Factors

- *Family History:* Indications are supporting a genetic inclination towards CTS. Those with a familial background of the condition might be more prone, hinting at a possible genetic aspect.
- *Anatomical Variations:* Certain anatomical features can increase the risk of CTS. A carpal tunnel that is smaller than the average size might make individuals more prone to the compression of the median nerve. Additionally, variations in the shape or structure of the carpal bones can contribute to increased pressure.

5. Hormonal Changes

- *Pregnancy:* Hormonal changes during pregnancy, including fluid retention, can exert pressure on the carpal tunnel, leading to the development or exacerbation of CTS symptoms.
- *Menopause:* Changes in hormone levels during menopause may also influence the development of CTS in women.

6. Age and Gender

- *Age-Related Changes:* The risk of CTS increases with age, with older individuals more prone to degenerative changes in the wrist structures.
- *Gender Differences:* Women, particularly those who are pregnant or postmenopausal, are at a higher risk of developing CTS compared to men.

Common Daytime Symptoms

- Tingling in the fingers.
- Decreased feeling in the fingertips.
- Difficulty using the hand for small tasks, like:
 - Handling small objects.
 - Grasping the steering wheel to drive.
 - Holding a book to read.
 - Writing.
 - Using a computer keyboard.

As carpal tunnel syndrome progresses, symptoms tend to become persistent. These symptoms can include:

- Weakness in the hand.
- The incapacity to execute activities necessitating precise movements (like fastening a shirt).
- Dropping objects.

In the advanced stage, the muscles near the base of the thumb visibly diminish in size (atrophy).

Diagnostic Process for Carpal Tunnel Syndrome

The diagnostic process for carpal tunnel syndrome involves a thorough examination of the patient's medical history, and clinical evaluations, and often includes specialized tests to confirm the diagnosis.

1. Medical History

- The diagnostic journey typically starts with a comprehensive medical background check. The healthcare professional will inquire about symptoms, their duration, and any pertinent factors like occupation, recent injuries, or underlying health conditions.

2. Physical Examination

- *Tinsel's sign:* The physician may perform Tinsel's sign test by tapping over the median nerve in the wrist. Tingling or electrical sensations radiating into the hand may indicate compression of the nerve.

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- *Phalanx's maneuver*: This entails bending the wrist for a minute to observe if it triggers any symptoms. Tingling or numbness during this maneuver may suggest CTS.
 - *Duran's compression test*: The doctor may apply direct pressure over the carpal tunnel to assess for symptoms. Reproduction of symptoms supports the diagnosis.
3. *Nerve Conduction Studies*
 - Nerve conduction studies (NCS) are a key diagnostic tool for CTS and involve measuring the speed of electrical impulses along the median nerve.
 - Electrodes are positioned on the skin, administering a gentle electrical impulse to stimulate the nerve, while the duration it takes for the impulse to travel along the nerve is measured and documented.
 - Slow conduction velocity across the carpal tunnel is indicative of nerve compression.
 4. *Electromyography (EMG)*:
 - EMG is often performed in conjunction with NCS and involves the insertion of small needles into specific muscles of the hand and forearm.
 - The needles detect electrical activity in the muscles, helping to assess the severity of nerve compression and identify any muscle damage.
 - Abnormal EMG findings may support the diagnosis of CTS.
 5. *Imaging Studies*:
 - While not always necessary for diagnosis, imaging studies such as ultrasound or magnetic resonance imaging (MRI) may be used to assess the anatomy of the wrist and identify any structural abnormalities.
 - Imaging serves as a valuable tool in excluding other conditions that might present similar symptoms to those of CTS.
 6. *Blood Tests*:
 - Sometimes, blood tests are performed to eliminate underlying health issues like diabetes or thyroid disorders that might add to or resemble symptoms of CTS.
 7. *Clinical Correlation*:
 - The results of clinical evaluations and diagnostic tests are correlated with the patient's symptoms and medical history to arrive at a comprehensive diagnosis.
 - CTS is diagnosed when there is evidence of median nerve compression at the wrist, along with characteristic symptoms such as numbness, tingling, and pain in the hand and fingers.
 8. *Differential Diagnosis*:
 - The healthcare provider might explore other ailments that could manifest comparable symptoms, like cervical radiculopathy or thoracic outlet syndrome.
 - A careful differential diagnosis helps ensure accurate identification of the underlying cause of symptoms.

Management

1. *Rest and Modification of Activities*: Relieving the affected hand by resting it and adjusting activities that worsen symptoms can offer relief. Incorporating pauses during repetitive tasks and ensuring correct ergonomics are crucial.
2. *Wrist Splints*: Using a wrist splint during sleep aids in maintaining the wrist in a neutral alignment, diminishing pressure on the median nerve, and easing symptoms.
3. *Physical Therapy*: Physical therapy exercises focus on strengthening and stretching the muscles around the wrist and hand. This can improve flexibility and reduce strain on the median nerve.
4. *Medication*: NSAIDs are often suggested to ease pain and inflammation, while corticosteroid injections might be used in certain situations to diminish swelling.
5. *Surgery*: If conservative treatments prove ineffective in serious instances, surgery might be an option. Carpal tunnel release surgery entails the severing of the ligament that creates the upper structure of the carpal tunnel, easing pressure on the median nerve [10].

CONCLUSION

The combination of clinical evaluations, nerve conduction studies, electromyography, and other diagnostic tools allows healthcare professionals to assess the severity of CTS, plan appropriate interventions, and tailor treatment strategies to the individual needs of the patient. Carpal tunnel syndrome significantly impacts the quality of life for individuals affected, affecting daily activities and work performance. Preventive measures, including ergonomic considerations, regular breaks, and stretching exercises, play a crucial role in reducing the risk of CTS, especially in occupational settings. Early detection and intervention are key to preventing the progression of the condition, and a comprehensive approach that considers individual factors is essential.

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