

## Review Article



# Physiatric Management of Carpal Tunnel Syndrome

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### Abstract

*Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy of the upper limb. Diagnosis of CTS was rare before middle of the nineteenth century but in recent years it continues to be made with increasing frequency by the virtue of wide spread public awareness and highly specific diagnostic tests. Individuals engaged in repetitive works which involves flexion and extension of the wrist, strong grip or exposure to vibration are particularly at risk of developing the disease. It is now accounted amongst the common work related claimed disabilities in our country.*

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## Introduction

CTS, the most common focal peripheral neuropathy, results from compression of the median nerve at the wrist.<sup>1</sup> The most common finding in CTS is an increased carpal tunnel pressure.<sup>2</sup> It used to be unclear whether this was due to a reduction of the size of the carpal tunnel or an increase of its content, but several authors have stated that the increase in volume is caused by a non-inflammatory synovial fibrosis of the connective tissue within the carpal tunnel.<sup>3</sup> The syndrome affects an estimated 3 percent of adult Americans and is approximately three times more common in women than in men.<sup>4</sup> Patients complain of paresthesia in the hand along the distribution of the median nerve and often pain radiates to the arm. The syndrome intensified at night and the patient tries to get relief by shaking the hand in the air.

## Synonyms

CTS have some special synonyms. They are:

- Tardy median nerve palsy<sup>5</sup>
- Acroparesthesia<sup>6</sup>
- Median neuritis
- Median thenar neuritis
- Occupational median neuritis
- Thenar neural atrophy

## Historical Background

Sir James Paget first described the symptoms of CTS in 1854 and in 1911 Ramsey Hunt described this neuropathy.<sup>7</sup> Phalen wrote several articles on CTS since 1950.<sup>8</sup>

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## Incidence and Epidemiology

A recent study shows that the mean annual crude incidence was 329 cases per 100,000 person-years, and the standardized incidence was 276. The sex-specific incidences were 139 for men and 506 for women. The mean annual incidence for men increased moderately but significantly during the study period, whereas that for women remained constant. The age-specific incidence for women increased gradually with age, reaching a peak between 50 and 59 years, after which it declined. In men, there was a bimodal distribution with peaks between 50 and 59 years and between 70 and 79 years. Rural and industrial areas had higher crude and age- and sex-specific incidences than did urban areas.<sup>9</sup>

## Anatomy and Etiology

The carpal tunnel consists of the flexor tendons and the median nerve. These structures are surrounded by the sub-synovial connective tissue (SSCT), which consists of multiple layers of fibrous tissue that are interconnected by collagenous fibers.<sup>10,11,12</sup> Guimberteau reported that blood and lymphatic vessels, which irrigate the tendons, are also present in the SSCT.<sup>13</sup> The SSCT is surrounded by a radial and ulnar bursa.<sup>14,15,16,17,18,19</sup> A non-inflammatory synovial fibrosis of the connective tissue is the most common finding in carpal tunnel syndrome.<sup>20,21,22,23</sup> but the reason why this fibrosis develops remains unclear.

## Pathophysiology

CTS is the classic example of a chronic compression neuropathy. The entrapment neuropathy combines phenomena of compression and traction. Nerve compression and traction may cause disorders of the intra neural microcirculation, lesions in the myelin sheath and the axon, as well as alterations in the supporting connective tissue. The entrapment of a peripheral nerve occurs as a result of its passage through an anatomical compartment that has become too tight, resulting in altered function within the nerve and dysfunction/damage of the nerve from the site of compression and beyond.<sup>24</sup> The pathophysiology of CTS is complex and results from interactions of many mechanisms like increased carpal tunnel pressure<sup>25</sup>, Median nerve microcirculation injury<sup>26</sup>, Median nerve connective tissue alteration<sup>27,28</sup> synovial tissue hypertrophy<sup>29,30</sup> has been proposed.

## Presentation

- Fullness of the wrist
- Poor dexterity of the fingers and dropping of items
- Paresthesia and numbness of the fingers and nocturnal dysesthesia
- Pain worsening at night which is relieved by shaking the hand in the air.<sup>31</sup>

## Clinical Findings

The median nerve is accessible in front of the wrist flexion crease and behind the long palmar tendon or in the middle of the wrist.

- Tinel sign: The sensitivity is between 26 and 79% and the specificity is between 40 and 100%.<sup>32</sup>
- Phalen sign: The sensitivity is between 67 and 83% and the specificity is between 47 and 100%.<sup>32,33</sup>
- Paley and Mc Murphy test: the sign is positive if manual pressure close to the median nerve (between 1 and 2 cm proximally to the wrist flexion crease) triggers pain or paresthesia. The sensitivity is 89% and the specificity is 45%.<sup>32,34</sup>
- Compression test with wrist flexed: pressure is applied using two fingers on the median region of the carpal tunnel, with the wrist flexed at 60°, elbow extended and forearm supinated. The test is positive if paresthesia appears in the area of the median nerve. Tetro et al. found sensitivity of 82% and specificity of 99%.<sup>31</sup>

## Diagnosis

The diagnosis of CTS is based on the history and physical examination. Nerve Conduction Study (NCS) is recognized as the diagnostic standard for it.<sup>35</sup> NCS considered positive when the median nerve sensory latency exceeds the standard radial and ulnar nerve sensory latency by more than 0.4 millisecond. MRI of wrist proves both sensitive and specific in detecting CTS.<sup>37</sup>

## Management

Non surgical management with rehabilitation of the affected condition in the department of Physical Medicine and Rehabilitation is popularly known as Physiatric management. A trial of physiatric or conservative management can be pursued after diagnosis.<sup>38,39</sup>

### A) Drug management

- 1) NSAIDs: NSAID have little effect in relieving the symptoms and night pain but are recommended as primary treatment by some authors.<sup>40,41</sup>
- 2) Diuretics: Chang et al found that Trichlorthiazide 2mg daily for 4 weeks is less effective than NSAIDs and Prednisolone.<sup>42</sup>
- 3) Vitamin B6: Vitamin B6 is effective in selected cases of CTS and help in relieving symptoms earlier.<sup>43</sup>
- 4) Oral Steroid: A significant improvement shown by using prednisolone 25 mg/day with two and four weeks of treatment.<sup>42,44,45</sup>

### B) Interventional Physiatry

Corticosteroid injections are used frequently to treat CTS as it is considered to be both safe and effective for short term management.<sup>46</sup> Pathology specimens from carpal tunnel release have revealed chronic synovial inflammation, and it is suggested that corticosteroid injections are effective by decreasing the swelling of the flexor synovialis. A common belief is that corticosteroid injections can relieve the early symptoms of CTS.<sup>47</sup> Intra lesional corticosteroid injection improves VAS scores and Boston carpal tunnel questionnaire (BCTQ) either the symptom severity or functional capacity for mild to moderate CTS.<sup>48</sup>

Ultrasound-guided hydrodissection has recently been proposed to treat nerve entrapment. Hydrodissection leads to improved nerve mobility, greater reduction in symptoms, or decreased recurrence rate in comparison with regular ultrasound-guided injections.<sup>49-51</sup>

### C) Physical Modalities

Iontophoresis is a method of transdermal administration of ionized drugs in which electrically charged molecules are propelled through the skin by an external electrical field.<sup>52</sup> Advantages of steroid iontophoresis include being painless, noninvasive, sterile and providing local and little systemic concentration of the drug.<sup>52</sup>

Therapeutic ultrasound is a modality that produces acoustical high-frequency vibrations with both thermal and non thermal effects.<sup>53</sup> Deep, pulsed ultrasound over the carpal tunnel for 15 min for 20 treatments decreases pain and paresthesia symptoms, reduces sensory loss, and improves median nerve conduction and strength when compared with sham ultrasound.<sup>54-56</sup>

### D) Therapeutic Splinting

Splinting is a relatively inexpensive, non operative treatment for CTS. As CTS has been associated with forceful, repetitive hand and wrist activities, one purpose of splinting is to minimize motion at the wrist and subsequently decrease symptoms of pain and/or numbness.<sup>57,58</sup> Splinting is helpful for the common symptom of nocturnal paresthesias by limiting prolonged periods of excessive wrist flexion or extension during sleep. Positions of wrist flexion and extension causes increased pressure within the carpal tunnel, similar to the findings of increased pressure in the carpal tunnel with CTS, and is associated with changes in nerve structure.<sup>59,60</sup> Neutral wrist position results in lower carpal tunnel pressures compared with flexion or extension.<sup>61,62</sup>

### E) Exercise

Mobilization exercises (e.g., tendon gliding and nerve gliding) are commonly employed for symptoms of CTS and are felt to improve axonal transport and nerve conduction.<sup>63</sup> Tendon and nerve gliding exercises may maximize the relative excursion of the median nerve in the carpal tunnel and the excursion of the flexor tendons relative to one another.<sup>64</sup>

### F) Acupuncture

Acupuncture may be useful as an adjunct treatment or an acceptable alternative for managing CTS.<sup>65</sup>

### G) Activities of daily living (ADL)

Changing the workstation and design of tools to eliminate the stimuli for cumulative trauma can be both preventive and curative.

### H) Occupationat therapy

Job modification decreases the incidence of CTS.<sup>66</sup>

## Conclusion

CTS is a frequent genesis of pain and impairment throughout the population. Nonsurgical interventions are regularly used for CTS and include medications, splinting, exercises, modalities and alternative therapies. Although there is no absolute satisfactory conservative management available at present, trials suggest that physiatric management which encompasses pharmacological, non-pharmacological and rehabilitation aspects seems to offer clear advantages over surgical options.

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