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Introductory Chapter: Current State of Carpal Tunnel Syndrome

*Leonel García Benavides, Miriam Méndez del Villar
and Leonel Garcia Valdés*

1. General considerations

The carpal tunnel is a fibrous extension that connects the anterior compartment of the forearm with the palm of the hand. It is delimited by the pisiform bone medially, by the hamate bone laterally, and the base of the scaphoid and trapezoid bone and the roof by the dorsal radiocarpal ligaments of the carpus. Through the carpal tunnel, various anatomical structures pass, such as the median nerve (NM), the nine flexor tendons of the fingers and the thumb, the nerve is located on a superficial plane over the tendons and medial to the radio palmar artery, although its trajectory and division has numerous anatomical variant, which present with a frequency of 11% approximately in general population. The principal anatomical variants are the presence of a residual median artery (5% of the population) and the anastomosis of Martin-Gruber, a motor communication between the median and cubital nerves at the forearm, present in 5–10% of the population [1].

The American Association of Orthopedic Surgery (AAOS) defines carpal tunnel syndrome as the most common mononeuropathy [2]. It has a prevalence of 3.8% in general population, and has an incidence of 276 for every 100,000 citizens [3, 4]. It affects women in major proportions than men, and 50–60% of all patients have bilateral affection [5].

CTS can be divided into primary or idiopathic, which is associated with repetitive manual activity and secondary, which is associated to other pathologies.

Other studies have established that idiopathic CTS is caused by a spaced conflict between the limits of the tunnel and the content that passes through it, which increases the pressure inside the tunnel and consequently alters the blood flow to the MN, provoking an inflammatory response and epineural edema. In healthy individuals, the pressure inside the tunnel (with the hand at neutral position) varies from 3 to 5 mm/hg. However, in patients with CTS, this pressure in the same conditions is an average of 35 mmHg [6].

Other studies have encountered morphological changes in the synovial tissue that surrounds the tendons. The principal findings have been inflammation, edema and fibrosis [7]. Multiple biochemical changes in the proteoglycans have also been reported, which causes a decrease in the capacity of the tendon to deform and compress itself [6, 7].

These findings suggest that the changes in the tendons and the synovial tissues caused by repetitive manual activity and aging degeneration, increase the volume of content inside the tunnel, resulting in the compression of the MN, leading eventually to CTS [8]. Another suggested mechanism of lesion is through repetitive microtrauma of the MN caused by alterations on the kinetic movement of the tendon and the nerve [7].

The pathologies with a higher prevalence associated to CTS are diabetes mellitus; with a prevalence of 14–30% of the patients, in which a dysfunction of The Schwann cells, alterations of the immune system and microangiopathy have been associated. Pregnancy is associated to diverse alterations of the peripheral nervous system. Amyloidosis through a direct lesion to the MN by amyloid deposits [5]. This book describes not only the prevalence, but also diagnostic methods and treatment efficacy of compressive neuropathies of the median and the ulnar nerves in patients with diabetes mellitus.

The clinical manifestations can be classified into three stages according its severity: first stage: nocturnal paresthesia and pain in the carpal region [3]. The sensorial symptoms and the pain continue through the day and the sensation of a having clumsy hand is added, presenting difficulties to perform precise activities with the hand. Atrophy of the thenar eminence and weakness are present in the final stage [4].

It is common that the patients mention the necessity to shake the hand to try to diminish the symptoms, which is known as Flick's sign [9], which reflects the presence of abnormalities in nerve conduction studies; it has a sensibility and specificity of 93 and 96%, respectively. Due to the variety in the clinical manifestations, we should focus on the new evaluation instruments used with the intent of identifying symptomatology and evolution, such as the Boston questionnaire [10, 11].

Provocative tests are numerous maneuvers that exist to detect CTS, these include Phalen's test, which has a sensibility of 57–91% and a specificity of 33.86%; Reversed Phalen's test, which has a sensibility of 23–60% and a specificity of 64–87%; Tinel's Sign, which has a sensibility of 67% and a specificity of 55–87% and Durkan's Test; which has a sensibility of 64% and a specificity of 83% [12, 13].

To quantitatively establish the electrophysiological state of the nerve and select the definitive treatment, it is required to perform nerve conduction studies, which have a sensibility and specificity of 85 and 94%, respectively, and are realized comparing the findings of the MN to another nerve [2, 14].

2. New approaches to be followed

This book will approach the current treatment regarding CTS, which can be classified into surgical and non-surgical. The decision of which treatment to follow is difficult and the severity of the symptoms must be taken into consideration. In patients with moderate to severe manifestations, surgical treatment must be considered as the first choice. Non-surgical treatment includes different therapeutic actions such as steroid injections or use of drugs with antioxidant and anti-inflammatory properties. Splinting is recommended before any option of treatment; surgical or non-surgical; the proper application of orthotic splinting is analyzed as well in this book as a special chapter to show the clinical convenience of a novel light guided medical device.

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Author details

Leonel García Benavides^{1,2*}, Miriam Méndez del Villar¹ and Leonel Garcia Valdés²

¹ Division of Health Sciences, Cutonala, University of Guadalajara, Jalisco, México

² Hospital Civil de Guadalajara “Fray Antonio Alcalde”, Guadalajara, Jalisco, México

*Address all correspondence to: drleonelgb@hotmail.com

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