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A Handy Overview to Carpel Tunnel Syndrome

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ABSTRACT:
Carpal Tunnel Syndrome (CTS), which affects 3.8% of the general population, is still a perplexing and incapacitating ailment. CTS is the most common and well-known median nerve entrapment, accounting for 90% of all entrapment neuropathies. The pathogenesis may be attributed to genetic susceptibility, repeated exposure to vibrations or jarring angular motions, injury, or specific medical conditions including diabetes, pregnancy, or morbid obesity. The prevalence of this phenomenon is higher in older people and females. When patients exhibit typical symptoms including numbness, tingling, nocturnal paresthesia, or neuritis "pins-and-needles" discomfort in the radial 3.5 digits, the diagnosis is mostly clinical and is suspected. To facilitate the diagnosis, some intriguing techniques can be used to elicit the disease's symptoms. Diagnostic uncertainty or the need for an unbiased assessment of whether or not a more invasive surgical intervention is necessary necessitates additional testing such as electrodiagnostic tests, ultrasonography, or magnetic resonance imaging. With a focus on the pathophysiology and clinical presentation, this study seeks to give an overview of this ubiquitous disorder. Additionally, various diagnostic techniques—such as nerve conduction tests, ultrasonography, and magnetic resonance imaging—are examined.

Keywords: Carpel Tunnel Syndrome, Median Nerve, Entrapment Neuropathy, Nerve Conduction Studies, Ultrasound.

I. INTRODUCTION:

Carpal tunnel syndrome (CTS) is one of the most prevalent upper limb compression neuropathies[1,2] CTS is a typical medical ailment that affects many people and leaves them with pain, numbness, and tingling in their hands and arms[3]. About 90% of entrapment neuropathies are caused by CTS occur when the median nerve is pinched or compressed as it passes through the wrist[1, 2], CTS develops[3]. A persistent localized compressive neuropathy known as entrapment neuropathy is brought on by an increase in pressure inside rigid anatomical structures. The carpal tunnel, which is bounded by the carpal bones and the transverse carpal ligament, is where the median nerve becomes entrapped, resulting in CTS[4].

Rheumatologists and orthopedic hand specialists frequently encounter the perplexing and incapacitating ailment known as carpal tunnel syndrome (CTS). It is a compressive neuropathy, which is characterized by mechanical distortion brought on by a compressive force and includes mononeuropathy and radiculopathy. It is described as a symptomatic compression neuropathy of the median nerve at the level of the wrist in the Clinical Guidelines on the Diagnosis of CTS published by the American Academy of Orthopaedics Surgeons (AAOS)[5,6,7].Women are more likely than men to experience CTS. The risk of CTS is larger for men between the ages of 75 and 84 than it is for women, according to more regular reviews of the disease's incidence[8].CTS's etiology can be linked to a person's job, way of life, accident, or genetic predisposition. The most frequent causes of CTS are believed to be repetitive vibration exposure or jarring angular motions, although other conditions such as diabetes, pregnancy, and morbid obesity may further increase the chance of developing CTS[9]. The anatomy, epidemiology, risk factors, pathogenesis, phases, diagnosis, and treatment options of CTS are covered in this review article.

ANATOMY

On the palmar surface of the wrist, there is a constrictive, hard canal known as the carpal tunnel[10]. It is frequently referred to as the transverse carpal ligament and is created anteriorly

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by the flexor retinaculum, with its middle section reaching 2-4 mm in thickness (TCL) [11].The volar surface of the carpus, which is concave and creates the so-called carpal sulcus, limits the posterior aspect. The radio-carpal eminence, which is made up of the tubercles of the scaphoid and trapezium bones, forms the lateral boundary of the carpal sulcus. The tubercles of the pisiform and hook of the hamate bones, also known as the ulnar carpal eminence, constitute the medial border. The volar surface of the wrist crease is where the most proximal part of the carpal tunnel starts, and it extends distally from there to the lateral border of the thumb[12].

Even though the anatomy may differ, CTS symptoms can evolve with time. For instance, the high split of the nerves caused by variations in their anatomical structure can result in a bifid median nerve. Another distinction can be seen in the median nerve's motor branch. This version has five possible thenar division paths and starting points. The two most common forms of variation are extraligamentous and transligamentous. The radial, anterior, or central portions of the median nerve may include the nerve bundles intended for the thenar branch[13].In other cases, the thenar branch enters the thenar muscles after passing through a tunnel. These variations highlight the inconsistent motor effect that can occur when the median nerve is severely compressed. The palmar cutaneous branch of the median nerve has another variation. The size and shape of the CT are also influenced by the movements of the wrist joint. The CT pressure also rises with flexion and extension. On the other hand, as the wrist joint bends, the cross-section of the proximal aperture of the CT diminishes. The transverse carpal ligament's (TCL) circular modifications and the migration of the capitates bone's distal end are to blame for this. The lunate bone is forced into the interior portion of the tunnel by extreme extension, constricting the route[14].

EPIDEMIOLOGY

The most frequent entrapment disorder, CTS affects one or more peripheral nerves and causes numbness or paralysis in the body organ that is being impacted. CTS affects, on average, at least 3.8% of patients who report hand aches, unresponsiveness, or itching[15]. Medical examinations and electrophysiological tests are used to diagnose CTS, albeit the most common diagnosis for patients exhibiting these symptoms is idiopathic CTS. Additionally, there are 276 cases of CTS per 100,000 annual reports, with a 9.2% incidence rate for women and a 6% incidence rate for men[15]. Although CTS occurrences are common across all age groups, persons between the ages of 40 and 60 are more likely to experience CTS.The prevalence statistics may also change between different jobs and industries; for example, the fish processing industry reports an estimated 73% of its workforce has CTS. While the prevalence of CTS in pregnant women has been estimated to be around 2%, diabetic patients had prevalence rates of 14% without and 30% with diabetic neuropathy, respectively[16].

AETIOLOGY

Acute and chronic CTS are two different types of the condition. The quick and persistent increase in pressure in the carpal tunnel causes the acute type, which is rather uncommon. Additionally, burns, coagulopathy, local infections, and injections are connected to it. The chronic form is significantly more prevalent, and the symptoms may last for years. Only 50% of cases have a known cause, which can be categorised as local, regional, or systemic[17].

1. Local Causes
- Inflammatory: e.g. tenosynovitis, histoplasma, fungal infection, hypertrophic synovium
- Trauma: e.g. Colles' fracture, dislocation of one of the carpal bones
- Tumors : e.g. Haemangioma, cyst, ganglion,
- Anatomical anomalies: e.g. thickened transverse carpal ligament, bony abnormalities, abnormal muscle bellies, persistent median artery.

2. Regional Causes
- Osteoarthritis
- Rheumatoid arthritis
- Amyloidosis
- Gout

3. Systemic Causes
- Diabetes
- Obesity
- Hypothyroidism
- Pregnancy
- Menopause
- Systemic lupus Erythematous
- Renal failure
- Leukemia/ Haemophilia
- Alcoholism

CLINICAL MANIFESTATIONS

Depending on the disease's severity, the symptoms change. Patients typically describe symptoms in the early stages that are caused by the median nerve's sensory component being involved,

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and only later do they report symptoms caused by the median nerve's motor fibres being involved. Burning pain, tingling, and numbness in the median nerve's distribution distal to the wrist are the most typical symptoms. Traditionally, the thumb, index, middle, and radial half of the ring finger are the hand parts involved[18].

CTS may be classified on the basis of symptoms and signs into three stages:

Stage 1: Patients frequently awaken in the middle of the night with the impression that their hands are bloated and numb. They experience excruciating pain that radiates from their wrist to their shoulder as well as a bothersome tingling in their hand and fingers (brachialgia paraesthetica nocturna). The flick sign, which is hand shaking, alleviates the symptoms. The feeling of hand stiffness typically lasts all morning.

Stage 2: The symptoms appear during the day as well, usually when the patient spends a lot of time in one place or makes repetitive movements with their hand and wrist. When a motor deficit first manifests, people frequently drop things out of their hands because they can no longer feel their fingers.

Stage 3: This is the last stage, during which the thenar eminence has manifested atrophy (wasting), and the median nerve typically reacts poorly to surgical decompression. Sensory problems may lessen at this point. Additionally, the thenar eminence is aching, and the abductor pollicis brevis and opponens pollicis have atrophy, severe compression, and weakness[19].

PATHOPHYSIOLOGY

Mechanical stress, elevated pressure, and ischemia insult to the median nerve within the carpal tunnel are all contributing factors in the pathogenesis of CTS[20]. In terms of increasing pressure, it has been observed that normal pressure ranges between 2 mmHg and 10 mmHg. The movement of the wrist can cause significant changes in the fluid pressure within the carpal tunnel. As a result, the pressure increases by more than 10 times with extension, whereas the pressure increases by 8 times with wrist flexion[21]. Repetitive wrist movements are therefore a major risk factor for CTS occurrences.The nerve's demyelination begins where the compression occurs and progresses to the intermodal segment, where the axons are still intact. Continuous compression disrupts blood flow to the endoneurial capillary system, altering the blood-nerve barrier and leading to endoneurial edoema formation. As a result, a powerful cycle that includes localised metabolic changes, ischemia, and venous congestion starts[20,21].Because symptoms quickly disappear following carpal tunnel release surgery, ischemic damage is also recognised as an important component of CTS. Paraesthesias in carpal tunnel syndrome patients are worsened by limb ischemia. Increased intrafunicular pressure, capillary damage with leakage and edoema, and obstruction of arterial flow in the patients are the three stages of this[21].

CLINICAL EXAMINATION

The appropriate medical practitioner must create a case history linked to the distinctive symptoms of CTS in order to diagnose patients with CTS. The patient should be questioned about the frequency of these symptoms, whether they occur during the day or night, and whether any positions or repetitive motions cause them[22].The physical examination of the patient's hand is a critical step in the diagnosis of CTS since certain findings may suggest the presence of other causes. The Tinel sign and Phalen manoeuvre are the first diagnostic procedures for carpal tunnel syndrome. When tapping over the median nerve distribution when the carpal tunnel is open results in symptoms, the Tinel's sign is positive.However, when a patient performs Phalen's maneuver, which involves flexing the wrist to 90 degrees, the test is successful if the flexing triggers symptoms throughout the median nerve's distribution.[23]

NERVE CONDUCTION STUDIES

Nerve Conduction Studies (NCS) were developed in response to the discovery in 1956 that median nerve conduction times are slowed across the wrists of CTS patients. Longer median nerve motor and sensory latencies as well as slower motor and sensory conduction velocities are considered as diagnostic indicators for CTS. However, new reports from certain authors suggest that the best diagnostic criteria are still ambiguous.[24]

NCS's objectives [3]

• To verify a specific median nerve injury within the carpal tunnel.

• To rate the severity of the neurophysiological condition.

• To specify if axonal degeneration, demyelination, or conduction block is the pathophysiology of the nerve.[25]

Because NCS is an objective test that provides details on the physiological health of the median nerve through the carpal tunnel, it is regarded as the gold standard in the diagnosis of CTS. Comparing the latency and amplitude of a

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median nerve segment crossing the carpal tunnel to another nerve segment that does not, such as the radial or unlar nerve, is the conventional technique of diagnosis. A transcutaneous electrical pulse stimulates the nerve, causing it to experience an action potential. Instead of utilising 'normal' values for the amplitude and latency of the median nerve response, it is more accurate to compare the median nerve response to another nerve segment that does not pass through the carpal tunnel[20].

ULTRASOUND

The use of ultrasound (US) has been linked to the diagnosis of CTS since the thickness of the median nerve, flattening of the nerve within the tunnel, and bowing of the flexor retinaculum are all symptoms specific to the condition. When the nerve is measured at the level of the pisiform, right before it flattens at the point of compression, US may show an increased cross-sectional area (CSA). As a result, ultrasound enhances EDX diagnosis and can be employed as an additional diagnostic tool that also enables screening for structural wrist problems.[25]

MAGNETIC RESONANCE IMAGING

The detection of uncommon pathological causes of CTS, such as ganglion, haemangioma, or bony deformity, using magnetic resonance imaging (MRI) is excellent since the existence of these conditions may change the course of surgical treatment. The symptoms to watch out for when diagnosing CTS include swelling of the median nerve and increased signal intensity on T2-weighted images showing accumulation of the axonal transportation, myelin sheath degradation, or oedema.[26] Because the medianulnar sensory delay difference and the length of the aberrant nerve signal on T2-weighted MRI are reliable indicators of surgical outcome, MRI can identify patients who would benefit from surgical intervention.

Magnetic Resonance Imaging (MRI) is excellent for picking up rare pathological causes of CTS such as ganglion, haemangioma or bony deformity - the presence of which may alter surgical intervention. Swelling of the median nerve and increased signal intensity on T2-weighted images indicating accumulation of the axonal transportation, myelin sheath degeneration or oedema are the signs to look out for when diagnosing CTS.[26] MRI is able to predict those patients who would benefit from surgical intervention, because the length of the abnormal nerve signal on T2-weighted MRI and the medianulnar sensory latency difference are good predictors of surgical outcome.It is frequently used to pinpoint the location of nerve entrapment following the failure of a CTR, to make a differential diagnosis in the event of ambiguous symptoms, and to confirm the presence of lesions that occupy space.[25]

Other Neurophysiologic Evaluations

Clinical neurophysiologic assessments of the median nerve over the wrist can take many different forms. These include the symptom questionnaire (hand diagrams), the vibrometry threshold test, the current perception test, and other quantitative sensory tests like the Semmel-Weinstein monofilament test, tactile sensation testing, and two-point discrimination. Due to their significant subjective components, these approaches are less sensitive than NCS[27].

MANAGEMENT

The severity of the condition determines how CTS incidences in patients should be managed. There are two types of CTS treatment: conservative and surgical. Typically, patients with mild to moderate CTS symptoms are given conservative treatment.[27] Oral and intravenous steroids, corticosteroids, vitamins B6 and B12, nonsteroidal anti-inflammatory drugs (NSAIDs), ultrasound, yoga, carpal bone mobilization, and the use of hand splints are all possible treatments for this condition.[28]

The first line of nonsurgical treatment for mild and severe CTS consists of wrist bracing, local corticosteroid injections, and oral medicines. If symptoms can spontaneously improve, nonsurgical treatment should also be taken into account (e.g, during pregnancy). Based on findings indicating CTS symptoms get better with rest and get worse with exercise[29], wrist splinting is justified. It may also be used to enhance other therapy modalities and is also advised for use in risk factors that are more treatable, such pregnancy. Compared to a placebo, oral administration of prednisone at a dose of 20 mg per day improves the person's symptoms and functional abilities, with gains lasting an average of eight weeks[27].Physical therapy, which includes exercises for the nerve glide and ultrasounds as well as carpal bone mobilisation, is another alternative for managing patients. These, however, are frequently less successful and necessitate the involvement of seasoned therapists. Conversely, patients with significant CTS or nerve damage as a result of electrodiagnostic results necessitate surgical

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decompression as a CTS therapeutic strategy[27,30]. The management of CTS incidences in patients depends on the severity of the disease. The treatment of CTS falls under two categories: conservative and surgical. Conservative treatment is generally offered to patients suffering from mild to moderate symptoms of CTS 30[27]. Options of such treatment include oral and transvenous steroids, corticosteroids, vitamins B6 and B12, nonsteroidal anti-inflammatory drug (NSAIDs), ultrasound, yoga, carpal bone mobilisation and the use of hand splints.[28, 31]

In patients with untreated mild and mild to severe CTS, the use of a rigid neutral splint immobilising the wrist, typically at night, for six weeks leads to improved clinical improvements. Local corticosteroid injections reduce swelling and inflammation of the tenosynovium that passes through the carpal tunnel, hence lowering tunnel pressure [29 31]. When compared to a placebo, this treatment for severe CTS improves symptoms after one month, but in mild and moderate cases, the benefit continues to be unclear. The primary negative impact of local corticosteroid injections is inhibition of collagen and proetoglycan synthesis in tenocytes, leading to a reduction in the mechanical strength of the tendon and subsequent degeneration.[32]

II. CONCLUSION

One of the most well-known and frequent forms of median nerve entrapment is CTS, a common medical ailment. When the median nerve is pinched or compressed as it passes through the wrist, CTS results. Pain, numbness, and tingling in the median nerve's distribution in the hand are symptoms of the syndrome. With an emphasis on anatomy, epidemiology, aetiology, clinical symptoms, pathophysiology, diagnosis, and therapeutic choices, this review of the literature gave an overview of CTS. Neutral wrist splints have been shown to be effective in non-operative initial management. Regardless of approach, there is compelling evidence that operational treatment is superior to non-operative management. Complications are rare, and the majority are minor and temporary..

REFERENCE;

[1]. Eversmann WW Jr. Entrapment and compression neuropathies. In: Green DP, editor. Operative hand surgery vol 2. New York: Churchill Livingstone; 1993. pp 1341 – 85

[2]. Omer GE, Jr. Median nerve compression at the wrist. Hand Clin 1992;8(2):317-24.

[3]. . Ashworth N: Carpal tunnel. BMJ. 2014, 349:g6437. 10.1136/bmj.g6437

[4]. Burns TM. Mechanisms of acute and chronic compression neuropathy. In: Dyck PJ, Thomas PK, Eds. Peripheral neuropathy. 4th ed. Amsterdam: Elsevier 2005; pp. 1391-402.

[5]. Paget J. Lectures on surgical pathology. Philadelphia: Lindsay and Blakiston 1854.

[6]. Alfonso C, Jann S, Massa R, Torreggiani A. Diagnosis, treatment and follow-up of the carpal tunnel syndrome: a review. Neurolog Sci 2010; 31(3): 243-52.

[7]. American Academy of Orthopaedic Surgeons Work Group Panel. Clinical guidelines on diagnosis of carpal tunnel syndrome, 2007.

[8]. Blumenthal S, Herskovitz S, Verghese J: Carpal tunnel syndrome in older adults. Muscle Nerve. 2006, 34:78-83. 10.1002/mus.20559

[9]. Franklin GM, Friedman AS. Work-Related Carpal Tunnel Syndrome. Diagnosis and Treatment Guideline. Phys Med Rehabil Clin N Am. 2015; 26(3): 523–537, doi: 10.1016/j.pmr.2015.04.003.

[10]. Goldberg G, Zeckser JM, Mummaneni R, et al. Electrosonodiagnosis in Carpal Tunnel Syndrome: A Proposed Diagnostic Algorithm Based on an Analytic Literature Review. PM R. 2016; 8(5): 463–474, doi: 10.1016/j.pmrj.2015.11.016.

[11]. Spinner RJ, Dellon AL. Emanuel B. Kaplan, M.D. (1894–1980): A Legendary Anatomist and Hand Surgeon. Clin Anat. 2018; (507)

[12]. Elsaftawy A, Gworys B, Jabłecki J ST. "Dangerous" anatomic varieties of recurrent motor branch of median nerve. Pol Przegl Chir. 2013; 85(8): 419–423.

[13]. Chammas M, Boretto J, Burmann LM, Ramos RM, Santos Neto FC, Silva JB: Carpal tunnel syndrome - part I (anatomy, physiology, etiology and diagnosis). Rev Bras Ortop. 2014, 49:429-436ss

[14]. Ghasemi-Rad M, Nosair E, Vegh A, et al.: A handy review of carpal tunnel syndrome: from anatomy to diagnosis and treatment. World J Radiol. 2014, 6:284-300.

[15]. Ibrahim I, Khan W, Goddard N, Smitham P: Carpal tunnel syndrome: a review of

the recent literature. Open Orthop J. 2012, 6:69-76.

[16]. Finsen V, Zeitlmann H. Carpal tunnel syndrome during pregnancy. Scand J Plast Reconstr Surg Hand Surg 2006; 40(1): 41-5.

[17]. Stolp-Smith KA, Pascoe MK, Ogburn PL Jr. Carpal tunnel syndrome in pregnancy: frequency, severity, and prognosis. Arch Phys Med Rehabil 1998;79(10):1285-7

[18]. Phalen GS. The carpal-tunnel syndrome. Seventeen years' experience in diagnosis and treatment of six hundred fifty-four hands. J Bone Joint Surg Am 1966;48(2):211-28.

[19]. Pfeffer GB, Gelberman RH, Boyes JH, Rydevik B. The history of carpal tunnel syndrome. J Hand Surg Br 1988; 13(1): 28-34.

[20]. Werner RA, Andary M. Carpal tunnel syndrome: pathophysiology and clinical neurophysiology. [Review] [71 refs]. Clin Neurophysiol 2002; 113(9): 1373-81.

[21]. Uchiyama S, Itsubo T, Nakamura K, Kato H, Yasutomi T, Momose T: Current concepts of carpal tunnel syndrome: pathophysiology, treatment, and evaluation. J Orthop Sci. 2010, 15:1-13

[22]. Ghasemi-Rad M, Nosair E, Vegh A, et al.: A handy review of carpal tunnel syndrome: from anatomy to diagnosis and treatment. World J Radiol. 2014, 6:284-300.

[23]. Genova A, Dix O, Saefan A, Thakur M, Hassan A. Carpal tunnel syndrome: a review of literature. Cureus. 2020 Mar 19;12(3).

[24]. Simpson JA. Electrical signs in the diagnosis of carpal tunnel and related syndromes. J Neurol Neurosurg Psychiatry 1956; 19(275): 280.

[25]. Ibrahim I, Khan WS, Goddard N, Smitham P. Suppl 1: carpal tunnel syndrome: a review of the recent literature. The open orthopaedics journal. 2012;6:69.

[26]. Kleindienst A, Hamm B, Hildebrandt G. Diagnosis and staging of carpal tunnel syndrome: comparison of magnetic resonance imaging and intra-operative findings. Acta Neurochir Wien 1966; 138: 228-33.

[27]. Wipperman J, Goerl K: Carpal tunnel syndrome: diagnosis and management. Am Fam Physician. 2016, 94:993-999.

[28]. Walker WC, Metzler M, Cifu DX, et al. Neutral wrist splinting in carpal tunnel syndrome: A comparison of night-only versus full-time wear instructions. Arch Phys Med Rehabil. 2000; 81(4): 424–429.

[29]. Ostergaard PJ, Meyer MA, Earp BE, et al. Non-operative Treatment of Carpal Tunnel Syndrome. 2020.

[30]. Prime MS, Palmer J, Khan WS, Goddard NJ. Is there Light at the End of the Tunnel? Controversies in the Diagnosis and Management of Carpal Tunnel Syndrome. Hand 2010; 5(4): 35460.

[31]. Sato Y, Honda Y, Iwamoto J, Kanoko T, Satoh K. Amelioration by mecobalamin of subclinical carpal tunnel syndrome involving unaffected limbs in stroke patients. J Neurol Sci 2005; 231: 13-8.

[32]. Osiak K, Elnazir P, Walocha JA, Pasternak A. Carpal tunnel syndrome: State-of-the-art review. Folia Morphologica. 2021 Nov 9.