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Review Article

CARPAL TUNNEL SYNDROME AND ITS TREATMENT MODALITIES: A REVIEW

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ABSTRACT

Carpal tunnel syndrome (CTS) is the most commonly diagnosed disabling condition of the upper extremities and it is the most commonly known and prevalent type of peripheral entrapment neuropathy that accounts for about 90% of all entrapment neuropathies. Carpal tunnel syndrome is a collection of characteristic symptoms and signs that occur following the compression of the median nerve with the carpal tunnel. This review aims to provide a clear view on CTS and give an outline for the treatment of CTS by considering its clinical manifestation, diagnostic modalities and give a clear view for the management of this common condition.

Keywords: Carpal tunnel syndrome; diagnosis.; entrapment neuropathy; median nerve; pathophysiology

INTRODUCTION

The carpal tunnel is formed by the concave anterior surface of the carpal bones and closed by the flexor retinaculum. It is tightly packed with the long flexor tendons of the fingers, with their surrounding synovial sheath and the median nerve. It affects mainly middle aged women. In the majority of patients, the exact cause and pathogenesis of CTS is unclear although several occupations have been linked to increased incidence and prevalence of CTS. The risk of CTS is high in occupations involving exposure to high pressure, high force, repetitive work, and vibrating tools. Clinically the syndrome consists of burning pain or "pins and needles" along the distribution of the median nerve to the lateral three and half fingers and weakness of the thenar muscles. There are several physical examination tests that will help in the diagnosis of CTS but none of these tests are diagnostic on their own. The gold standard test is nerve conduction studies. However, they are also associated with false positive and false negative results. The diagnosis of CTS should be based on history, physical examination and results of electrophysiological studies. The patient with mild symptoms of CTS can be managed with conservative treatment, particularly local injection of steroids[1] Carpal tunnel syndrome is a compressive neuropathy, which is defined as a mononeuropathy or radiculopathy caused by mechanical distortion produced by a compressive force [2] CTS is the most well-known and frequent form of median nerve entrapment and accounts for 90% of all entrapment neuropathies [1, 3-5]

Physical examination:

The diagnosis of carpal tunnel syndrome is primarily based on history and physical examination findings. Ecchymosis or abrasions on the wrists and hands suggest an acute injury to the tissue, including the median nerve, as the etiology. Bony abnormalities, such as boutonniere deformity, swan neck deformity, and ulnar deviation of the wrist, suggest rheumatoid arthritis whereas carpal or distal phalanx bossing suggests osteoarthritis. Thenar atrophy usually occurs only with severe, chronic carpal tunnel syndrome, and is more commonly associated with other neuropathy syndromes and carpometacarpal arthritis

Diagnostic Value of History and Physical Examination Findings for Carpal Tunnel Syndrome

FINDING	*SENSITIVITY (%)*	*SPECIFICITY (%)*	*POSITIVE LIKELIHOOD RATIO*	*NEGATIVE LIKELIHOOD RATIO*
Flick sign	93	96	21.4	0.1
Hypalgesia	39	88	3.1	0.7
Square wrist sign	53	80	2.7	0.6
Classic or probable pattern on hand symptom diagram	64	73	2.4	0.5
Abduction weakness	65	65	1.8	0.5
Thenar atrophy	16	90	1.6	0.94
Tinel sign	36	75	1.4	0.8
Phalen maneuver	57	58	1.3	0.7
Nighttime or morning symptoms	70	43	1.2	0.7

Patients should be evaluated for the presence of hypalgesia (diminished ability to perceive painful stimuli) along the palmar aspect of the index finger compared with the ipsilateral little finger of the affected hand. A two-point discrimination test, in which the inability to discriminate points less than 6 mm apart is considered abnormal, can be performed with a caliper. The abductor pollicis brevis may display notable weakness on strength testing. The physician can observe this weakness by instructing the patient to raise his or her thumb perpendicular to the palm as the physician applies downward pressure on the distal phalanx, resisting thumb abduction

Nerve Conduction Analysis

The electrophysiological classification, in agreement with the AAEM guidelines, follows the neurophysiological progression of CTS severity and includes the following classes:

Negative CTS: Normal findings on all tests (including comparative and segmental studies)

Minimal CTS: Abnormal findings only on comparative or segmental tests

Mild CTS: SCV slowed in the finger-wrist tract with normal DML

Moderate CTS: SCV slowed in the finger-wrist tract with increased DML

Severe CTS: Absence of sensory response in the finger-wrist tract with increased DML

Extreme CTS: Absence of thenar motor response

Phalen maneuver and Tinel sign have been used to observe for reproduction of the patient's symptoms when the wrist is placed in flexion or when it is percussed on the volar surface, respectively. However, Phalen maneuver, Tinel sign, presence of thenar atrophy, and history of nocturnal paresthesias have little diagnostic value compared with other history and examination findings

Adjunctive tests:

Electrodiagnostic testing is indicated for selected patients, whereas ultrasonography, magnetic resonance imaging, and computed tomography generally are not helpful.[6]Nerve conduction studies and electromyography can be used for confirmation of diagnosis in patients with an intermediate pretest probability or with an atypical presentation and also be used to quantify and stratify disease severity, which may aid in treatment decisions. A slowed median nerve conduction velocity supports the diagnosis. Nerve conduction studies have a sensitivity of 56 to 85 percent and a specificity of at least 94 percent for carpal tunnel syndrome.[7, 8] Electromyography is often paired with nerve conduction studies to differentiate primary muscle conditions from muscle weakness caused by neurologic disorders. In patients with a high probability of carpal tunnel syndrome based on history and physical examination, nerve conduction studies and electromyography generally are not indicated. Electrodiagnostic studies have a sensitivity of 56% to 85% and specificity of 94% to 99% for CTS.[9] Results may be normal in up to one-third of patients with mild CTS. Therefore, these studies should be reserved for confirming CTS in atypical cases and excluding other causes.

Ultrasonography:

The cross-sectional area of the median nerve is closely correlated with CTS symptoms and severity. A meta-analysis found that a cross-sectional area of 9 mm^2 or more is 87.3% sensitive and 83.3% specific for CTS. Experience in performing ultrasonography for the diagnosis of CTS correlates with greater inter-rater reliability when measuring the cross-sectional area.[10] Advantages of ultrasonography include lower cost; noninvasiveness; patient comfort; and evaluation of etiologies such as tenosynovitis, mass lesions, and tendinopathies. However, ultrasonography relies on local expertise and cannot rule out etiologies such as polyneuropathies or gauge severity of CTS.[11, 12]

Other tests:

Plain radiography may be useful if structural abnormalities, such as bone or joint disease, are suspected. Magnetic resonance imaging is not generally indicated due to its high costs and it not being readily available. Laboratory testing for comorbidities, such as diabetes or hypothyroidism, may be considered if there are other signs suggesting disease.

Treatment:

Treatment modalities for carpal tunnel syndrome comprises of non-invasive as well as surgical methods of decompression.

Non-invasive/non-surgical treatments:

Non-surgical treatments, also referred to as conservative treatments, include a wider range of options such as splinting, cortical steroid injections, non-steroidal anti-inflammatory drugs, B6 vitamin, diuretics, ultrasound therapy, ergonomic positioning and using ergonomic equipment (e.g., wrist rest, mouse pad), taking breaks, using keyboard alternatives (e.g., digital pen, voice recognition and dictation software), manual therapy intervention, lidocaine patches and acupuncture avoiding repetitive motions, and alternating job functions have traditionally been advocated for management of carpal tunnel syndrome. However, there is inconsistent evidence to support or refute the effectiveness of any of these interventions.[13-15].

Non-surgical treatment of CTS is recommended for patients that show mild to moderate symptoms of CTS, however, splinting and steroids are most commonly used and supported by evidence. The most common splinting method is the neutral splint, which involves the immobilization of the wrist in a neutral position. This neutralizes flexion and extension of the wrist, thus increasing carpal tunnel pressure [16-19] Treatment using steroids is done by local injection of corticosteroids directly into the patient's carpal tunnel. There is a risk

associated with the injections and the possible decompression of the median nerve. Several studies have been conducted using an ulnar approach to the palmaris longus tendon[20, 21] and have shown the treatment to be effective and risk free.[22]

Surgical treatment:

Surgical treatments include standard open carpal tunnel release, endoscopic carpal tunnel release, open carpal tunnel release combined with procedures and open carpal tunnel release using various incision techniques[23].Surgery is recommended for most patients with moderate to severe CTS. There are two different categories of methods used for surgical treatment of CTS: open release and endoscopic release. Open carpal tunnel release consists of the standard method of open release, as well as several modified methods. Modifications to the standard open carpal tunnel release (OCTR) include new incision techniques, such as the mini-open release, and addition of other procedures such as epineurotomy[24] Epineurotomy has been used as an additional procedure to the OCTR, with the prospective of minimizing median nerve compression occurring after standard OCTR[25].

Endoscopic carpal tunnel release (ECTR) is another new technique that was developed by Okutsu and colleagues since 1986[26]. ECTR release is sometimes favored over OCTR as dividing the skin from below preserves the muscle and overlying skin, thus facilitating return to work; however, it has an increased risk of nerve or artery injury because of limitations in visualization .ECTR has been shown to have better outcomes in muscle strength within 12 wk of surgery [24] [27] and better outcomes compared to both standard open and mini-open release within 4 wk of surgery[28].

CONCLUSION

In this reviewwe have explored one of the most common entrapment neuropathies which is mostly common amongst women of middle age. There are several imaging modalities for assessing this condition but after analyzing the various options, it is seen that ultrasound examination with high-frequency probes and improved power Doppler technology should be used as the primary imaging investigation in the initial evaluation of CTS as it is the most beneficial and accurate amongst all the available tests. In terms of treatment modalities ECTR has shown to have better outcomes than both standard open and mini-open release since it has proved to have better outcomes in regaining muscle strength as well as in preserving the muscle and overlying skin.

REFERENCES

1. Aroori, S. and R.A. Spence, *Carpal tunnel syndrome.* Ulster Med J, 2008. **77**(1): p. 6-17.
2. Alfonso, C., et al., *Diagnosis, treatment and follow-up of the carpal tunnel syndrome: a review.* Neurol Sci, 2010. **31**(3): p. 243-52.

3. Padua, L., et al., *Neurophysiological classification of carpal tunnel syndrome: assessment of 600 symptomatic hands.* Ital J Neurol Sci, 1997. **18**(3): p. 145-50.
4. Lo, S.L., et al., *Carpal tunnel syndrome: a historical perspective.* Hand Clin, 2002. **18**(2): p. 211-7, v.
5. Pfeffer, G.B., et al., *The history of carpal tunnel syndrome.* J Hand Surg Br, 1988. **13**(1): p. 28-34.
6. Graham, B., *The Value Added by Electrodiagnostic Testing in the Diagnosis of Carpal Tunnel Syndrome*. Vol. 90. 2009. 2587-93.
7. Keith, M.W., et al., *Diagnosis of carpal tunnel syndrome.* J Am Acad Orthop Surg, 2009. **17**(6): p. 389-96.
8. Chang MH, L.Y., Hsieh PF, *The real role of forearm mixed nerve conduction velocity in the assessment of proximal forearm conduction showing in carpal tunnel syndrome.* J Clin Neurophysiol, 2008 Nov 6.
9. Jablecki, C.K., et al., *Practice parameter: Electrodiagnostic studies in carpal tunnel syndrome.* Report of the American Association of Electrodiagnostic Medicine, American Academy of Neurology, and the American Academy of Physical Medicine and Rehabilitation, 2002. **58**(11): p. 1589-1592.
10. Fowler, J.R., D. Hirsch, and K. Kruse, *The Reliability of Ultrasound Measurements of the Median Nerve at the Carpal Tunnel Inlet.* J Hand Surg Am, 2015. **40**(10): p. 1992-5.
11. Lee D, v.H.M., Janevski PK et al., *Diagnosis of carpal tunnel syndrome. Ultrasound vs electromyography.* Radiol Clin North Am, 1999 Jul. **37**(4): p. 859-72.
12. Tai TW, W.C., Su FC, Chern TC, Jou IM., *Ultrasonography for diagnosing carpal tunnel syndrome: a meta-analysis of diagnostic test accuracy.* Ultrasound Med Biol, 2012 Jul. **38**(7): p. 1121-8.
13. Kumnerddee, W. and A. Kaewtong, *Efficacy of acupuncture versus night splinting for carpal tunnel syndrome: a randomized clinical trial.* J Med Assoc Thai, 2010. **93**(12): p. 1463-9.
14. Maddali Bongi, S., et al., *A manual therapy intervention improves symptoms in patients with carpal tunnel syndrome: a pilot study.* Rheumatol Int, 2013. **33**(5): p. 1233-41.
15. Nalamachu, S., et al., *An open-label pilot study evaluating the effectiveness of the heated lidocaine/tetracaine patch for the treatment of pain associated with carpal tunnel syndrome.* Pain Pract, 2014. **14**(7): p. 607-12.
16. Gerritsen, A.A., et al., *Splinting or surgery for carpal tunnel syndrome? Design of a randomized controlled trial [ISRCTN18853827].* BMC Neurol, 2001. **1**: p. 8.
17. Walker, W.C., 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): p. 424-9.
18. Povlsen, B., M. Bashir, and F. Wong, *Long-term result and patient reported outcome of wrist splint treatment for carpal tunnel syndrome.* J Plast Surg Hand Surg, 2014. **48**(3): p. 175-8.
19. Gerritsen, A.A., et al., *Splinting for carpal tunnel syndrome: prognostic indicators of success.* J Neurol Neurosurg Psychiatry, 2003. **74**(9): p. 1342-4.
20. Jenkins, P.J., et al., *Corticosteroid injection for carpal tunnel syndrome: a 5-year survivorship analysis.* Hand (N Y), 2012. **7**(2): p. 151-6.
21. Smith, J., et al., *Sonographically guided carpal tunnel injections: the ulnar approach.* J Ultrasound Med, 2008. **27**(10): p. 1485-90.

22. Marshalll S, T.G., Ashworth N, *Local corticosteroid injection for carpal tunnel syndrome.* Cochhrane database Syst Rev, 2007(2:CD001554).
23. Shi, Q. and J.C. MacDermid, *Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? A systematic review.* J Orthop Surg Res, 2011. **6**: p. 17.
24. Mintalucci, D.J. and C.F. Leinberry, Jr., *Open versus endoscopic carpal tunnel release.* Orthop Clin North Am, 2012. **43**(4): p. 431-7.
25. Katz, J.N., et al., *A self-administered hand symptom diagram for the diagnosis and epidemiologic study of carpal tunnel syndrome.* J Rheumatol, 1990. **17**(11): p. 1495-8.
26. Okutsu, I., et al., *Endoscopic management of carpal tunnel syndrome.* Arthroscopy, 1989. **5**(1): p. 11-8.
27. Ejiri, S., et al., *Short-term results of endoscopic (Okutsu method) versus palmar incision open carpal tunnel release: a prospective randomized controlled trial.* Fukushima J Med Sci, 2012. **58**(1): p. 49-59.
28. Aslani, H.R., et al., *Comparison of carpal tunnel release with three different techniques.* Clin Neurol Neurosurg, 2012. **114**(7): p. 965-8.