



# A Brief Review of Recent Advances in Carpal Tunnel Syndrome

Farhad Mirzaei<sup>1</sup>, Morteza Delkhosh Reihani<sup>2</sup>, Firooz Salehpour<sup>1</sup>, Marzieh Marahem<sup>3\*</sup>

## Abstract

**Objectives:** Carpal tunnel syndrome (CTS) is a complicated disorder which occurs when a localized median nerve is compressed in the carpal tunnel. It causes neurological symptoms, pain, and functional limitation of the wrist, which in turn leads to problems in daily routines and activities and reduced ability to work, ultimately negatively affecting the quality of life and public health status. In this regard, this review aimed to evaluate the effective diagnosis and conservative treatments of CTS.

**Materials and Methods:** To conduct this review study, Google Scholar, PubMed, and Elsevier databases were searched using the keywords “carpal tunnel syndrome, treatment outcome, review, corticosteroids, and diagnosis”. At last, 40 articles were selected and fully reviewed.

**Results:** Our results were obtained based on the results of the reviewed articles. Therefore, local and oral corticosteroid, splint, physical examination, and reported outcomes in surgeries revealed the effective diagnosis and conservative treatments in CTS.

**Conclusions:** Based on the results, the CTS diagnosis should be based on the medical history of patient. In addition, physical examination must be done along with electrodiagnostic test. To reduce the signs and symptoms of moderate CTS, the use of local and oral corticosteroid could be effective according to the evidence. Only in some limited conflicting evidence, it was observed that nonsteroidal anti-inflammatory drugs, vitamin B6, and diuretics were no more effective than placebo in relieving the CTS symptoms. Therefore, surgery may be the sole treatment that takes away the median nerve compression in moderately severe cases.

**Keywords:** Carpal tunnel syndrome (CTS), Treatment outcome, Corticosteroids, Diagnosis

## Context

Carpal tunnel syndrome (CTS) is a complex disorder with local compression of the median nerve in the carpal tunnel (1,2). The term “carpal tunnel syndrome” was first published by Kremer in 1953 (3). This disease, with the compression of one of the median nerves to the hand, causes symptoms like nerve pain and functional limitation of the wrists, and leads to problems in daily routines and reduction of the ability to work, by affecting the quality of life and general health (4,5). The disease is more common in middle-aged individuals between the ages 30 and 60. More severe clinical and electrophysiological symptoms of median nerve compression may be seen in the elderly (6,7). The most typical symptoms are pain, feeling of hand falling asleep, paresthesia, and numbness (8,9), and its diagnosis is based on the medical history, physical examination, and electrodiagnostic test (1,10). Most cases of CTS are idiopathic or caused by congenital anomalies, and some focal or systemic diseases such as wrist injury, arthritis, diabetes, thyroid disease, rheumatoid arthritis, and pregnancy can increase median nerve compression in the carpal tunnel and help develop CTS (11,12). Recent evidence highlights that there is high prevalence of CTS in Iran (13). Hence, this review intended to evaluate the effective diagnosis and conservative treatments that can

help in choosing the appropriate therapies and clinical tests for CTS.

## Evidence Acquisition

To conduct the study, Google Scholar, PubMed, and Elsevier databases were searched using the keywords “carpal tunnel syndrome, treatment outcome, review, corticosteroids, and diagnosis”. At last, 40 articles were selected.

## Results

The results of this review included were categorized into 2 classes: effective diagnosis and treatment.

### Effective diagnosis in Carpal Tunnel Syndrome

#### Medical History

The results of reviewed articles showed that patients might complain of a sense of swelling in their hands. Feeling of hand falling asleep was an early symptom. Moreover, paresthesia occurred when the hands were shaken out. Numbness and tingling were the late symptoms (14,15).

#### Physical Examination

Clinical tests such as Phalen’s and Tinel’s sign tests were developed to evoke symptoms with passive compression

Received 1 September 2018, Accepted 8 November 2018, Available online 11 December 2018

<sup>1</sup>Department of Neurosurgery, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. <sup>2</sup>Fellowship of Pain and Palliative Medicine, Tabriz University of Medical Sciences, Tabriz, Iran. <sup>3</sup>Department of Physiology, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

\*Corresponding Author: Marzieh Marahem, Tel: +989148929418, Email: m.marahem@yahoo.com



of the median nerve and were commonly used for the detection of nerve pathologies (1,16,17).

### *Imaging*

Electromyography and nerve conduction study can confirm the diagnosis (18,19), determine the possible severity of nerve injury, measure and guide the effects of the treatment, and rule out diseases, such as radiculopathy and brachial plexus (20). The diagnosis is achieved by electrodiagnostic tests or electromyography, which is used to investigate the speed of neural conduction in the electrodes placed on the patient's hands and wrists (21,22). To this end, a few small electric shocks are established in the place, where the speed of transmission of messages is measured by the nerves. Therefore, the severity of the injury to the medial nerve can be determined. Ultrasound scan and visualization of median nerve enlargement may help the diagnosis process (23). Ultrasound scan may typically show flattening of the nerve inside the tunnel and enlargement of the proximal and distal nerves to the tunnel (24). Apparently, recent studies may confirm that transverse plane ultrasound of the median nerve cannot replace the electrodiagnostic test for the detection of CTS, but can provide complementary results. Therefore, ultrasound scan should be considered in suspicious or secondary CTS cases (25). Several studies support that ultrasound therapy produces desired results than laser therapy (26,27) while other studies report contradictory results (9,28). Furthermore, wrist radiography may be useful in case of suspected fracture or degenerative joint disease (29).

### **Treatment**

#### *Splinting*

According to some studies, splinting is known as the first line of non-surgical treatments and may help completely reduce or relieve the symptoms of CTS. Nonetheless, there is evidence that in initial splinting, if the symptoms were not relieved, further splinting should be discontinued (1,30,31).

#### *Local Corticosteroid Injections*

Out of the articles reviewed in this study, 6 were of high quality. There was strong evidence that local corticosteroid injection is considered a common primary care intervention, which provides symptomatic relief from three months to one year (32,33). It may also defer the need of patients with mild to moderate CTS for surgery (8,34,35). Local anesthesia is fast, safe, and effective, and leads to a reduction in invasive procedures, hospital stay, and related costs (36).

#### *Oral Corticosteroid*

There was strong evidence that oral corticosteroid can be effective for short-term management of CTS and has been widely used; However, there is limited clinical evidence on

their role in treating physical problems. Recent systematic reviews have demonstrated that the use of oral medication such as nonsteroidal, anti-inflammatory drugs, vitamin B6, and diuretics are no more effective than placebo in relieving the CTS symptoms (8,37,38).

#### *Surgery*

Relevant studies have shown that surgery can provide better relief than repeat injections or splint, and to make a decision whether to have surgery may take place after a long period of non-surgical treatment and sever symptoms (39-43).

### **Conclusions**

Based on our brief review, it seems the diagnosis of CTS should be based on the medical history of the patient, and physical examination must be done along with electrodiagnostic test. To reduce the signs and symptoms of moderate CTS, the use of local and oral corticosteroid could be effective according to the evidence. Only some limited conflicting evidence have shown that nonsteroidal anti-inflammatory drugs, vitamin B6, and diuretics are no more effective than placebo in relieving the CTS symptoms. Therefore, surgery may be the sole treatment that takes away the median nerve compression in moderately severe cases.

### **Conflict of Interests**

Authors have no conflict of interests.

### **Ethical Issues**

Not applicable.

### **Financial Support**

None.

### **References**

1. Padua L, Coraci D, Erra C, et al. Carpal tunnel syndrome: clinical features, diagnosis, and management. *Lancet Neurol.* 2016;15(12):1273-1284. doi:10.1016/s1474-4422(16)30231-9
2. Mondelli M, Giannini F, Giacchi M. Carpal tunnel syndrome incidence in a general population. *Neurology.* 2002;58(2):289-294.
3. Amadio PC. History of carpal tunnel syndrome. In: Luchetti R, Amadio P, eds. *Carpal tunnel syndrome.* Berlin, Heidelberg: Springer; 2007:3-9.
4. Bugajska J, Jedryka-Goral A, Sudol-Szopinska I, Tomczykiewicz K. Carpal tunnel syndrome in occupational medicine practice. *Int J Occup Saf Ergon.* 2007;13(1):29-38. doi:10.1080/10803548.2007.11076706
5. Jarvik JG, Comstock BA, Kliot M, et al. Surgery versus non-surgical therapy for carpal tunnel syndrome: a randomised parallel-group trial. *Lancet.* 2009;374(9695):1074-1081. doi:10.1016/s0140-6736(09)61517-8
6. Roquelaure Y, Ha C, Pelier-Cady MC, et al. Work increases the incidence of carpal tunnel syndrome in the

- general population. *Muscle Nerve*. 2008;37(4):477-482. doi:10.1002/mus.20952
7. Watson JC. The electrodiagnostic approach to carpal tunnel syndrome. *Neurol Clin*. 2012;30(2):457-478. doi:10.1016/j.ncl.2011.12.001
  8. Dehghani Mohammadabadi H, Azizi S, Dadarkhah A, Reza Soltani Z. Evaluation of Effectiveness of the Wrist Mobilization Compared with Local Corticosteroid Injection in Treatment of Moderate Carpal Tunnel Syndrome. *Ann Mil Health Sci Res*. 2018;16(2):e83335. doi:10.5812/amh.83335
  9. Hashempur MH, Naseri M, Ashraf A. Carpal tunnel syndrome in lactation: a challenging issue. *Women Health Bull*. 2015;2(4):e31414. doi:10.17795/whb-31414
  10. Goldberg G, Zeckser JM, Mummaneni R, Tucker JD. 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. Chung CP. Carpal Tunnel Syndrome with Bifid Median Nerve: Sonographic and Electrophysiological Findings. *Ultrasound Med Biol*. 2017;43(Suppl 1):S203. doi:10.1016/j.ultrasmedbio.2017.08.1692
  12. Huang YC, Leong CP, Chen MJ, Wang LY. Clinical Outcome and Sonographic Findings on Hemiplegic Shoulder Pain and Rotator Cuff Injuries after Hyaluronic Acid Injection in Subacute Stroke Patients. *Ultrasound Med Biol*. 2017;43(Suppl 1):S203. doi:10.1016/j.ultrasmedbio.2017.08.1694
  13. Moosazadeh M, Asadi-Aliabadi M, Rostami F, Farshidi F, Karimi N. Prevalence of Carpal Tunnel Syndrome in Iran: A Systematic Review and Meta-analysis. *Journal of Mazandaran University of Medical Sciences*. 2018;28(161):144-153.
  14. Jackson D, Zerpa C, Sanzo P, Newhouse I. The usefulness of a carpal tunnel compression assessment tool: evidence of reliability and validity in assessing carpal tunnel syndrome. *Clin Pract*. 2016;5(1):6-15. doi:10.5923/j.cp.20160501.02
  15. Kondziella D, Waldemar G. Clinical History and Neuroanatomy: "Where Is the Lesion?". *Neurology at the Bedside*. Springer; 2017:5-77.
  16. Singh DP, Rahman SA, Prasad K. Carpal Tunnel Syndrome: A Clinical and Electrophysiological Appraisal in Carpal Tunnel Syndrome. *J Med Sci Clin Res*. 2016;4(11):14004-14009. doi:10.18535/jmscr/v4i11.82
  17. Razek A, Shabana AAE, El Saied TO, Alrefey N. Diffusion tensor imaging of mild-moderate carpal tunnel syndrome: correlation with nerve conduction study and clinical tests. *Clin Rheumatol*. 2017;36(10):2319-2324. doi:10.1007/s10067-016-3463-y
  18. Dangayach NS, Smith M, Claassen J. Electromyography and nerve conduction studies in critical care: step by step in the right direction. *Intensive Care Med*. 2016;42(7):1168-1171. doi:10.1007/s00134-015-4137-y
  19. Hulens MA, Dankaerts W, Rasschaert R, et al. Can patients with symptomatic Tarlov cysts be differentiated from patients with specific low back pain based on comprehensive history taking? *Acta Neurochir (Wien)*. 2018;160(4):839-844. doi:10.1007/s00701-018-3494-z
  20. Baumer P, Kele H, Kretschmer T, et al. Thoracic outlet syndrome in 3T MR neurography-fibrous bands causing discernible lesions of the lower brachial plexus. *Eur Radiol*. 2014;24(3):756-761. doi:10.1007/s00330-013-3060-2
  21. Beekman R, Van Der Plas JP, Uitdehaag BM, Schellens RL, Visser LH. Clinical, electrodiagnostic, and sonographic studies in ulnar neuropathy at the elbow. *Muscle Nerve*. 2004;30(2):202-208. doi:10.1002/mus.20093
  22. Allen JA. Electrodiagnostic testing. In: Walk D, ed. *Clinical handbook of neuromuscular medicine*. Springer; 2018:161-182.
  23. Eaton LM, Lambert EH. Electromyography and electric stimulation of nerves in diseases of motor unit; observations on myasthenic syndrome associated with malignant tumors. *J Am Med Assoc*. 1957;163(13):1117-1124.
  24. Lee D, van Holsbeeck MT, Janevski PK, Ganos DL, Ditmars DM, Darian VB. Diagnosis of carpal tunnel syndrome. Ultrasound versus electromyography. *Radiol Clin North Am*. 1999;37(4):859-872, x.
  25. Cartwright MS, Hobson-Webb LD, Boon AJ, et al. Evidence-based guideline: neuromuscular ultrasound for the diagnosis of carpal tunnel syndrome. *Muscle Nerve*. 2012;46(2):287-293. doi:10.1002/mus.23389
  26. Kalliainen LK. Nonoperative Options for the Management of Carpal Tunnel Syndrome. In: Duncan S, Kakinoki R, eds. *Carpal Tunnel Syndrome and Related Median Neuropathies*. Cham: Springer; 2017:109-24. doi:10.1007/978-3-319-57010-5\_11
  27. Watson T. Ultrasound in contemporary physiotherapy practice. *Ultrasonics*. 2008;48(4):321-9.
  28. Coleman DJ, Lizzi FL, Driller J, Rosado AL, Chang S, Iwamoto T, et al. Therapeutic ultrasound in the treatment of glaucoma: I. Experimental model. *Ophthalmology*. 1985;92(3):339-46.
  29. Watanabe A, Souza F, Vezeridis PS, Blazar P, Yoshioka H. Ulnar-sided wrist pain. II. Clinical imaging and treatment. *Skeletal Radiol*. 2010;39(9):837-857. doi:10.1007/s00256-009-0842-3
  30. So H, Chung V. AB0954 Local Steroid Injection Versus Wrist Splinting for Carpal Tunnel Syndrome: A Randomized Clinical Trial and a Qualitative Exploration. *Ann Rheum Dis*. 2015;74(Suppl 2):1218. doi:10.1136/annrheumdis-2015-eular.3106
  31. Mehmetoglu O, Tascioglu F, Bakilan F, Armagan O. Efficacy of splint treatment or splint plus gabapentin treatment in idiopathic carpal tunnel syndrome Splint or splint plus gabapentin in carpal tunnel syndrome. *J Clin Anal Med*. 2018;9(2):116-120. doi:10.4328/JCAM.5483
  32. Huisstede BM, Randsdorp MS, van den Brink J, Franke TPC, Koes BW, Hoogvliet P. Effectiveness of oral pain medication and corticosteroid injections for carpal tunnel syndrome: a systematic review. *Arch Phys Med Rehabil*. 2018;99(8):1609-1622.e1610. doi:10.1016/j.apmr.2018.03.003
  33. Oh JK, Messing S, Hyrien O, Hammert WC. Effectiveness of Corticosteroid Injections for Treatment of de Quervain's Tenosynovitis. *Hand (N Y)*. 2017;12(4):357-361. doi:10.1177/1558944716681976
  34. Hoffecker B, Hightower A, Jarvis J, Lewis D, Wipperman J. Efficacy of Local Corticosteroid Injection for Carpal Tunnel Syndrome. *Kans J Med*. 2015;170-174.
  35. Ekinci Y, Ulusoy EK, Cirakli A. Complementary treatment options in carpal tunnel syndrome surgery; Prospective randomized controlled study. *Ann Med Res*.

- 2018;25(2):236-240. doi:10.5455/jtomc.2018.03.042
36. Mesa J, Lalonde D, Vasconez LO. Local and regional anesthesia in plastic surgery: safety considerations and management of adverse events. In: Finucane BT, Tsui BCH, eds. *Complications of regional anesthesia: principles of safe practice in local and regional anesthesia*. Cham, Switzerland: Springer International Publishing; 2017:399-409.
  37. Bland JDP. Hydrodissection for treatment of carpal tunnel syndrome. *Muscle Nerve*. 2018;57(1):4-5. doi:10.1002/mus.25759
  38. Sharma D, Jaggi AS, Bali A. Clinical evidence and mechanisms of growth factors in idiopathic and diabetes-induced carpal tunnel syndrome. *Eur J Pharmacol*. 2018;837:156-163. doi:10.1016/j.ejphar.2018.08.017
  39. Albalawi SSA, Alrahman RWA, Althagafi AM, et al. Evaluation of Carpal Tunnel Diagnosis, Management, and Outcome in Primary Health Care Center. *Egypt J Hosp Med*. 2018;73(3):6230-6237.
  40. Fernandez-de-Las-Penas C, Cleland J, Palacios-Cena M, Fuensalida-Novo S, Pareja JA, Alonso-Blanco C. The Effectiveness of Manual Therapy Versus Surgery on Self-reported Function, Cervical Range of Motion, and Pinch Grip Force in Carpal Tunnel Syndrome: A Randomized Clinical Trial. *J Orthop Sports Phys Ther*. 2017;47(3):151-161. doi:10.2519/jospt.2017.7090
  41. Hameso A, Bland JD. Prevalence of decompression surgery in patients with carpal tunnel syndrome 8 years after initial treatment with a local corticosteroid injection. *J Hand Surg Eur Vol*. 2017;42(3):275-280. doi:10.1177/1753193416671102
  42. Rashid M. Surgical Management of severe Carpal Tunnel Syndrome. What's the Long-Term Outcome. *Ophthalmology*. 2017;15(4):424.
  43. Shi Q, Bobos P, Lalone EA, Warren L, MacDermid JC. Comparison of the Short-term and Long-term Effects of Surgery and Nonsurgical Intervention in Treating Carpal Tunnel Syndrome: A Systematic Review and Meta-analysis. *Hand (N Y)*. 2018:1558944718787892. doi:10.1177/1558944718787892

**Copyright** © 2019 The Author(s); This is an open-access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.