

Clinical differences between patients with and without electrophysiological evidence of carpal tunnel syndrome*

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ABSTRACT

Aims: It was aimed to determine the clinical differences between patients with and without electrophysiological evidence of carpal tunnel syndrome (CTS).

Methods: Patients who were clinically diagnosed with CTS were included in this retrospective cohort study. Median nerve compound muscle action potential and compound nerve action potential of the patients were analyzed. Clinically diagnosed CTS patients were divided into two groups according to the results of nerve conduction studies as patients with and without electrophysiological evidence of CTS. At the same time the age, body-mass index (BMI), duration of symptoms and comorbidity of all the patients were recorded.

Results: 60 patients clinically diagnosed with CTS (52 women and 8 men) were included in the study. Electrophysiological evidence of CTS was present in 40 patients (66.7%) and absent in 20 (33.3%). Patients with electrophysiological evidence of carpal tunnel syndrome were older ($p=0.021$) and had higher body weight and BMI (both $p<0.001$) compared to those without such findings. Symptom duration was also longer in this group ($p<0.001$), while no significant difference was observed in height ($p=0.654$).

Conclusion: Electrophysiological abnormalities are more often detected in CTS patients with longer symptom duration and higher BMI. Older age is also associated with the presence of electrophysiological abnormalities.

Keywords: Body-mass index, carpal tunnel syndrome, electrophysiology, nerve conduction studies

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INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common entrapment mononeuropathy. Patients typically present with paresthesia in the first three digits. In some cases, neuropathic pain may develop, and weakness or atrophy of the hand muscles may also occur.^{1,2} Early diagnosis, appropriate treatment, and prevention of progression are therefore important.

Clinical evaluation and electrophysiological studies are commonly used in the diagnosis of CTS. Electrophysiological testing plays a key role in confirming the diagnosis, assessing severity, and supporting the differential diagnosis.^{3,4} However, CTS cannot be confirmed electrophysiologically in all patients. In some individuals with strong clinical suspicion, electrophysiological findings may remain normal.^{2,5} Given this background, the present study examined whether CTS could be identified electrophysiologically in patients with a clinical diagnosis of CTS and aimed to determine the clinical differences between patients with and without electrophysiological evidence of CTS.

METHODS

Subjects

Patients aged 18 years or older who were clinically diagnosed with CTS between March 2012 and May 2013 at the Department of Neurology, Çukurova University Faculty of Medicine were included in this retrospective study. Ethical approval was obtained from the Çukurova University Faculty of Medicine Non-interventional Clinical Researches Ethics Committee (Approval Date: 09.02.2012, Decision No: 5/28). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. A clinical diagnosis of CTS was established when at least one of the following was present: (1) paresthesia in the first three digits, more pronounced at night; (2) sensory complaints involving the first three digits; or (3) sensory abnormalities in the first three digits on neurological examination; or (4) nocturnal worsening of symptoms affecting the same distribution. These findings could be accompanied by weakness or atrophy of median nerve-innervated hand muscles. Patients were excluded if they

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had clinical or electrophysiological findings consistent with cervical radiculopathy or brachial plexopathy, or a known neurodegenerative disease. Patients were categorized into two groups based on whether electrophysiological findings consistent with CTS were present.

Electrophysiological Tests

Nerve conduction studies were performed using a Medelec Synergy EMG device. For sensory and motor studies, filter settings were 20 Hz-2 kHz and 20 Hz-10 kHz, respectively. Recordings were obtained with surface electrodes. Studies were conducted when extremity temperature exceeded 32°C; otherwise, the limb was warmed. Compound muscle action potentials (CMAPs) were recorded from the abductor pollicis brevis muscle. In motor studies, the distance between the stimulation site at the wrist and the recording electrode was 8 cm. Sensory nerve action potentials were recorded antidromically from the second digit-wrist segment. Sensory conduction velocity was calculated using onset latency. Electrophysiological CTS was defined by the presence of any of the following: (1) median sensory conduction velocity <50 m/s in the second digit-wrist segment; (2) median sensory conduction velocity <50 m/s in the same segment together with distal CMAP latency >4 ms; or (3) absent median sensory response in the second digit-wrist segment together with distal CMAP latency >4 ms.

Statistical Analysis

The Shapiro-Wilk test was used to determine the distribution of the data. Pearson’s Chi-squared test was used to analyze categorical variables. Mann-Whitney U test was used in group comparisons. Mean±standard deviation (SD) and median were calculated for descriptive statistics. Post hoc power analysis was performed for the variables that differed significantly between groups, including age, body weight, BMI, and symptom duration, using the observed between-group differences at an alpha level of 0.05. If p-value was <0.05, it was considered statistically significant. Statistical Package for the Social Sciences (SPSS IBM Corp; Armonk, NY, USA) 22.0 was used to perform the statistical analysis.

RESULTS

The study included 60 patients with clinically diagnosed CTS (52 women and 8 men). Of these, 55 had bilateral involvement and 5 had unilateral involvement. The mean age was 51.2±12.6 years (range, 22-80), mean height was 165.1±5.9 cm (151-183), mean weight was 80.4±14.5 kg (51-128), and mean body-mass index (BMI) was 28.9±5.3 kg/m² (18-48). The mean duration of symptoms was 16.8±11.7 months (2-60). Electrophysiological evidence of CTS was present in 40 patients (66.7%) and absent in 20 (33.3%). Bilateral

CTS was identified electrophysiologically in 23 patients, while 15 had right-sided CTS and 2 had left-sided CTS. Demographic characteristics of patients with and without electrophysiological CTS are compared in **Table**. Patients with electrophysiological evidence of CTS were significantly older than those without (p=0.021). They also showed higher body weight and BMI (both p<0.001), along with a longer duration of symptoms (p<0.001), whereas height did not differ between the groups (p=0.654). Post hoc power analysis showed adequate statistical power for the significant between-group differences in age, body weight, BMI, and symptom duration. Among patients with electrophysiological CTS, 8 had diabetes mellitus and 1 had thyroid disease, whereas none of those without electrophysiological CTS had diabetes mellitus or thyroid disease (**Figure**).

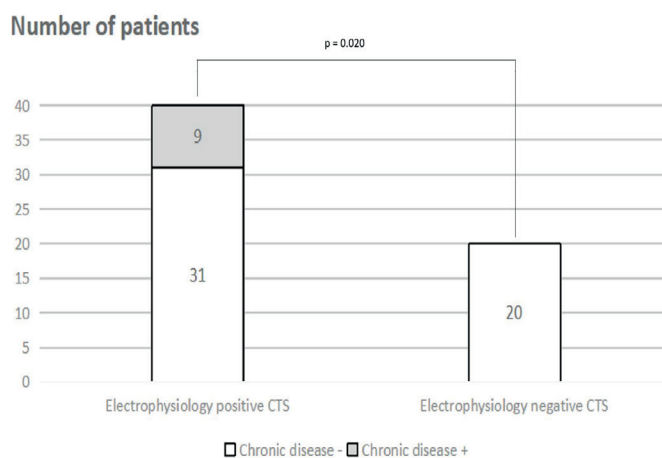


Figure. Number of patients

DISCUSSION

This study showed that approximately one-third of patients with a clinical suspicion of CTS had normal electrophysiological findings. This observation indicates a potential mismatch between clinical assessment and electrophysiological results.^{5,6} The longer symptom duration in patients with electrophysiological confirmation suggests that these tests may remain normal early in the disease course.

Patients with electrophysiological evidence of CTS were older and had higher body weight and BMI. Increased body mass may contribute to greater mechanical stress on the median nerve, thereby increasing susceptibility to CTS. In addition, variations in age, weight, and BMI may promote endoneural edema and microvascular compromise, which can further facilitate the development of CTS. These findings are in line with previous reports identifying obesity and older age as important risk factors for CTS.⁷

Table. Demographic characteristics of patients with and without electrophysiological evidence of carpal tunnel syndrome

Demographic characteristics	Patients without electrophysiological evidence of CTS (n=20)	Patients with electrophysiological evidence of CTS (n=40)	p-value
	Median (min-max)	Median (min-max)	
Age	45 (22-75)	54 (29-80)	0.021
Size (cm)	165 (154-173)	164 (151-183)	0.654
Weight (kg)	66 (51-86)	85 (66-128)	<0.001
BMI	24 (18-30)	30 (25-48)	<0.001
Duration of complaint (month)	6 (2-25)	24 (6-60)	<0.001

CTS: Carpal tunnel syndrome, BMI: Body-mass index

Symptom duration was longer in patients with electrophysiological evidence of CTS than in those with a clinical diagnosis but no electrophysiological confirmation.⁸ This pattern suggests that demyelination and axonal involvement become more apparent over time. Electrophysiological findings may remain normal in patients with a short duration of symptoms. In cases with strong clinical suspicion, close follow-up and repeat testing, when appropriate, may be warranted. Additionally, the presence of diabetes mellitus and thyroid disease in patients with electrophysiological evidence of CTS is noteworthy.⁹⁻¹¹ Neuropathies, including CTS, are well recognized in diabetes. In this setting, endoneural microvascular ischemia, endoneural edema, and alterations in connective tissue may increase susceptibility to nerve compression.¹² In the present study, diabetes was present in 20% of patients with electrophysiological CTS, supporting a possible association between the two conditions. CTS may also occur in the context of thyroid disease and should be considered in these patients.^{10,13}

Electrophysiological studies play a central role in the diagnosis, assessment of severity, and differential diagnosis of CTS.^{3,9} However, normal findings may be encountered in some patients, which represents an important limitation.¹⁴ This may reflect the inability of routine nerve conduction studies to assess small fiber involvement.^{5,15,16} For this reason, electrophysiological results should be interpreted in conjunction with clinical findings. Moreover, overlapping symptom profiles in certain disorders may contribute to underdiagnosis or misinterpretation of CTS, even when objective findings are limited.¹⁴

Ultrasonographic evaluation, which has been shown to correlate with clinical findings in CTS in certain patient populations, may provide complementary information beyond electrophysiological studies.¹⁴

Limitations

This study has several limitations. First, its retrospective design may have affected patient selection. The relatively small sample size and single-center setting may limit the generalizability of the findings. In addition, conventional nerve conduction studies may not detect mild or early cases of CTS, which could have led to underestimation in some patients. Other diagnostic approaches, such as ultrasonography or small fiber assessment, were not used. Finally, the absence of longitudinal follow-up does not allow assessment of whether patients with normal electrophysiological findings later developed detectable abnormalities.

CONCLUSION

Electrophysiological studies may not detect CTS in all patients, particularly in those who are younger, have a shorter duration of symptoms, and a lower BMI. These findings suggest that such tests may be less sensitive early in the course of the condition. Clinical assessment therefore remains essential, and electrophysiological results should be interpreted together with the overall clinical picture rather than relied upon alone when making the diagnosis.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Çukurova University Faculty of Medicine Non-interventional Clinical Researches Ethics Committee (Approval Date: 09.02.2012, Decision No: 5/28).

Informed Consent-Non-Retrospective Studies

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

Concept: ŞB, ŞFR; Design: ŞB; Control: ŞB, ŞFR; Resources: ŞB, ŞFR; Materials: ŞB, ŞFR; Data Collection and/or Processing: ŞB; Analysis and/or Interpretation: ŞB; Literature Review: ŞB; Writing the Article: ŞB, ŞFR; Critical Review: ŞB.

REFERENCES

- Genova A, Dix O, Saefan A, Thakur M, Hassan A. Carpal tunnel syndrome: a review of literature. *Cureus*. 2020;12(3):e7333. doi:10.7759/cureus.7333
- Werner RA, Andary M. Electrodiagnostic evaluation of carpal tunnel syndrome. *Muscle Nerve*. 2011;44:597-607. doi:10.1002/mus.22208
- Jordan R, Carter T, Cummins C. A systematic review of the utility of electrodiagnostic testing in carpal tunnel syndrome. *Br J Gen Pract*. 2002;52:670-673. doi:10.1053/jhsu.2000.jhsu025a0120
- Padua L, Coraci D, Erra C, et al. Carpal tunnel syndrome: clinical features, diagnosis, and management. *Lancet Neurol*. 2016;15:1273-1284. doi:10.1016/S1474-4422(16)30231-9
- Witt JC, Hentz JG, Stevens JC. Carpal tunnel syndrome with normal nerve conduction studies. *Muscle Nerve*. 2004;29:515-522. doi:10.1002/mus.20019
- Chen X, Cao J, Lao J, Liu A, Rui J. Evaluation of electrophysiological examinations for the diagnosis of carpal tunnel syndrome. *J Orthopaed Surg Res*. 2025;20:68. doi:10.1186/s13018-025-06122-2
- Moghtaderi A, Izadi S, Sharafadinzadeh N. An evaluation of gender, body-mass index, wrist circumference and wrist ratio as independent risk factors for carpal tunnel syndrome. *Acta Neurol Scand*. 2005;112(6):375-379. doi:10.1111/j.1600-0404.2005.00528.x
- Kouyoumdjian JA. Carpal tunnel syndrome. Age, nerve conduction severity and duration of symptomatology. *Arq Neuropsiquiatr*. 1999;57:382-386. doi:10.1590/S0004-282X1999000300007
- Pourmemari MH, Shiri R. Diabetes as a risk factor for carpal tunnel syndrome: a systematic review and meta-analysis. *Diabet Med*. 2016;33(1):10-16. doi:10.1111/dme.12855
- Deveci Ş. Association of diabetic polyneuropathy and carpal tunnel syndrome: role of glycemic control and microvascular complications. *Sakarya Med J*. 2023;13(3):440-445. doi:10.31832/smj.1331815
- Stevens JC, Beard CM, O'Fallon WM, Kurland LT. Conditions associated with carpal tunnel syndrome. *Mayo Clin Proc*. 1992;67:541-548. doi:10.1016/s0025-6196(12)60461-3
- Rempel D, Dahlin L, Lundborg G. Pathophysiology of nerve compression syndromes: response of peripheral nerves to loading. *J Bone Joint Surg Am*. 1999;81(11):1600-1610. doi:10.2106/00004623-199911000-00013
- Shiri R. Hypothyroidism and carpal tunnel syndrome: a meta-analysis. *Muscle Nerve*. 2014;50:879-883. doi:10.1002/mus.24453

14. Akkaya S, Saglam Akkaya G, Alisar K, Cetinkaya Alisar D, Karakullukcu S. Presence of carpal tunnel syndrome and its impact on clinical and ultrasonographic evaluations in patients with fibromyalgia. *Arch Rheumatol*. 2026;41(1):64-71. doi:10.5152/ArchRheumatol.2026.25157
15. Sonoo M, Menkes DL, Bland, JD, Burke D. Nerve conduction studies and EMG in carpal tunnel syndrome: do they add value? *Clin Neurophysiol Pract*. 2018;3:78-88. doi:10.1016/j.cnp.2018.02.005
16. Chan L, Turner J.A, Comstock BA, et al. The Relationship between electrodiagnostic findings and patient symptoms and function in carpal tunnel syndrome. *Arch Phys Med Rehabil*. 2007;88(1):19-24. doi:10.1016/j.apmr.2006.10.013