Original Article

The Role of Electrophysiological Examination in the Diagnosis of Carpal Tunnel Syndrome: Analysis of 2516 Patients

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ABSTRACT

Objective: The aim of the present study was to assess the correlation between patient history, physical examination, and electrophysiological method of assessment in patients with clinical suspicion of carpal tunnel syndrome (CTS). **Patients and Methods:** Results of electrophysiological examinations performed from 2009 to 2016 on 3151 hands of 2516 patients who had symptoms that clinically suggested CTS were examined retrospectively. Patients were assessed in terms of age, gender, direction of nerve compression, and presence and degree of CTS as determined electrophysiologically. Kolmogorov–Smirnov test, Levene's test, and Chi-square test were used for statistical analyses. Level of significance was accepted as $P < 0.05$. **Results:** Of the 2516 patients, 1838 (73.1%) were female and 678 (26.9%) were male. Average age was 48.60 ± 14.83 years, and 1858 (73.8%) of the patients had complaints in only 1 hand, whereas 658 (26.2%) had complaints in bilateral hands. CTS was detected in 1383 patients (54.9%; female/male: 1019/364) and average age was 52.16 ± 13.84 years. No statistically significant association was found between CTS and gender. Nerve compression was found in 1 hand of 71.5% (1328) of females and 28.5% (530) of males, and this result was found to be statistically significant. No significant association was found between degree and direction of nerve compression. **Conclusion:** Only 54.9% of the patients with clinical suspicion were found to have CTS. Given complexity of the hand and a large number of potential pathologies, electrophysiological examination is necessary for definitive diagnosis to avoid unnecessary surgical interventions.

Keywords: *Carpal tunnel syndrome, clinic, correlation, electrophysiological examination, entrapment neuropathy, median nerve*

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Introduction

Carpal tunnel syndrome (CTS) is the most common type of peripheral nerve entrapment neuropathy of the upper extremities and develops as result of compression of median nerve in the carpal tunnel of the wrist.[1] This condition is frequently seen in the clinic and has negative effects on daily activities and quality of life of patients.[2-4] Although its etiology is not completely known, repetitive use of wrist, advanced age, obesity, giving birth, acromegaly, trauma, amyloidosis, diabetes mellitus, kidney disease, thyroid disease, and osteoarthritis are seen as risk factors for the development of the disease.[2,5,6]

While CTS is most often seen in patients between 40 and 74 years of age, its general prevalence in society is between 3.7% and 5.8%.[7] CTS is 10 times more frequent in women than men.[8] Early diagnosis is important to prevent disability as result of entrapment neuropathy. CTS diagnosis can be made with clinical symptoms, findings, and electrophysiological methods.[3,9] Clinical symptoms are paresthesia complaints such as stinging, tingling, or pain that occurs at night, especially in the first three digits on lateral

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side of hand, weakness, and itching in the palm. Pain may be reflected to the arm and shoulder.[10,11] Although there are many methods available, due to objective results, electrophysiological studies are thought to be gold standard to verify diagnosis, determine severity, and plan treatment.[2,12]

This study was conducted to assess correlation between patient history, physical evaluation, and electrophysiological methods in patients who were clinically thought to have CTS to enhance diagnosis and treatment procedures in outpatient clinics in Turkey facing a large number of patients and time constraints.

Patients and Methods

Electrophysiological examination results of 3151 hands of 2516 patients examined by neurologists and orthopedists in our hospital between 2009 and 2016 with complaints that brought CTS prediagnosis to mind clinically were analyzed retrospectively. Patients with cervical spine or brain injury, as well as other systemic diseases were excluded from the study. The study was conducted in line with Helsinki Declaration after approval was granted by the local Ethical Board. All of the patients were assessed in terms of age, gender, direction of nerve compression, and electrophysiological presence and degree of CTS.

Electrophysiological assessment

Neuropack (Nihon Kohden Corp., Tokyo, Japan) 4 channel electroneuromyography device was used for electrophysiological examination. Electrophysiological examination was based on anatomical localizations described by Oh [Figure 1].[13] Sensorial nerve axon potential peak amplitude, transmission speed of sensorial nerve fibrils, motor nerve axon potential peak amplitude, distal motor latency, and speed of motor nerve fibrils were measured. Diagnosis was made according to American Association of Electrodiagnostic Medicine criteria.[14] CTS was classified as mild, moderate, or severe.

Statistical method

SPSS software, version 21.0 (IBM Corp., Armonk, NY, USA) was used to perform statistical analyses. Numerical variables were summarized with average ± standard deviation values and categorical variables were expressed as numbers and percentages. Kolmogorov–Smirnov test was used to analyze whether numerical variables were normally distributed. Levene's test was applied to determine equality of group variances. Differences between two groups in terms of numerical variables were analyzed with independent *t*-test when parametric test assumptions were met, and with Mann–Whitney U-test when test assumptions were not met. Chi-square test was used to evaluate association between categorical variables. Significance level was accepted as $P < 0.05$.

Results

Of the 2516 patients, 1838 (73.1%) were female and 678 (26.9%) were male, with average age of 48.60 ± 14.83 years (female: 48.34 ± 14.72 years and male: 47.47 ± 15.05 years). A total of 1858 (73.8%) patients had complaints in one hand, whereas 658 (26.2%) had complaints in bilateral hands.

Average age of the patients who were found to have CTS was 52.16 ± 13.84 years, whereas average age of the patients who were not found to have CTS was 44.26 ± 14.85 years. Age range of 40–50 years (25.9%) was interval with most findings of CTS, followed by 50–60 years (20.9%) and 30–40 (18.4%) years. CTS was confirmed in 55% of the females and 53.6% of the males. No statistically significant association was found between CTS and gender ($P = 0.433 > 0.05$). CTS was present in the right hand of 51.8% (1056) of the patients and in the left hand of 48.2% (984). Dominant hand of 76.8% (1058) of the patients was affected. Nerve compression was found in one hand of 71.5% (1328) of the females and 28.5% (530) of the males, a statistically significant result ($P = 0.003 < 0.05$).

When degree of nerve compression was analyzed, moderate compression was most frequently observed (1031; 50.6%), followed by mild (594; 29.1%) and severe (413; 20.3%) nerve compression. No significant association was found between degree and direction of nerve compression ($P = 0.097 > 0.05$).

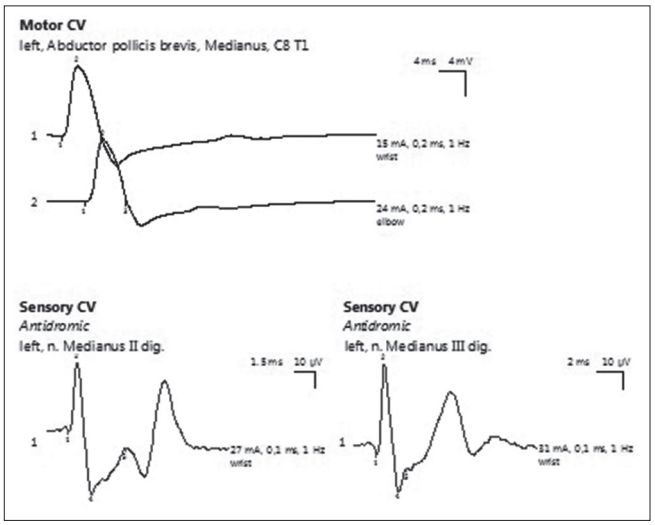

Figure 1: Electrophysiological examination was based on anatomic localizations used by Oh

Discussion

CTS can be diagnosed to a great extent with a patient history and physical examination; however, results of the present study are valuable in terms of correlation to definitive diagnosis.

CTS is the most common entrapment neuropathy of the upper extremity.[15] Various studies have reported CTS rate to change between 54% and 75%. One reason for the disparity may be due to location of research, i.e., rural or urban setting. In general, CTS is seen more frequently in patients who perform manually intensive labor such as assemblers, manufacturing workers, tailors, cleaning staff, and agricultural workers.[16] The present study was conducted in the countryside, and the patient group used their hands extensively in their daily work.

CTS affects women more than men, and it peaks on average between ages of 40 and 60.[8] This is thought to be due to the fact that carpal tunnel is smaller in women. In a study conducted by Gül Yurdakul *et al*.,[5] 85.7% of CTS patients were women, and average age was 46.32 ± 12.18 years. In our study, 72% of the patients were women and average age was 52.16 ± 13.84 years. Most of the patients (65.2%) were between 30 and 60 years of age.

In cases of CTS, torpor, tingling, and nocturnal symptoms have been described as major symptoms, whereas pain, weakness, and ineptness have been reported as minor symptoms. While major symptoms are specific for nerve damage, minor symptoms are extensive in soft tissue injuries and other musculoskeletal diseases.[17] In the present study, 2516 patients with major symptoms were assessed electrophysiologically for CTS; however, it was confirmed in only 54.9%. When the degree of nerve compression was analyzed, moderate nerve compression was observed most frequently (50.6%), followed by mild (29.1%) and severe (20.3%) nerve compression. No statistically significant association was found between degree and direction of nerve compression.

Although CTS is generally seen in bilateral hands, it may first be seen in the dominant hand unilaterally and more severely in idiopathic patients.[5] In a study of idiopathic patients, Bagatur and Zorer.[18] found unilateral CTS at a rate of 66%. In our study, CTS was found in bilateral hands of 26.2% patients and in the dominant hand of 76.8% patients. Nerve compression was found in one hand of 71.5% of the female patients and 28.5% of the male patients. This result was statistically significant and thought to be associated with housework and gardening performed by women in rural areas.

Although patient history and physical examination are important in the diagnosis of CTS, due to objective results, electrophysiological assessment is considered gold standard to verify diagnosis, determine severity, and plan treatment.[12] Efficacy of magnetic resonance imaging (MRI) and ultrasonography (USG) have also been examined in several studies. Onen *et al*.[19] reported that in electrophysiologically confirmed CTS cases, they found 71 additional pathologies with MRI. They noted that although this finding would not affect type of surgery, it could significantly decrease failures that can occur after surgery. In studies of USG, it has been stated that sensitivity of USG is lower than physical examination or electrophysiological examination in the diagnosis of CTS; however, in addition to being fast and cheap, it enables visualization of additional pathologies and anatomical nerve variations.[20,21]

Although the present study is retrospective and has the limitation of no comparison group, it is significant since it reveals the importance of communication with patient and thorough physical examination. Women, in particular, may develop pathology suggesting CTS as result of housework and outdoor labor; however, the hand is very complex. CTS was confirmed in only just over half the patients with clinical suspicion in this study; lack of definitive diagnosis with electrophysiological examination can lead to unnecessary surgical intervention.

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Conflicts of interest

There are no conflicts of interest.

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