



Evaluation of Clinical Symptoms in Patients with Different Severities of Carpal Tunnel Syndrome

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ARTICLE INFO	ABSTRACT
<p>Article type: <i>Original Article</i></p> <p>Bullet point:</p> <ul style="list-style-type: none">• Rely on clinical symptoms of CTS is not enough for planning• Electrodiagnostic evidence is essential for planning in CTS <p>Article history: Received: 10 Jul 2016 Accepted: 14 Sep 2016 Available online: 8 Aug 2017 CJNS 2017; 3 (10): 143-150</p> <p>*Corresponding author: Associate Professor of Neurology, Isfahan University of Medical Science, Isfahan, Iran Email: ghasemimajid59@yahoo.com</p>	<p>Background: The carpal tunnel syndrome (CTS) is a common neuropathy caused by the entrapment of the median nerve in the carpal tunnel. It causes pain and paresthesia in the hand.</p> <p>Objectives: To evaluate the role of clinical symptoms of CTS to determine the severity of this disorder.</p> <p>Materials and Methods: This descriptive cross-sectional study examined 75 hands of 40 patients were referred with CTS symptoms to Kashani and Alzahra hospitals in Isfahan, Iran, with signs of CTS from 2014 to 2015. The definitive diagnosis and severity of the disease were determined using electromyography and nerve conduction study (EMG-NCS). The correlation of the severity of CTS with clinical symptoms was examined using Spearman’s correlation coefficient and Man-Whitney test.</p> <p>Results: A total of 75 hands with CTS in 40 patients with mean age of 49.73 ± 12.53 years were examined (24% males, 76% female). The severity of CTS directly and significantly correlated with age, physical activities done with the involved hand, shaking or ringing the hands, weakness or atrophy of the thenar eminence, positive Phalen's test, and positive reverse Phalen’s test ($p < 0.05$). It correlated with duration of signs ($p < 0.05$) inversely and significantly and did not correlate with the score of pain (VAS) ($p > 0.05$).</p> <p>Conclusion: It is concluded that the different severities of the disease cannot be differentiated only through evaluation of clinical symptoms although they played the main role in diagnosis of the disease. Thus, electrodiagnostic evidence is still required for determining its severity and planning the treatment.</p> <p>Keywords: Carpal Tunnel Syndrome; Electrodiagnosis; Electromyography; Neural Conduction</p> <p>➤ Please cite this paper as: Abbasi S, Ghasemi M, Khorvash F, Ghadimi K, Madahian P. Evaluation of Clinical Symptoms in Patients with Different Severities of Carpal Tunnel Syndrome. <i>Caspian J Neurol Sci</i> 2017; 3(10): 143-150.</p> <p>1. Isfahan University of Medical Sciences, Isfahan, Iran 2. Associate Professor of Neurology, Department of Neurology, Isfahan Neuroscience Research Center, Alzahra Hospital, Isfahan University of Medical Science, Isfahan, Iran 3. Medical Student, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran</p>

Introduction

The carpal tunnel syndrome (CTS) is one of the most common neuropathies in the upper extremity and occurs following the blockage and compression of the median nerve in the wrist (1). It begins in the thirties or forties, and mostly in females (2). The annual mean incidence of CTS is 0.3% in general population, and its prevalence in the United States is 5% (3,4). The signs of CTS include pain, numbness, paresthesia, tingling, and weakness, which often occurs in the index, thumb, and middle fingers though may spread over the forearm (however, it occurs mostly in the hands and wrists). These signs usually appear at the time of waking up in mornings and also at nights (5). The signs of CTS appear when doing activities with the hands (e.g., when patients hold up an object in their hand). Furthermore, some studies show that pregnancy, obesity, and rheumatoid diseases, such as rheumatoid arthritis, are risk factors for the disease (6,7). There is also evidence showing that hypothyroidism increases the risk of CTS (8). CTS may cause atrophy of the thenar muscle and weaken the abduction of the thumb's muscle. The Phalen's and Tinel's sign clinical tests are widely used to diagnose CTS, and their specificity and sensitivity are very high in patients with advanced stages of the disease (9). The positive Phalen's test refers to the sensation of tingling in fingers when patients bend their hands down and put the dorsal surface of hands together for 30-60 seconds. The reverse Phalen's test refers to the sensation of numbness in fingers when patients extend their hands and fingers and put their palms together for 2 minutes (10,11). The standard methods for diagnosis of CTS are nerve conduction studies, including electrodiagnostic nerve conduction tests that

enjoy high sensitivity (84%-60%) and specificity (over 95%) (12). The ultrasound and magnetic resonance imaging methods are efficient in diagnosis of CTS but do not meet the diagnostic specificity and sensitivity of EMG and are not performed routinely (13). The criteria of European Federation of Neurological Societies/Peripheral Nerve Society (EFNS/PNS) classify the severity of CTS into minimal, mild, moderate, extreme, and severe (14). The disease is treated with surgical and non-surgical therapies. Surgical therapies are applied in severe cases of CTS, such as damage to the median nerve, and non-surgical therapies are used for mild and moderate cases of CTS or cases where the surgery is contraindicated (4). Non-surgical therapies include oral steroids, parenteral steroid, physiotherapy, laser, changing jobs, and holding the hands with splinting instruments (15). Physiotherapy can reduce the risk of the progress of CTS, and signs are controlled when splinting the wrist or injecting corticosteroids. Administration of non-steroidal analgesics, such as NSAID and gabapentin, is not efficient in treatment of CTS. In the open surgery or endoscopy, the transverse carpal ligament is cut, and signs of the disease are improved in 75%-99% of cases. They are more favorable and responsive than the non-surgical therapies, and the wrist does not need to be splinted after the surgery (13). Given that the electromyography and nerve conduction study (EMG-NCS) is a painful and costly method, it seems that finding clinical signs that can help the diagnosis of the severity of the disease without using EMG-NCS would save the patients' expense and time and may prevent painful diagnostic methods.

Materials and Methods

This descriptive cross-sectional study recruited 40 patients going to Kashani and Alzahra hospitals in Isfahan, Iran, with signs of CTS, including pain, numbness or paresthesia, tingling, and weakness of the upper extremity from 2014 to 2015. The signs had often occurred in the index, thumb, and middle fingers but spread to the forearm in some patients. However, they were limited mostly to the hands and wrists. The signs usually appeared at the time of waking up in mornings and also at nights. The definitive diagnosis of the disease was determined using EMG-NCV test (5). Of the 40 patients examined in this study, 35 patients had bilateral CTS, and 5 patients had unilateral CTS. The patients with positive EMG-NCS test and definitive diagnosis of CTS by the specialist were included in the study. In EMG-NCS test, the severity of CTS was classified using the diagnostic criteria of EFNS/PNS (minimal, mild, moderate, severe, and extreme severity). In this regard, minimal severity refers to normal latency of the median sensory nerve action potential (SNAP), mild severity refers to long latency (more than 3.5 ms) of the SNAP, moderate severity refers to increased latency (more than 3.5 ms) of both SNAP and median nerve compound motor action potential (CMAP), severe severity occurs when the SNAP is not achieved or has been missed, and extreme severity occurs when neither SNAP nor CMAP is achieved. The information about signs of the disease, including night pain, upper extremity pain, neck pain, shaking, pain or paresthesia when holding objects, sensation of numbness in all five fingers, sensation of numbness spreading from the neck and shoulder to lower parts of

the hand, sensory impairment of the median nerve, thenar atrophy or weakness, reduced nimbleness of the hand, and hypothenar muscle atrophy or weakness were collected through examining the patients and asking questions of the patients. Moreover, clinical examinations (sensory, motor, and reflexes) and tests, including Phalen's test, Tinel's test, and reverse Phalen's test were performed in this regard. Demographic specifications (such as age, sex, occupation, and comorbidities), pain severity based on the global benchmark of visual analogue scale (VAS), and also information obtained from EMG-NCS were collected using a checklist. All the patients consented to access to their information. The patients suffering comorbid radiculopathy or polyneuropathy or both were excluded from the study. The statistical tests used in this study included Kolmogorov-Smirnov test for examining the normal distribution of the data, Spearman's correlation coefficient for examining the correlation between CTS and demographic specifications (age, pain severity or VAS, duration of the disease, occupation, and comorbidities), and Mann-Whitney test for examining the correlation between severity of CTS and variables, such as signs of the disease, sex, and use of the involved hand. The data were analyzed using SPSS software version 20. The *p-value* less than 0.05 was considered as the significance level, and Mean \pm SD and number of data were presented.

Results

In this study, 75 hands of 40 patients with CTS and mean age of 49.73 ± 12.53 years (range: 31-84 years). Of the 75 hands, 18 hands (24%) belonged to males, and 57 hands (76%) belonged to females. Therefore, the

disease was more frequent in females than in males, and Mann-Whitney U test showed that the severity of CTS in males was significantly higher than that in females ($p < 0.001$) (table 1).

Table 1. Frequency distribution of the severity of CTS based on the patients' gender

CTS	Males n (%)	Females n (%)	Total n (%)
Minimal	0 (0)	11 (19.3)	11 (14.7)
Mild	1 (5.6)	17 (29.8)	18 (24)
Moderate	9 (50)	20 (35.1)	29 (38.7)
Severe	6 (33.3)	7 (12.3)	13 (17.3)
Extreme	2 (11.1)	2 (3.5)	4 (5.3)
Total	18 (100)	57 (100)	75 (100)

Mean pain score (VAS) in 66 cases (88%) was 4.82 ± 2.77 (0-10), and mean duration of signs in 70 cases (93%) was 1.76 ± 2.29 years (from one week to 10 years). Spearman's correlation coefficient showed that the severity of CTS correlated directly with age (figure 1) and inversely with duration of

signs, and did not correlate with pain score significantly (table 2).

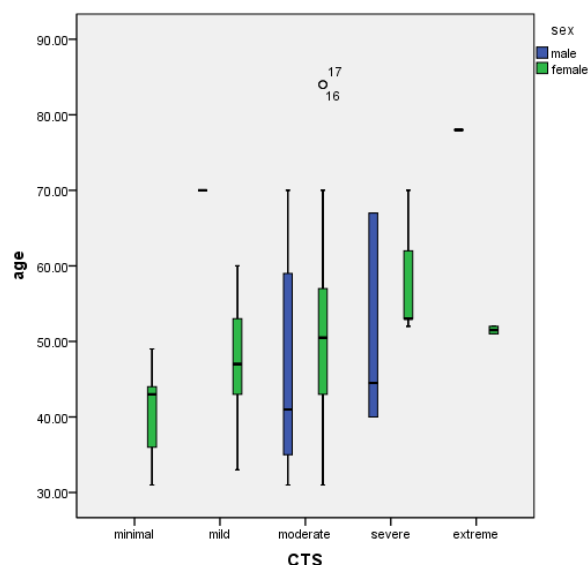


Figure 1. Age distribution of the patients in terms of the severity of CTS for each sex

Table 2. Distribution of age, pain score, duration of pain, and Spearman's correlation coefficients for the correlation between CTS and these variables

Variable	Number	Minimum	Maximum	Mean	Standard deviation	Severity of CTS	
						Correlation coefficient	P-value
Age (year)	75	31	84	49.73	12.53	0.362	0.001
Pain score	66	0	10	4.82	2.77	0.09	0.46
Duration of sign (year)	70	0.02	10	1.76	2.29	-0.192	0.047

The most frequent occupation was housekeeping (38 cases), and there was no significant difference between patients' occupation and the disease severity ($p = 0.26$). Of the patients, 11 cases (14.7%) were engaged in jobs without physical activities,

and 64 cases (85.3%) had a job involving physical activities and use of hands. There was a significant correlation between performance of physical activities done by hands and the severity of CTS ($p = 0.004$) (table 3).

Table 3. Distribution of the occupation of patients working with the hands and patients not working with the hands

Occupation	Severity					Total n (%)	<i>p-value</i>
	Minimal n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Extreme n (%)		
Doing activities with hands	11 (17.2)	17 (26.6)	25 (39.1)	9 (14.1)	2 (3.1)	64 (85.3)	0.004
Non-use of hands	0 (0)	1 (9.1)	4 (36.4)	4 (36.4)	2 (18.2)	11 (14.7)	

The frequency of underlying diseases was as follows: 21 cases (28%) suffered diabetes, 3 cases (4%) had hypothyroidism, and 2 cases (2.7%) suffered both diseases; there was no significant difference between underlying diseases and the severity of CTS ($p=0.45$). Mann-Whitney test showed that the severity

of CTS significantly correlated with signs, including shaking or ringing the hands, weakness or atrophy of the thenar eminence, positive Phalen's test, and positive reverse Phalen's test ($p=0.04$, 0.002 , 0.03 , & 0.03) but did not significantly correlate with other signs ($p>0.05$) (table 4).

Table 4. Frequency distribution of signs and their correlation with the severity of the disease (given that there were only 4 cases of extreme severity, the extreme and severe severities were integrated in order to obtain more reliable and realistic results)

Positive sign or test	Severity of CTS				Total N = 75 n (%)	<i>p-value</i>
	Minimal N = 11 n (%)	Mild N = 18 n (%)	Moderate N = 29 n (%)	Severe N = 17 n (%)		
Night pain	7 (63.6)	12 (66.7)	18 (62.1)	8 (47)	45 (60)	0.25
Pain in the upper extremity	8 (72.7)	11 (61.1)	22 (75.9)	10 (58.9)	51 (68)	0.65
Neck pain	3 (27.3)	5 (27.8)	9 (31)	4 (23.5)	21 (28)	0.87
Shaking or ringing the hands	4 (36.4)	13 (72.2)	23 (79.2)	13 (76.5)	53 (70.07)	0.04
Pain or paresthesia when holding objects	9 (81.8)	15 (83.3)	26 (89.7)	14 (82.4)	64 (85.3)	0.99
Numbness in all 5 fingers	4 (36.4)	9 (50)	21 (72.4)	8 (47)	42 (56)	0.47
Numbness spreading from the neck and shoulder to lower parts of the hands	3 (27.3)	2 (11.1)	5 (17.2)	4 (23.5)	14 (18.7)	0.92
Sensory impairment of the median nerve	4 (36.4)	7 (38.9)	8 (27.6)	9 (53)	28 (37.3)	0.45
Weakness or atrophy of thenar eminence	0 (0)	0 (0)	0 (0)	4 (23.5)	4 (5.3)	0.002
Reduced nimbleness of the hands	4 (36.4)	7 (38.9)	18 (62.1)	10 (58.9)	39 (58.9)	0.07
Hypothenar muscle weakness or atrophy, thumb flexion, pronation of the arm, forearm flexion	0 (0)	2 (11.1)	2 (6.9)	2 (11.8)	6 (8)	0.52
Positive Phalen's test	3 (27.3)	9 (50)	20 (69)	11 (64.7)	43 (57.3)	0.03
Positive Tinel's test	3 (27.3)	7 (38.9)	11 (37.9)	8 (47)	29 (38.7)	0.27
Positive reverse Phalen's test	2 (18.2)	6 (33.3)	16 (55.2)	9 (53)	33 (44)	0.03

Of the 14 signs, mean number of positive signs in the patients was 6.37 ± 2.76 , and Spearman's correlation coefficient showed a direct correlation between the number of positive signs and the severity of CTS ($p=0.02$ & $r=0.22$).

Discussion

In this study, CTS was more frequent in females than in males such that females/males ratio was 3.16 to 1. However, the severity of CTS was higher in males than that in females probably due to the fact that males consult

doctors later than females do. Furthermore, increasing age was determined as a cause of CTS. In Petit *et al.*'s study performed to examine the risk factors of CTS in the population of labor organization within two periods, the female sex and increased age were determined as risk factors of CTS (16). In Rouq *et al.*'s study, hands, forearms, and the three lateral fingers of males were more affected with CTS than those of females, and the distal part of the three lateral fingers of females was more affected with CTS than those of males. The involvement of the three lateral fingers were more frequent in ages more than 50 years and the involvement of wrists in ages lower than 50 years (17). The pain score did not significantly correlate with the severity of CTS in the present study. In Karadağ's study, the severity of CTS significantly correlated with VAS (18). The most frequent occupation in this study was housekeeping, and there was a significant association between the severity of CTS and occupation. It seems that the severity of CTS was higher in patients with activities done by hands. The prevalence of CTS in Ghasemi *et al.*'s study was higher in males. Moreover, the severity of CTS in assembly workers was higher than that in computer users (people using their hands and wrists more than others), and mean age and duration of working in patients with CTS were more than those in normal people; both groups were aged less than 30 years (19). Mc. Diarmid examined the incidence rate of CTS in males and females and showed that the incidence rate of the disease in occupations, including typing, cleaning the house, packaging products in factories, butchering, and non-construction workers in males was equal to that in females. Mc. Diarmid concluded that the higher prevalence of CTS in females was

not related to their occupation but to the type of activities more frequent in females (20). In this study, there were few cases of hypothyroidism but more cases of diabetes, and no significant association was found between underlying diseases and the severity of CTS. Hypothyroidism significantly correlated with CTS in Karne's study ($p < 0.0001$), and the incidence of CTS did not correlate with age, duration of disease, level of serum TSH, etiology of the disease, and thyroid hormone replacement therapies ($p > 0.05$) (21). In Bahrmann *et al.*'s study, CTS was more prevalent in patients with diabetes, and the diabetes associated with peripheral neuropathy was more frequent than the uncomplicated diabetes (22). The severity of CTS in this study significantly correlated with shaking the hands, and weakness or atrophy of thenar eminence. A study examined signs at different severity of CTS and revealed that feelings of tingling and heaviness were the most frequent signs, and the mild, moderate, and severe severities of pain did not much differ from one another (23). In this study, the positive Phalen's test and positive reverse Phalen's test significantly correlated with the severity of CTS. However, the positive Tinel's test did not significantly correlate with the severity of CTS. Hansen *et al.* performed a study on 142 patients presented for diagnosis of CTS using electrodiagnostic studies and Phalen's test, Tinel's test, and flick test to examine the sensitivity, specificity, and predictive value of these tests. Of the 142 patients, 67% of them suffered CTS, and the sensitivity of flick test, Tinel's test, and Phalen's test was 37%, 27%, and 34%, respectively. The results of flick and Phalen's maneuver diagnose cases of CTS better than Tinel's test does (24). It seems that there are few studies further

examining key signs of the disease and their correlation with the severity of the disease, and this study is a novel one, which was performed on the population of Isfahan, Iran to evaluate all clinical signs of CTS and their different severities. However, taking the history and doing examinations in each case of disease are the important factors in the clinical diagnosis.

Conclusion

This study showed that most of the signs of CTS did not significantly correlate with severity of the disease. However, identification of key signs for diagnosis of the disease and patients' follow-up are necessary. This study demonstrated that although clinical signs contribute to the clinical evaluation of the disease, electrodiagnostic evidence is required for definitive diagnosis of the disease and determining its severity.

Conflict of Interest

The authors have no conflict of interest.

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