

Factors affecting symptoms and functionality of patients with carpal tunnel syndrome: a retrospective study

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Abstract. [Purpose] The aim of this retrospective study was to determine the associations between clinical, physical, and neurophysiological outcomes and self-reported symptoms and functions of patients after surgical carpal tunnel release. [Subjects and Methods] Among 261 patients who had undergone open surgical carpal tunnel release within the last three years, 83 (mean age 50.27 ± 11.13 years) participated in this study. Their socio-demographics and comorbidities were recorded. The intensity of pain, paresthesia, and fatigue symptoms in the hand were assessed by means of a Visual Analogue Scale, the Semmes-Weinstein Monofilaments test of light touch pressure sensation, and Jamar dynamometry for measurement of grip and pinch strengths. The Boston Carpal Tunnel Questionnaire evaluated the severity of symptoms and hand functional status, and the variables were analyzed by multivariate linear regression. [Results] The severity of the symptoms and functional status of release surgery patients was associated with diabetes mellitus, migraine, night pain, paresthesia and fatigue symptoms, impaired light touch pressure, and lack of medical treatment. [Conclusion] Appropriate post-surgery treatment programs for these factors should be taken into consideration to help patients obtain optimal functionality and health in their daily lives.

Key words: Carpal tunnel syndrome, Patient outcome assessment, Surgical therapy

(This article was submitted Nov. 4, 2014, and was accepted Dec. 4, 2014)

INTRODUCTION

Carpal tunnel syndrome (CTS) is a common disorder of the wrist and hand which, in chronic cases, is characterized by impaired hand function. Some patients may experience loss of strength, but the primary clinical symptoms are pain, a burning sensation, or numbness along the median nerve, localized to the first three digits and the lateral aspect of the fourth digit¹⁾.

Approaches for the treatment of CTS include non-steroidal anti-inflammatory drugs, activity modification, physical therapy, steroid injections, splinting, tendon/nerve gliding exercises, and surgery²⁻⁴⁾. Open carpal tunnel release under local anesthesia remains the standard surgical technique to relieve CTS^{4, 5)}. To optimize the functional recovery of patients after this surgery, factors that may influence the diagnosis and the treatment of the disease need to be ascertained before the surgery.

Comorbidities may affect the prognosis of CTS. Some of the risk factors associated with CTS are diabetes mellitus,

thyroid disease, and rheumatoid arthritis^{6, 7)}. The frequency of CTS is greater in diabetics than in non-diabetics because of the increased susceptibility of diabetics to chronic focal neuropathies^{6, 8)}. According to one study, CTS is also related to certain personal characteristics (such as gender) and to occupational factors such as repetitive hand use⁹⁾. Women are reported to be more at risk of CTS than men, probably due to their culturally mandated gender-related duties at home. Hormonal changes that occur at menopause may also be associated with CTS^{4, 9, 10)}. Other factors associated with a poor prognosis following surgery are older age, an extended history of CTS, and prolonged or absent sensation or motor response^{2, 11)}. Nanavati et al. reported that most of their patients with persistent CTS symptoms were older and mainly female⁵⁾. Zyluk et al. found that patients with CTS at any age experienced similar benefits from surgery¹¹⁾. CTS is also affected by different lifestyle choices. Smoking cigarettes or being overweight, for instance, increases its incidence^{12, 13)}.

There are patients with CTS who had impaired health of daily life, because of symptomatic and functional decline. Studies are rare that show the effects of the above-mentioned factors on patient functionality after carpal tunnel release. Although these factors seem to be known, patients may still continue to have problems with CTS. The aim of this study was to investigate multiple factors concomitantly and determine those affecting self-reported symptoms and functions of patients after carpal tunnel release surgery.

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SUBJECTS AND METHODS

The subjects were recruited from a list of patients who had undergone open carpal tunnel release within the last three years at the Department of Neurosurgery at Bezmialem Vakif University. Each surgery had been performed by the same fellowship-trained surgeon. There were three criteria for surgery: moderate to severe nerve entrapment verified by electromyography, continued complaints despite medical treatment, and deficiency of motor skills. Of the 261 patients who underwent surgery, 83 with complaints participated in this study. Of those who did not participate, 31 had no complaints, 8 patients were unwilling to join the study and 139 could not be reached for reasons such as changed telephone numbers, or having moved out of town. The human research ethics board of Bezmialem Vakif University approved the study, and informed consent was obtained from each participant.

Socio-demographic data were gathered, including age, gender, body mass index (BMI), literacy, marital status, hand dominance, side of involvement, side of operation, occupation, and smoking status. The duration of CTS since diagnosis and after operation plus complaints before surgery were tallied. Participants were asked if they had received any treatment before or after surgery, including medical treatment (non-steroidal anti-inflammatory drugs), physical therapy, splinting, local steroid injection, and tendon/nerve gliding exercises. The presence of sleeping difficulties and comorbidities (diabetes mellitus, osteoarthritis, rheumatoid arthritis, hypothyroidism, migraine, vitamin deficiency, and trauma) was also noted⁴. The intensity of the paresthesia (during the day and at night), pain (at rest, with movement, and at night), and fatigue symptoms in the hand were assessed using a Visual Analogue Scale¹⁴.

Light touch pressure sensation and hand strength were evaluated since these may affect the symptoms and functionality of the patients. The Semmes-Weinstein Monofilament (SWM) test was performed on the pulp of the index fingers of both hands to test light touch pressure sensation^{7, 15}. Five monofilaments from Minikit were used: 2.83 (normal), 3.61 (diminished light touch), 4.31 (diminished protective sensation), 4.56 (loss of protective sensation), and above 6.65 (unstable)^{7, 16}. A Jamar dynamometer was used to assess motor findings, and to measure grip and tip pinch strength with subjects in the position standardized by the Association of American Hand Therapists. The mean score of three trials was recorded separately for both hands¹⁷.

The Turkish version of the Boston Carpal Tunnel Questionnaire (BCTQ) was used to evaluate the severity of symptoms and the functional status¹⁸. The BCTQ is a questionnaire that is frequently used to evaluate two domains of CTS. The symptom severity scale assesses 11 items related to hand pain severity, numbness, and weakness. The functional status scale assesses the ability to perform hand-related activities on an 8-item scale. Each item asks the difficulty in performing the task, which is rated from 1 (little) to 5 (most). The average total score is calculated for each subscale, with higher scores indicating worsening severity.

An initial power calculation indicated that a sample size of 80 was required. This figure was based on correlation

coefficients (r) exceeding 0.30 and a power of 80% in order to yield a statistically significant result. Data were analyzed using SPSS software v.18.0 (SPSS Inc., Chicago, IL, USA). Descriptive data are presented as mean (\bar{x}) \pm standard deviation (SD). Categorical data are presented as counts (n) and percentages (%). Spearman's test was used for categorical variables and Pearson's test for continuous variables. The influence of various demographic and clinical variables on the BCTQ functional status and symptom severity scales was investigated by multivariate linear regression analysis. The normality of data distribution was verified with the Kolmogorov-Smirnov test. Variables with p values < 0.1 in correlation analyses were considered to be potentially independent in multivariate analysis. A stepwise method was used to construct the multivariate regression models in relation to various dependent variables.

RESULTS

The mean age of the subjects was 50.27 ± 11.13 (range 31–85) years; the female-male ratio was 74 (89.2%) to 9 (10.8%). Of the 83 subjects, 68 (81.92%) were housewives, 7 (8.43%) were housekeepers, and 8 (9.63%) were repairmen. Their mean BMI was 32.14 ± 6.75 (20.76–55.16). Sixty (72.3%) of the patients were affected bilaterally, 35 (42.2%) had diabetes mellitus, 51 (61.4%) had sleeping difficulties. The mean elapsed time after diagnosis until surgery was 31.64 ± 16.7 (2–48) months. The duration of complaints before surgery was 46.99 ± 8.56 (4–60) months. The mean elapsed time since the operation was 22.92 ± 10.54 (3–34) months. Two of the 83 patients had undergone repeat surgery. Table 1 presents the socio-demographic characteristics of the patients.

The mean severities of pain at rest, with movement, and at night were 4.96 ± 3.64 (0–10), 5.83 ± 3.47 (0–10), and 6.33 ± 3.67 (0–10), respectively. The mean intensity of paresthesia during the day was 4.40 ± 3.65 (0–10), and 5.98 ± 3.83 (0–10) at night. The score of fatigue was 5.83 ± 3.39 (0–10). Table 2 shows motor measurement and light touch pressure sensation outcomes.

According to the BCTQ, the affected hands scored 32.63 ± 10.26 (13–55) on the symptom scale and 24.67 ± 8.79 (8–40) on the functional status scale. Multivariate regression analyses (Table 3) indicated that the BCTQ-functional status scale was independently associated with diabetes mellitus, medical treatment, pain/paresthesia at night, and light touch pressure (B values 3.533, 4.470, 0.919, 1.260, and 2.280, respectively; $p < 0.05$). The BCTQ-symptom severity scores were independently associated with diabetes mellitus, migraine, night paresthesia, and fatigue (B values 6.427, -5.147 , 0.532, and 0.492, respectively; $p < 0.05$).

DISCUSSION

This study determined the associations between clinical, physical, and neurophysiological outcomes and self-reported symptoms and functions of the patients who had carpal tunnel release surgery.

The BCTQ scores of our patients were associated with diabetes mellitus, migraine, lack of medical treatment,

Table 1. Socio-demographic characteristics of the patients

		n (%)		n (%)	
Education	Illiterate	4 (4.8)	Affected hand	right	12 (14.5)
	Primary school	69 (83.1)		left	11 (13.3)
	Secondary school	3 (3.6)		bilateral	60 (72.3)
	High school	7 (8.4)		Hand dominance	right
Marital status	Single	8 (9.6)	left		4 (4.8)
	Married	64 (77.1)	ambidextrous	3 (3.6)	
	Divorced	11 (13.3)	Side operated	right	33 (39.8)
Comorbidities	Osteoarthritis	7 (8.4)		left	32 (38.6)
	Hypothyroidism	3 (3.6)	both	18 (21.7)	
	Rheumatoid arthritis	7 (8.4)	Treatments before/after the surgery		
	Trauma	6 (7.2)		Medical treatment	28 (33.7)
	Vitamin deficiency	15 (18.1)		Physical therapy	7 (9.6)
	Migraine	9 (10.8)		Splinting	11 (13.3)
	Diabetes mellitus	35 (42.2)		Injection	1 (1.2)
Smoking		25 (30.1)		Exercise	11 (13.3)

n, number; %, percentage

Table 2. Motor measurement and light touch pressure sensation outcomes

		mean±SD	min-max
Grip strength	right	18.5±67.31	3.3–39.0
	left	17.98±5.74	2.0–30.0
Pinch strength	right	4.77±2.85	0.4–12.5
	left	4.72±2.66	1.0–11.8
Light touch pressure test	Right		Left
		n (%)	n (%)
	2.83	38 (45.8)	55 (66.3)
	3.61	34 (41.0)	25 (30.1)
	4.31	5 (6.0)	2 (2.4)
	4.56	4 (4.8)	1 (1.2)
	6.65	2 (2.4)	0

SD, standard deviation; min, minimum; max, maximum; n, counts; %, percentage; 2.83, normal; 3.61, diminished light touch; 4.31, diminished protective sensation; 4.56, loss of protective sensation; and above 6.65, unstable

impaired light touch pressure sensation, pain/paresthesia at night, and fatigue symptoms. The presence of these factors in CTS adversely affected our patients' symptoms and functionality. Gulabi et al. indicated that diabetes mellitus is a risk factor of a poor functional outcome of carpal tunnel decompression⁸. Isik et al. found that after open carpal tunnel release, symptoms persisted more in diabetic patients than in non-diabetics¹⁹. Since 42.2% of our subjects were diabetic, it might explain their poor symptoms and their slow post-surgery recovery. Although, some CTS studies have excluded subjects with diseases such as diabetes mellitus^{6, 8}, we did not categorize our patients according to their comorbidities, which is one limitation of this study. In the literature, there are many CTS studies related to diabetes mellitus^{6, 8}, and we found a few that mentioned other factors.

Table 3. Influence of demographic and clinical variables on the BCTQ

BCTQ	Associated parameters	β
Function	Diabetes mellitus	3.533**
	Medical treatment	4.470*
	Night pain	0.919*
	Night paresthesia	1.260*
Symptom	Light touch pressure- left	2.280*
	Diabetes mellitus	6.427*
	Migraine	-5.147**
	Night paresthesia	0.532**
	Fatigue	0.492**

β , Standardized partial regression coefficients, t test of regression model; BCTQ, Boston Carpal Tunnel Questionnaire, *p=0.00, ** p<0.05.

With the progression of CTS, symptoms may radiate proximally towards the shoulder. Weakness of hand grip may be a symptom of some other disease such as cervical radiculopathy or tendinitis^{4, 17}. The complaints of many of our patients were on-going during this study. On medical re-examination after our assessments, we encountered some diseases which may cause or be confused with CTS, but we did not elaborate on these to our patients, a weakness of our study.

The repetitive manual tasks housewives perform at home, such as preparing meals, might be a factor involved in the continuation of symptoms, but since almost all of our subjects were housewives, we could not examine occupational risk factors separately, which is another weakness of this study. Most of the women were at the age of menopause. Fernández-de-Las-Peñas C et al. found that a number of factors were associated with function in women with CTS¹⁰. The effect of female psychology on the progress of healing after carpal tunnel surgery should be examined in future

research.

Padua et al. found that 87% of their patients had bilateral CTS. CTS generally begins in the dominant hand and affects the other later, but the hand first affected usually has the worse symptoms and more severe neurophysiologic involvement¹²). In our study, although most of the patients were right-handed, their complaints were frequently in both hands. Those with complaints in both hands had surgery on the hand with the worst symptoms. Whether the hand operated upon is the dominant hand or not affects the results of its functionality. Another limitation of our study was not distinguishing the results by the dominant hand.

In our study, patients had night pain and severe paresthesia which caused sleeping difficulties. Their pain at rest averaged 5; however, in another study it was 1 out of 10 in CTS patients after surgery²⁰). Also, patients' light touch pressure sensation outcomes were worse than normal values. Because of these outcomes, patients might have received rehabilitation after surgery.

Cross-sectional studies reported an association between smoking and CTS; however, smoking was not associated with CTS in a meta-analysis of cohort studies¹³). Similarly, smoking was not associated with the symptoms and functions of the patients in our study.

Patients with CTS have deficits in grip and pinch strength²¹). Our patients exhibited that loss of grip and pinch strength after release surgery, but the surgery did not affect their functionality.

An important limitation of this research was that we could not reach all of the 261 patients who had undergone carpal tunnel decompression, it is difficult to draw conclusions regarding the overall success of this surgical method; however, almost one-third (31.8%) of the 83 subjects involved in this study had continuing complaints. Was surgery the right decision for these patients? Was a patient's diagnosis and subsequent surgery delayed despite the patient having had complaints for a long time? How long after the complaints started should surgery be scheduled? Did patients' demographics hamper recovery? Finding the answers to these questions might be the topics for future studies.

For the treatment of CTS, Atroshi and Gummesson claimed that patients could be successfully managed without surgery²). Standard conservative treatment may effectively relieve symptoms and improve functional status²²), and may also reduce the number of patients who need surgery, especially during the early stages of management²³). Elfar et al. stated that conservative therapy generally offers only temporary relief of symptoms⁷). On the other hand, some studies have reported that conservative treatment is ineffective, and that almost one-third of patients diagnosed with CTS will require surgery²⁴⁻²⁶). Two-thirds of patients who underwent carpal tunnel release reported being completely or very much satisfied with the outcome in follow-up examination 6, 18, and 30 months after surgery²⁵). A number of non-surgical interventions reported in the literature have been useful for the treatment CTS in the short-term, but there is sparse in the evidence of their long-term effectiveness³). This paucity of knowledge indicates there is a need to investigate the mid- and long-term results of various treatment approaches. Future studies should also compare patients who had surgery

with patients receiving conservative treatment who did not have surgery.

Our patients received no conservative therapy, and they continue to have complaints. This study highlights that patients should be given the necessary guidance and treatment, either pre- or post-operatively. Other treatments and management programs should be implemented to support the success of CTS surgery. In order to minimize the number of patients who still suffer after surgery, conservative treatment should also be considered.

After the assessments, we advised our patients on task modification in order to control symptoms, such as being aware of activities like squeezing and other forced actions. Patients were guided towards conservative therapy related to their needs.

The implementation of an appropriate, personalized approach is important in order to minimize carpal tunnel problems in the future. When planning a study, exclusion criteria may be determined considering the above-mentioned factors. It may be advisable to analyze the factors that affect symptoms and functions to help patients obtain functionality after release surgery by means of appropriate treatment programs.

ACKNOWLEDGEMENTS

The author appreciates the contributions provided by Hakan Seyithanoglu MD from the Department of Neurosurgery in receiving the list of patients and the editorial assistance provided by Susan Delacroix, and wishes to thank Omer Uysal, certified statistician from the Department of Biostatistics and Medical Informatics, for his statistical guidance.

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