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Boston Carpal Tunnel Questionnaire Scores Alone Do Not Predict Surgical Intervention for Patients With Carpal Tunnel Syndrome

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Abstract

Background: With the expanded indications for telemedicine, there is increased utility for screening methods to determine which patients are likely to progress to surgical intervention, requiring in-person visits. Patient-rated tools such as the Boston Carpal Tunnel Questionnaire (BCTQ) may be one such tool for screening patients with carpal tunnel syndrome (CTS). The aim of the study was to evaluate whether BCTQ scores were predictive of offering conservative treatment or surgical intervention for CTS. **Methods:** Patients diagnosed with CTS from January 2017 to February 2020 completed BCTQ questionnaires prior to in-person office visits. Demographics, comorbidities, and highest level of intervention recommended were recorded for each patient as conservative, injection, or surgery. Pearson χ^2 and independent-samples *t* tests were conducted to determine whether BCTQ symptom severity and functional scores were associated with intervention type. **Results:** A total of 200 patients with CTS were included. Of these, 103 were recommended conservative or injection treatment and 97 were recommended surgery. There were no differences in comorbidities between groups, including other upper extremity pathology ($P = .57$), previous upper extremity surgery ($P = .32$), hypertension ($P = .17$), hypothyroidism ($P = .15$), rheumatoid arthritis ($P = .34$), and diabetes ($P = .30$). Between these groups, there were no differences in BCTQ symptom severity score (symptom severity scale [SSS]; $P = .16$) or BCTQ functional severity score (functional severity scale [FSS]; $P = .96$). **Conclusions:** There is no correlation between comorbidities and BCTQ SSS or FSS score, and offering surgery for CTS. In an era of minimizing non-essential health care visits, the BCTQ is insufficient in screening patients as potential surgical candidates.

Keywords: carpal tunnel syndrome, nerve, diagnosis, patient-reported outcomes, Boston Carpal Tunnel Questionnaire, Levine-Katz, telemedicine

Introduction

Prevalence of carpal tunnel syndrome (CTS) in the adult population is estimated to be between 1% and 16%.[1] As patients with CTS symptoms are commonly seen by a variety of providers including neurologists, physiatrists, primary physicians, rheumatologists, and orthopedic surgeons, accurate diagnosis of CTS and appropriate treatment intervention are crucial.[2] With a rise in telemedicine capabilities amid the COVID-19 pandemic, there has been a desire to more adequately screen patients at home to determine ultimate conservative versus surgical intervention.[3]

To supplement history, physical exam, imaging, and electrodiagnostic modalities, multiple standardized questionnaires have been developed to provide an objective measure of upper extremity impairment for patients with CTS. Of these standardized questionnaires, only the Boston Carpal Tunnel Questionnaire (BCTQ), also known as Levine-Katz Questionnaire, is specific for CTS, whereas others are used to evaluate a myriad of upper extremity diagnoses.[4] The BCTQ is separated into 2 sections based on a symptom severity scale (SSS) and functional severity scale (FSS). Patients answer questions about their degree of symptom and functional impairment on a scale of 1 to 5, with 5 indicating the highest impairment. A patient's final

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score is calculated as the averages of the answers to the questions in both the SSS and FSS, with higher scores indicating greater impairment.[4]

Since the BCTQ was first introduced in 1993, multiple studies have investigated its feasibility and efficacy in evaluating patients with CTS.[5] (Lue, Wu and Liu, 2015) In 2019, De Kleermaeker et al[6] found that CTS patients with more severe disease require greater BCTQ SSS and FSS improvements to report clinical change. Multiple other studies have translated the BCTQ to other languages and have investigated its efficacy.[7-11] Few studies, however, have correlated BCTQ scores with treatment for CTS.

Given that the other diagnostic tools that assess nerve entrapment severity, such as physical exam, ultrasound, and electrodiagnostics, require in-person visits, we were interested in determining whether BCTQ scores correlated with ultimate treatment type. If so, administration of this survey could help guide clinicians in recommending in-person versus telemedicine visits for initial evaluation of common upper extremity nerve entrapment. As telemedicine expands, we hypothesized that screening based on BCTQ may help predict if intervention is likely. Specifically, we aimed to determine whether BCTQ scores could predict treatment recommendation for conservative management or surgical intervention in the diagnosis of CTS.

Materials and Methods

Prior to their office visits, all patients at our institution were asked to complete BCTQ questionnaires. Eventually, only those patients who were diagnosed with CTS and who completed BCTQ questionnaires were included in the study. Following Institutional Review Board approval, patients who were being evaluated for a diagnosis of CTS from January 2017 to February 2020 by 2 fellowship-trained hand surgeons at our institution were retrospectively reviewed. Demographics and comorbidities were recorded. These included age, sex, race/ethnicity, body mass index (BMI), side of injury, and occupation. Comorbidity information collected included hypertension, hypothyroidism, cervical radiculopathy, neuromuscular disorders, diabetes status, dialysis, and rheumatoid arthritis. Type of work was categorized as desk work, light manual labor, or heavy manual labor. All patients completed the BCTQ prior to their visit. The BCTQ questionnaires contained both the 11-question SSS and the 8-question FSS with each question scored from 1 to 5. Patient responses to their BCTQ questionnaires were averaged to obtain an average SSS and FSS. These averages were then input into OBERD (Universal Research Solutions, LLC, Columbia, Missouri) software. Patients who already received treatment (injection or surgery) prior to initial visit were excluded.

At the conclusion of their office visits with our fellowship-trained hand surgeons, patients were recommended either of the following interventions: (1) conservative or injection; or (2) surgery. Conservative intervention included non-steroidal anti-inflammatory drugs (NSAIDs), splints, or brace recommendations. Injection intervention included cortisone steroid injection to the affected area. Surgical intervention was carpal tunnel release surgery.

All analyses were performed using Statistical Package for the Social Sciences (Version 25; SPSS Inc, Armonk, New York). Pearson χ^2 tests were performed for comorbidities for conservative/injection versus surgery groups. Independent-samples *t* tests were performed for average BCTQ SSS and FSS scores for conservative/injection versus surgery groups. This was reported with 95% confidence interval (CI). Statistical significance was set at $P < .05$.

Results

Demographic information is presented in Table 1. There were a total of 200 patients with CTS in this study, of which 103 had conservative or injection and 97 had surgery. The average age for the conservative/injection group was 61.36 (SD = 15.05), and for the surgery group, the average age was 65.1 (SD = 12.48). The average BMI for the conservative/injection group was 27.81 (SD = 7.09), and the average BMI for the surgery group was 28.54 (SD = 6.04). In total, there were 70 women and 33 men in the conservative/injection group, whereas there were 52 women and 45 men in the surgery group. Notably, one physician recommended 28 (35.9%) out of 78 patients for surgery, and the other recommended 69 (56.6%) out of 122 patients for surgery ($P < .003$).

Comorbidity information is presented in Table 2. In the conservative/injection group, 53 had other upper extremity pathology, and in the surgery group, 46 had other upper extremity pathology ($P = .569$). In the conservative/injection group, 21 had previous upper extremity surgery, and in the surgery group, 27 had previous upper extremity surgery ($P = .316$). In the conservative/injection group, 33 had hypertension, whereas in the surgery group, 38 had hypertension ($P = .173$). There were 16 patients with hypothyroidism in the conservative/injection group and 9 with hypothyroidism in the surgery group ($P = .150$). There were 7 patients with rheumatoid arthritis in the conservative/injection group and 6 in the surgery group ($P = .339$). Finally, 12 patients had diabetes in the conservative/injection group and 9 of them had diabetes in the surgery group ($P = .302$). There were no statistically significant differences in comorbidities between the 2 groups.

Average BCTQ SSS and FSS scores for the 2 groups are presented in Table 3. The average BCTQ SSS for the conservative/injection group was 2.854 (SD = 0.819) and 2.925 for the surgery group (SD = 0.7576) ($P = .163$). The average BCTQ FSS for the conservative/injection group was 2.377 (SD = 0.883) and 2.344 (SD = 0.928) for the

Table 1. Patient and Clinical Characteristics of the Study Population.

	Conservative or injection		Surgery	
	n = 103		n = 97	
Demographic and clinical characteristics	n	%	n	%
Race				
White	78	75.7	90	92.8
Black or African American	10	9.7	3	3.1
Hispanic	8	7.8	3	3.1
Asian or Pacific Islander	2	1.9	1	1.0
Other or unknown	5	4.9	0	0.0
Sex				
Female	70	68.0	52	53.6
Male	33	32.0	45	46.4
Other or unknown	0	0.0	0	0.0
Work type				
Desk work	36	35.0	28	28.9
Light manual labor	9	8.7	5	5.2
Heavy manual labor	4	3.9	1	1.0
Unknown	54	52.4	63	64.9
	Conservative or injection		Surgery	
Age (SD)	61.36 (15.05)		65.1 (12.48)	
Body mass index (SD)	27.81 (7.09)		28.54 (6.04)	

Table 2. Comorbidity Information of Study Population by Intervention Type.

	Conservative or injection		Surgery		
	n = 103		n = 97		
Comorbidities	n	%	n	%	*P* value
Other upper extremity pathology	53	51.5	46	47.4	.569
Previous upper extremity surgery	21	20.4	27	27.8	.316
Hypertension	33	32.0	38	39.2	.173
Hypothyroidism	16	15.5	9	9.3	.150
Rheumatoid arthritis	7	6.80	6	6.19	.339
Diabetes mellitus	12	11.65	9	9.28	.302

surgery group ($P = .956$). While there were differences in surgical intervention across the 2 surgeons, there were no statistically significant differences in BCTQ SSS and FSS between the 2 groups. No individual question was predictive of surgical intervention.

Discussion

As telemedicine continues to expand for upper extremity services, the potential ability of remotely administered questionnaires to stratify patients among intervention type could reduce the need for multiple office visits. In this study, we investigated whether the results from BCTQ symptom severity scores (SSS) and functional severity scores (FSS) could predict an intervention type for patients with CTS. Notably, we found that BCTQ SSS and FSS are not sufficient in predicting surgical intervention for CTS. For patients receiving either surgical or non-surgical intervention, we found no differences in comorbidities. While we found that surgeons and patients may prefer one intervention over another, when using independent-samples *t* tests for BCTQ scores between the 2 groups, we also found that BCTQ SSS and FSS scores do not affect the decision to pursue surgery. Thus, the ultimate decision to pursue surgery for CTS should not be based on a pre-office BCTQ or comorbidity information, as scores on these questionnaires are poorly predictive of clinical decision-making.

Table 3. BCTQ Symptom Severity Score and Functional Severity Score by Intervention Type From Independent-Samples *t* Test.

					95% CI	
	n	Mean	SD	*P* value	Lower	Upper
BCTQ symptom severity score						
Conservative or injection	103	2.854	0.8186	.163	−0.2915	0.149
Surgery	97	2.925	0.7576			
BCTQ functional severity score						
Conservative or injection	103	2.377	0.883	.956	−0.219	0.286
Surgery	97	2.344	0.928			

Note. BCTQ = Boston Carpal Tunnel Questionnaire; CI = confidence interval.

As modern health care focuses on improving patient outcomes while decreasing cost, the use of patient-reported outcome measures, such as the BCTQ, have become common practice.[12,13] In conjunction with more traditional, objective physical measurements, these questionnaires can help hand surgeons stratify risk and gather additional quantitative data about daily activities, effectively allowing for monitoring of progress over time or for comparison of cohorts of patients.[12,13] Research into the BCTQ, which was developed in 1993, has focused on translating and validating the BCTQ into different languages, and monitoring CTS after diagnosis.[6,7,10,11,14-16] Recently, Sirisena et al[16] determined that the BCTQ could be used as an effective screening tool among patients previously undiagnosed with CTS, suggesting that the questionnaire may have predictive utility. However, to our knowledge, there is no evidence about the ability of the BCTQ to predict intervention type in CTS. Thus, in light of this knowledge gap, the findings of our study conclude that in fact the BCTQ is not sufficient in predicting ultimate treatment intervention in CTS. We find that the BCTQ cannot be used alone to predict the need for surgery for patients with CTS.

As telemedicine expands for the upper extremity services, there has been interest in investigating whether the BCTQ and/or past medical history alone can predict an intervention, which could possibly eliminate the need for in-person office visits. Due to the COVID-19 pandemic, telemedicine has gained increasing attention in orthopedic surgery and has significant advantages over regular in-person visits, including improved access to care, cost-effectiveness, and efficiency.[3,17] In hand surgery, Grandizio et al[18] implemented a postoperative hand and upper extremity telemedicine program and determined that it significantly decreased visit time over in-person visits. Furthermore, the authors noted that telemedicine led to high patient satisfaction, as it was preferred by 90% of patients in subsequent encounters.[18] Although telemedicine may be limited in specific physical examination maneuvers, unique substitutes, such as smartphone photography as an alternative to goniometry, have been introduced and make remote patient encounters effective in hand surgery.[19] However, the results of our study show that the information provided by remote questionnaires is not sufficient in informing clinical decision making in patients with CTS. Nevertheless, a virtual consultation can still be beneficial as it can still allow for certain physical exam maneuvers such as Phalen's test and Tinel's test for CTS. In addition, virtual medicine visits may offer additional advantages of comfort and convenience for the patient as well as reduced contact with COVID-19. Taken together, in this study we find that the BCTQ used in isolation cannot predict a need for surgery, although telemedicine visits are still beneficial. In light of our findings, we propose that the BCTQ prescreening questionnaire alone cannot predict a need for surgery. Instead, this decision should be based on a virtual or in-person visit, which also includes a patient-physician discussion of patient preference, a physical exam, and a discussion of risks and benefits.

Our study has several limitations and directions for future investigation. As this study was a retrospective review of the patients of 2 fellowship-trained hand surgeons at a single institution, the results of the study may not be generalizable to the entirety of patients diagnosed with CTS. There is also bias to recommend surgery given our evaluation by solely hand surgeons. Furthermore, although the present study was able to account for potential confounding factors including patient demographics, other variables may potentially remain unaccounted for and influence the results of the study. Thus, a prospective study is needed to determine causality. Next, for patients who were recommended multiple interventions, such as both injection and surgery, we placed these patients in the group with highest treatment intervention and did not investigate why they were recommended both. Additional limitations include there is no gold standard for the diagnosis of CTS and none that is validated that can be assessed remotely. While nerve conduction studies (NCS) and electromyography (EMG) can also be used to diagnose CTS, we did not investigate the use of these techniques in the diagnosis of CTS in our patient cohort. In addition, we used the BCTQ as a measurement of functional status and symptom severity in the patients in our study. There are alternative patient-reported outcome measures, which could have certainly

yielded differing results, but the BCTQ is widely used and the most specific for CTS.[12,14] Future studies could investigate each patient's BCTQ scores before and after intervention and examine how their scores change over time based on their intervention received.

Conclusions

To conclude, we examined 200 patients with CTS and determined that BCTQ symptom severity scores (SSS) and functional severity scores (FSS), even when combined with demographics and comorbidities, are not sufficient in predicting surgical intervention for CTS. Although telemedicine and administration of online questionnaires may play an important role in the future of hand surgery, we find that certain questionnaires are insufficient to predict the need for surgery alone for CTS. Virtual consultations can still be beneficial. We find that the BCTQ alone cannot predict surgical decision making and there still remains a place for in-person office visits and in-person consultation when determining treatment intervention for CTS.

Authors' Note

Daniel A. Osei and Duretti T. Fufa is now affiliated to Weill Cornell Medical College, New York, NY, USA.

Ethical Approval

This study was approved by our Institutional Review Board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration.

Statement of Informed Consent

Informed consent was not applicable to this report as this study was a retrospective review. The Institutional Review Board (IRB) at our institution approved the study (IRB# 2016-987).

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: L.E.W. has stock or stock options in Abbott, Amgen Co, Bristol-Myers Squibb, Eli Lilly, Express Scripts, Gilead Sciences, Johnson & Johnson, Merck, and Sanofi-Aventis. D.A.O. is on the Editorial Board for the *Journal of Hand Surgery* and is a board member for the American Society for Surgery of the Hand. D.T.F. is a consultant and provides research support for Integra, and is a consultant for Medartis. The other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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