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Choosing the most efficacious scoring method for carpal tunnel syndrome

Hülya YÜCEL[1], Hakan SEYİTHANOĞLU[2]

[1]Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Bezmialem Vakif University, Istanbul, Turkey;
[2]Department of Neurosurgery, Faculty of Medicine, Bezmialem Vakif University, Istanbul, Turkey

Objective: The aim of this study was to determine the most efficacious hand-specific questionnaire to determine functionality in patients with carpal tunnel syndrome.

Methods: The study included 89 patients who underwent open carpal tunnel release surgery within three years prior to the study. A visual analog scale was used to assess the intensity of pain and paresthesia symptoms. Each participant completed the Boston Carpal Tunnel Questionnaire (BCTQ), the Michigan Hand Outcome Questionnaire (MHQ), the quick form of the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, and the Duruoz Hand Index (DHI). The BCTQ, pain and paresthesia results were assumed as gold standards. Correlations between the MHQ, QuickDASH, and the DHI were analyzed. A correlation analysis between the variables was tested using Spearman's rho test or Pearson's test for variables.

Results: The QuickDASH was well correlated with pain, paresthesia and the BCTQ ($p<0.001$). The questionnaires complied with each other.

Conclusion: In addition to its complicated scoring, the MHQ contained detailed subparameters with similar questions and takes a long time to complete. Further studies may confirm the effective usage of the DHI. The easier QuickDASH questionnaire appears to be more practical for carpal tunnel release patients.

Key words: Boston Carpal Tunnel Questionnaire; carpal tunnel syndrome; Duruoz Hand Index; Michigan Hand Outcome Questionnaire; quick Disabilities of the Arm, Shoulder and Hand questionnaire; scoring method; surgery.

Carpal tunnel syndrome (CTS), one of the most common entrapment neuropathies, is a result of compression of the median nerve in the carpal tunnel of a wrist. In chronic conditions, CTS is characterized by impaired hand function and disability with clinical symptoms of pain and paresthesia, and in some cases, muscular atrophy and loss of strength.[1,2] CTS is more prevalent between the fourth and sixth decades, and one-third of the cases require surgery.[3]

Various instruments have been proposed to assess symptoms, functionality in daily life and outcomes of surgery in CTS patients.[4-9] While these instruments have been evaluated on the basis of reliability and validity, studies still seek the ideal post-surgery outcome scoring method. Performance-based tests of hand function are not frequently used due to time constraints and

Correspondence: Hülya Yücel, PT, Asst. Prof. Bezmialem Vakıf Üniversitesi Sağlık Bilimleri Fakültesi, Fizyoterapi ve Rehabilitasyon Bölümü, Adnan Menderes Bulvarı, Fatih, 34093 Istanbul, Turkey.
Tel: +90 212 – 523 22 88 e-mail: hyucel@bezmialem.edu.tr

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the need for equipment and training.[10] For this reason, clinically useful and easily administered written questionnaires are preferred for determining a patient's perception of difficulties in daily life and hand functionality in order to plan an appropriate and effective treatment program. The challenge lies in establishing a scoring method that objectively evaluates the hand function.[11] As comprehensive assessment tools, self-administered questionnaires are effective and sensitive to change in function and provide physical measures of recovery.[12] The Boston Carpal Tunnel Questionnaire (BCTQ) was found to be effective as electromyography testing for determining postoperative treatment outcomes of CTS patients.[2] In the literature, the Michigan Hand Outcomes Questionnaire (MHQ) and the Disabilities of the Arm, Shoulder, Hand (DASH) questionnaire are two of the most frequently used hand-specific instruments.[4,10,13] Both have been validated and adapted for the Turkish population.[14,15] In addition, the Duruoz Hand Index (DHI) is also used for many hand-related disorders in Turkey.[16,17]

The aim of this was to determine the most efficacious measure for assessing patients with CTS. Questionnaires used were the BCTQ, MHQ, the quick form of the DASH and the DHI.

Patients and methods

Of the 267 patients who underwent open carpal tunnel release surgery within the prior three years at the Department of Neurosurgery at the Bezmialem Vakif Hospital, a total of 89 volunteers participated in this retrospective study. Patients who underwent surgery within three months prior to the beginning of the study were not called. A total of 44 patients were unwilling to join the study and 126 could not be reached for reasons such as changed telephone numbers or having moved out of town. Additionally, eight patients who were unable to complete questionnaires due to illiteracy or other communication problems were excluded. Study procedures were approved by the Research Ethics Board of the University and written informed consent was signed by all patients.

Sociodemographics including age, gender, education, occupation, hand dominance, side of involvement and operation date were recorded. The intensity of the pain and paresthesia symptoms during the day were analyzed using the visual analog scale (VAS), which indicates a range of complaints from 0 (absent) to 10 (severe).[3]

Commonly used hand-related questionnaires were administered. Patients were asked to respond consecutively and appropriately as the questions related to their affected hands. As missing responses can compromise the validity of the questionnaires, patients were monitored to assure completion of all questions.[4,11] We helped patients understand any question that was unclear.

The Turkish version of the BCTQ as validated by Sezgin et al.[18] is a self-report measure of CTS that evaluates two domains. The symptom severity scale (BCTQ-SS) assesses 11 items related to hand pain severity, numbness and weakness; and the functional status scale (BCTQ-FS) assesses the ability to perform hand-related activities according to an eight-item scale. Each item asks the severity or difficulty from 1 to 5, with higher scores indicating increasing severity of the symptoms.[2,18]

The MHQ distinguishes between the left and right hands over six parameters, including overall hand function, activities of daily living, work performance, pain, aesthetics, and patient satisfaction with function. Each parameter is scored from 0 to 100, where lower scores show more severe disability, with the exception of the pain parameter in which the opposite holds true.[5]

The QuickDASH, a short version of the DASH outcome measure, uses 11 items to measure physical functions and symptoms, in addition to two optional scales concerning the ability to work, do sports and play musical instruments.[19] We did not request participants to complete these optional parts. Each item is scored between 1 and 5, ranging from no difficulty/no symptoms to unable to perform activity/very severe symptoms. Results of the summation and transformation of the scores from all items showed that the scores of the subscales of the QuickDASH ranged from 0 (no disability) to 100 (the most severe disability).[20]

The DHI, also called the Hand Functional Disability Scale or the Cochin Scale, was used to assess hand-related activity limitations and functional performance.[16] The DHI contains 18 activities commonly performed by hand in the kitchen, or during activities of dressing, doing personal hygiene and office tasks, in addition to other general items. Ability is rated from 0 (no difficulty) to 5 (impossible to do). Scores for kitchen tasks range from 0 to 40. Scores for dressing, hygiene, and office tasks range from 0 to 10. Scores for the 'other' category range from 0 to 20. The maximum total score is 90, with higher scores indicating severe activity limitation or more difficulty.[17]

An initial power calculation indicated that a sample size of 84 was required based on correlation coefficients (r) exceeding 0.30 and power set at 80% to yield a statistically significant result. Data were analyzed using the SPSS software v.18.0 (SPSS Inc., Chicago, IL, USA).

Table 1. Descriptive features of the patients.

Patient characteristics		Mean±SD			n	%
Age (yrs)		49.31±8.85	Hand dominance	Right	81	91.0
Mean time after the operation (mos)		22.16±10.72		Left	5	5.6
				Ambidextrous	3	3.4
Education, n (%)	Primary school	79 (88.8)	Side operated	Right	34	38.2
	High school	10 (3.4)		Left	37	41.6
				Both	18	20.2

Descriptive data were presented as mean and standard deviation (SD). Categorical data were given as counts and percentage. Correlation analysis between the variables was tested using Spearman's rho test for non-normally distributed variables and Pearson's test for normally distributed variables where the BCTQ, pain, and paresthesia results were assumed as gold standards. Multiple linear regression analysis was tested with backward elimination method for each the BCTQ, pain, and paresthesia as dependent variables. Normal distribution was verified with the Kolmogorov-Smirnov test. Statistical significance was based on a value of $p<0.05$.

Results

Of the 89 patients evaluated in this study, 80 (89.9%) were women. Of these, 71 (79.8%) were housewives and the other 9 (10.1%) were cleaners. The 9 males (10.1%) were repairmen. Table 1 shows demographic features of the patients. Mean pain and paresthesia symptoms and questionnaire scores of the subjects are presented in Table 2.

Table 3 shows the correlations of the MHQ, the QuickDASH and the DHI with pain, paresthesia and the BCTQ. Of the subparameters of the MHQ, the best correlation of overall hand function of both hands was via the BCTQ-SS ($p<0.001$). The best correlation of activities of daily living of both hands together and also separately was found with the BCTQ ($p<0.001$). Work performance was not correlated with paresthesia or the BCTQ ($p>0.05$). Pain and satisfaction-right hand parameters were well correlated with pain and the BCTQ ($p<0.001$). Aesthetics was not correlated with any of the other parameters ($p>0.05$). The QuickDASH was well correlated with all variables ($p<0.001$). The DHI was well correlated with pain and both subparameters of the BCTQ ($p<0.001$).

In the model applied for pain ($R^2=0.30$), overall hand function-left, activities of daily living-left and pain subparameters of the MHQ were significant within the remaining variables (p values were 0.015, 0.003, and 0.017, respectively). In the model for paresthesia ($R^2=0.39$), overall hand function-right and left, satis-

Table 2. Pain and paresthesia symptoms and questionnaire scores of the subjects.

	Min-Max	Mean±SD		Min-Max	Mean±SD
Pain	0-10	5.58±3.6	MHQ		
Paresthesia	0-10	4.26±3.59	Overall hand function-Right	10-100	58.54±23.39
BCTQ-SS	12-55	32.09±10.51	Left	0-100	56.91±25.89
BCTQ-FS	8-40	24.54±8.72	Activities of daily living-Right	15-100	67.53±26.65
			Left	0-100	60.73±29.17
QuickDASH	25-135	82.11±25.05	Both	11-100	48.70±27.37
DHI			Work performance	0-100	45.62±26.47
Kitchen	0-32	12.78±8.83	Pain	0-95	56.40±23.16
Dressing	0-10	2.61±2.69	Aesthetic-Right	0-100	59.56±25.90
Personal hygiene	0-10	1.93±2.31	Left	0-100	65.99±28.46
Office tasks	0-10	2.29±2.7	Satisfaction-Right	8-10.0	51.87±23.94
Others	0-20	5.08±4.83	Left	0-100	46.55±24.08
Total	0-82	24.67±19.38	Total-Right	17-98	53.49±17.90
			Left	16-98	52.14±19.62

BCTQ-FS: Functional status scale of the Boston Carpal Tunnel Questionnaire; BCTQ-SS: Symptom severity scale of the Boston Carpal Tunnel Questionnaire; DHI: Duruoz Hand Index; MHQ: Michigan Hand Outcomes Questionnaire; QuickDASH: Short form of the Disabilities of the Arm, Shoulder, Hand questionnaire; SD: Standard deviation.

Table 3. Correlations of questionnaires with pain, paresthesia, and the BCTQ.

		Pain	Paresthesia	BCTQ-SS	BCTQ-FS
MHQ					
Overall hand function					
Right	r	-0.423‡	-0.120	-0.387‡	-0.343†
Left	r	-0.319†	-0.406‡	-0.414‡	-0.354†
Activities of daily living					
Right	r	-0.478‡	-0.209*	-0.491‡	-0.473‡
Left	r	-0.352†	-0.287†	-0.415‡	-0.448‡
Both	r	-0.476‡	-0.106	-0.485‡	-0.543‡
Work performance	r	-0.223*	-0.323	-0.198	-0.160
Pain	r	0.424‡	0.340†	0.543‡	0.467‡
Aesthetic-Right	r	0.006	0.036	0.028	0.087
Left	r	0.021	-0.130	0.015	0.120
Satisfaction-Right	r	-0.506‡	-0.294†	-0.499‡	-0.385‡
Left	r	-0.119	-0.242*	-0.214*	-0.218*
Total-Right	r	-0.553‡	-0.297†	-0.526‡	-0.445‡
Left	r	-0.351†	-0.363‡	-0.413‡	-0.400‡
QuickDASH	r	0.419‡	0.463‡	0.612‡	0.650‡
Duruoz Hand Index					
Kitchen	r	0.442‡	0.245*	0.503‡	0.594‡
Dressing	r	0.505‡	0.256*	0.446‡	0.636‡
Personal hygiene	r	0.385‡	0.245*	0.498‡	0.499‡
Office tasks	r	0.347†	0.241*	0.362‡	0.469‡
Others	r	0.516‡	0.352†	0.517‡	0.543‡
Total	r	0.507‡	0.314†	0.537‡	0.624‡

*: <0.05; †: <0.01; ‡: <0.001.

BCTQ-FS: functional status scale of the Boston Carpal Tunnel Questionnaire; BCTQ-SS: Symptom severity scale of the Boston Carpal Tunnel Questionnaire; MHQ: Michigan Hand Outcomes Questionnaire; QuickDASH: Short form of the Disabilities of the Arm, Shoulder, Hand questionnaire.

faction-right subparameters of the MHQ, the QuickDASH, the DHI-others and DHI total scoring were significant (p values were 0.013, 0.003, 0.021, 0.000, 0.023 and 0.019, respectively). In the model for BCTQ-SS (R^2=0.55), overall hand function-left, activities of daily living-both, work performance, satisfaction-right subparameters of the MHQ, the QuickDASH, and the DHI-dressing were significant (p values were 0.016, 0.006, 0.001, 0.001, 0.001, 0.032, respectively). In the model for BCTQ-FS (R^2=0.58), work performance, pain, aesthetic-left subparameters of the MHQ, the QuickDASH, the DHI-dressing, the DHI-office tasks and the DHI-others were significant (p values were 0.012, 0.003, 0.048, 0.000, 0.007, 0.004, 0.027, respectively). The QuickDASH was more significant with dependent variables than other questionnaires.

Table 4 presents the internal correlations of questionnaires. Results showed that the correlation of the aesthetic parameters of the MHQ with the DHI was weaker than with the other parameters. Total scores of the MHQ were well correlated with the QuickDASH and all parameters of the DHI (p<0.001). The QuickDASH was well correlated with all parameters of the DHI (p<0.001).

Discussion

In this study, we used questionnaires showing perception of difficulties in hand functions of patients with CTS to correlate these questionnaires with symptoms and functions of the patients. Of the most commonly used questionnaires, the QuickDASH was more practical and effective than the MHQ and the DHI.

The MHQ correlates with the DASH. The clinical relevance of both questionnaires were high.[21] Oksuz et al. reported that the MHQ and the DASH can be used effectively in patients with different hand injuries.[11] McMillan and Binhammer indicated that the DASH and the MHQ are suitable for surgery-related outcome research to treat CTS.[4] In another study, the BCTQ showed strong positive correlations with the DASH and

Table 4. Correlations between the MHQ, the QuickDASH and the DHI.

MHQ		Duruoz Hand Index						QuickDASH
		Kitchen	Dressing	Personal hygiene	Office tasks	Others	Total	
Overall hand function								
Right	r	-0.369‡	-0.384‡	-0.366‡	-0.399‡	-0.434‡	-0.442‡	-0.454‡
Left	r	-0.367‡	-0.410	-0.241*	-0.323†	-0.368‡	-0.406‡	-0.461‡
Activities of daily living								
Right	r	-0.567‡	-0.551‡	-0.488‡	-0.447‡	-0.544‡	-0.606‡	-0.458‡
Left	r	-0.403‡	-0.446‡	-0.279‡	-0.346†	-0.384‡	-0.435‡	-0.432‡
Both	r	-0.530‡	-0.546‡	-0.462‡	-0.304†	-0.448‡	-0.539‡	-0.479‡
Work performance	r	-0.285†	-0.257*	-0.282†	-0.263*	-0.317†	-0.308†	-0.417‡
Pain	r	0.457‡	0.363‡	0.374‡	0.325†	0.520‡	0.474‡	0.589‡
Aesthetic								
Right	r	-0.226*	-0.172	-0.264*	-0.174	-0.151	-0.219*	0.009
Left	r	-0.160	-0.115	-0.185	-0.211*	-0.176	-0.188	-0.131
Satisfaction								
Right	r	-0.426‡	-0.385‡	-0.365‡	-0.343†	-0.417‡	-0.457‡	-0.403‡
Left	r	-0.360†	-0.274†	-0.291†	-0.236*	-0.320†	-0.351†	-0.341†
Total								
Right	r	-0.569‡	-0.551‡	-0.482‡	-0.498‡	-0.569‡	-0.613‡	-0.528‡
Left	r	-0.510‡	-0.481‡	-0.409‡	-0.492‡	-0.513‡	-0.552‡	-0.498‡
QuickDASH	r	0.606‡	0.575‡	0.541‡	0.389‡	0.608‡	0.634‡	

*: <0.05; †: <0.01; ‡: <0.001.

BCTQ-FS: Functional status scale of the Boston Carpal Tunnel Questionnaire; BCTQ-SS: Symptom severity scale of the Boston Carpal Tunnel Questionnaire; MHQ: Michigan Hand Outcomes Questionnaire; QuickDASH: Short form of the Disabilities of the Arm, Shoulder, Hand questionnaire.

was recommended to assess postoperative patient-related outcome measures for CTS.[22] As severity scoring using the BCTQ preoperatively is predictive of outcome with therapy, it can be used to identify patients who are likely to respond to treatment.[2]

In our study, almost all the subparameters of the MHQ were correlated with pain, paresthesia and the BCTQ. The aesthetic parameters of this questionnaire was not correlated with the DHI and the QuickDASH, because they do not contain this parameter. One advantage of the MHQ is its many detailed subparameters while another is that it assesses both hands separately; therefore, the MHQ might be chosen when comparison is needed. On the other hand, the disadvantages of the MHQ are that it takes a long time to complete, has a complicated scoring method and contains questions quite similar to each other. Shorter questionnaires are preferable as they can be completed quickly by the patients and are less burdensome.

The QuickDASH is reliable and valid for patients with CTS and should be chosen due to its ease of administration.[19] In our study, the QuickDASH was well correlated with pain, paresthesia and the BCTQ. Although the QuickDASH is an effective questionnaire that evaluates functions and symptoms, it does not separately show disability scores of both hands.[11] Another disadvantage of the QuickDASH compared to the DHI is that an additional calculation is needed in order to obtain the final score.

In previous studies, the MHQ and the QuickDASH questionnaires showed significant postoperative improvement in hand function in CTS patients.[4,10] Our study did not assess responsiveness and future studies should be more effective in using these questionnaires.

Some studies have indicated the DHI for use as both a descriptive outcome measure for assessing hand function and the effectiveness of clinical and therapeutic interventions in patients with stroke, scleroderma and diabetes mellitus.[17,23,24] In our study, all subparameters of the DHI were correlated with pain, paresthesia, the BCTQ and the QuickDASH. The DHI and the QuickDASH can probably be used alternatively. They are also relevant, easy to understand and have a short completion time. As their application and scoring are more practical, they are effective questionnaires in assessing hand disability and should be chosen for patients with CTS. While the QuickDASH is accepted and well-known worldwide, further studies might confirm the effective usage of the

DHI in order to determine self-report of functionality and to allow more precise treatment planning.

One of the advantages of our study was that patients had no difficulty understanding questions, since the MHQ and the QuickDASH were culturally adapted to Turkish people and the DHI was authentically Turkish. An additional advantage was the limitation of the study group to patients with a confirmed diagnosis of CTS, which the questionnaires were specifically designed for.

A disadvantage of ours study was the lack of preoperative outcomes of the questionnaires and postoperative follow-up. Further studies that clarify the assessment questionnaire and that best represents the patient's condition by comparing patients preoperative outcomes to the postoperative ones would be useful.

In conclusion, each questionnaire correlated with the other two in many parameters and may be used instead of each other. The QuickDASH appears to be more practical and effective than the MHQ and the DHI. However, the most appropriate scoring method for patients should be chosen depending on the advantages and disadvantages of these three instruments. We believe that the use of simpler means of scoring will aid in studies where notable amounts of time and effort are required for assessment. Future scientific and evidence-based studies are needed.

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