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Original Article

Full cup test (FCT) for symptom severity assessment in carpal tunnel syndrome/comparing scores with clinical and neurophysiological findings

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Abstract

Aim: Carpal tunnel syndrome (CTS) is a compression neuropathy. There is neuropathic pain in the clinic. Treatment is planned according to electrodiagnostic testing (EDX) and symptom severity. This study was planned to evaluate of full cup test (FCT) to demonstrate symptom severity in CTS and investigate the relationship between FCT and EDX.

Material and Methods: This study included patients with idiopathic CTS. The self-administered Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) and FCT were used to determine the severity of clinical symptoms. The severity of CTS was classified as mild, moderate and severe according to EDX.

Results: A total of 97 hands (55 right, 42 left) were evaluated. 29 patients had bilateral symptoms. The severity of CTS was 51.5% mild, 44.3% moderate, and 4.1% severe. The mean FCT score was 51.13 ± 20.80 (min: 6.6-max: 100). The mean symptom severity scale (SSS) of the BCTQ was 24.25 ± 7 and the functional severity scale (FSS) was 13.26 ± 4.55. The score of FCT was significantly correlated with SSS and the FSS (r=0.60 p <0.001, r=0.65 p <0.001). Significant correlation was observed between FCT and EDX (r=0.57, p=0.001).

Conclusion: FCT can be used to assess the severity of neuropathic pain in CTS and may be a guide in planning treatment.

Keywords: Carpal tunnel; electrodiagnostic test; full cup test; neuropathy; pain

INTRODUCTION

Carpal tunnel syndrome is the most commonly encountered entrapment neuropathy in clinical practice. Its prevalence and incidence have varied in previous studies, and it affects an estimate of one per ten persons. It is seen more commonly in women than men, and the mean age at the time of diagnosis is around 50 years (1). It may affect one or both hands. It is bilateral in 60% of cases (2). Clinical symptoms and EDX, which is recommended by the American Academy of Neurology and American Academy of Physical Medicine and Rehabilitation, are important diagnostic tools. EDX and clinical symptoms are decisive during treatment planning.

Its clinical manifestations include compression of the median nerve in the wrist and neuropathic pain in the distribution of the median nerve in the hand. Affected patients typically report nocturnal pain, morning itching-paresthesia; however, it may be difficult for a clinician to interpret these symptoms and determine their severity.

Boston carpal tunnel questionnaire was first developed by Levine et al. for rating severity of clinical symptoms of CTS and determining their functional impairment and has gained wide-scale acceptance after its development (3). FCT was first developed by Ergun et al. for rating pain in clinical practice. It has been first used for headache and rheumatologic pain and found to be correlated with the visual analog scale (VAS) (4). In this study we aimed to demonstrate the use of FCT for assessing the severity of neuropathic pain in CTS, to compare it with BCTQ, and to investigate its relationship with EDX.

MATERIAL and METHODS

Patients

This study included patients with pain or sensory symptoms affecting at least two of three of one or both hands who had a positive Tinel and/or Phalen test and documented compression of the median nerve at the wrist with EDX. The patients were enrolled from the electrophysiology laboratories of the neurology and

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physical therapy and rehabilitation departments. Patients with diabetes, cervical radiculopathy, brachial plexopathy, thyroid disorders, rheumatoid arthritis, prior CTS surgery, wrist fractures, obesity, renal failure, cognitive failure preventing properly responding to the questions, or a mini-mental state examination (MMSE) score<27 were excluded. Education level was divided according to the local education system. Less education was defined as ≤ 5 years.

Methods

The FCT and BCTQ were applied to all patients for each symptomatic hand. Correlation of FCT with BCQT was evaluated in assessing the severity of neuropathic pain. The relationship between the FCT and EDX was investigated.

Assessment tools

Full cup test (FCT)

In FCT (Figure 1), the patient is asked the following question: if you had the worst imaginable pain, this cup would be completely full. If so, please indicate how would the cup be filled by your complaints? The patient draws a level on the cup. The test score is calculated as the height of the line (cm)/height of cup (cm)x100. A higher score indicates a worse symptom severity.

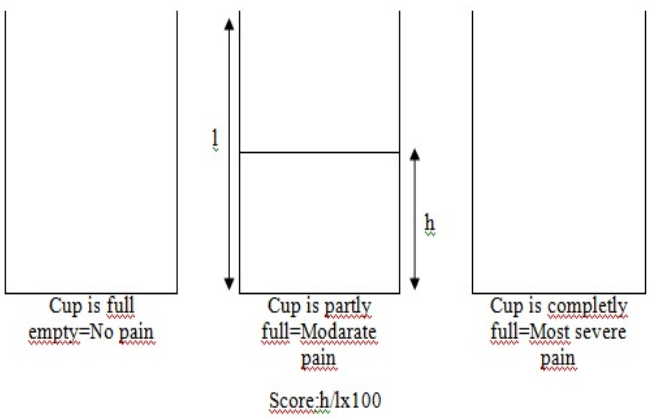

Figure 1. Full cup test

Boston carpal tunnel questionnaire (BCTQ)

BCTQ is composed of two sections. The first one, Symptom Severity Scale (SSS), contains a total of 11 questions. In addition to questions rating CTS-induced pain and sensory symptoms, two questions rate the severity of weakness and difficulty grasping. The second one, Functional Status Scale (FSS), rates CTS-induced functional impairment using 8 questions. Each question is rated between 1 (no symptom) and five (severe). A higher score indicates a severe symptom and/or worse functional status.

Electrodiagnostic testing (EDX)

Nerve conduction studies (NCS) in EDX were performed using a Synergy Medelec with two channels. Motor and sensory conduction studies were performed with the orthodromic method using superficial electrodes at room temperature (25°C).

The recordings in the median nerve motor conduction studies were taken from the pollicis brevis muscle. Stimulation was performed 5-7 cm proximal to the active electrode between both tendons at the midline of the wrist, and from the ulnar half of the brachial artery pulse in the elbow. In the sensory conduction study, the recordings were made between both tendons at the midline of the wrist, with stimulation being made from the interphalangeal joint space of the index finger. Nerve conduction velocity (NCV) was then calculated by integrated software after the definition of the latency and distance by the examiner. Distal motor latency (DML) was defined as the time from zero to the beginning of the negative deflection of the action potential. Laboratory reference values of median nerve were; sensory nerve conduction velocity (SCV) >39.4 m/sn for digit II and >35.2m/sn for palm, DML of the median nerve <3.8 msn, velocity (wrist-elbow) >49.4 m/sn, F wave latency <29.8 msn. Sensory and motor conduction of ulnar nerve were also performed to exclude polyneuropathy. The severity of CTS was classified as mild, moderate and severe according to EDX (5).

The study was approved by the local ethics committee (01.10.2018-15/30). Informed consent form for the study was obtained from all patients.

Statistical analysis

The data were summarized with descriptive statistics. Continuous quantitative variables are expressed in terms of mean and standard deviation values. Minimum and maximum values were given in nonparametric distribution. Spearman correlation test was used for analyzing the correlation between categorical (ordinal) and continuous variables. Biserial correlation was used for ordinal outcome continuous. All tests were conducted at the two-sided 5% significance level using SPSS 20 (6).

RESULTS

This study included a total of 69 patients, of whom 60 (87%) were women and 9 (13%) were men. The mean age was 41.97 8.08 (range 22-54) years, and the MMSE was 29.94±0.31. Five years and under education was in 35 (50.72%) patients, education for 6-11 years was in 29 (42.0%) patients, 12 years and more than of education was in 5 (7.2%) patients.

All patients had a right-hand dominancy. A total of 97 (55 right, 42 left) symptomatic hands of 69 patients were assessed. Unilateral CTS was present in 41 (59.4%) patients and bilateral CTS in 28 (40.5%) patients. The severity of CTS was assessed by EDX was mild in 50 (51.5%) hands, moderate in 43 (44.3%) hands, and severe in 4 (4.1%) hands.

Subgroups of the BCTQ, SSS, and FSS, and FCT scores were presented in Table 1. There was a significant intermediate correlation between FCT and SSS (r=0.60, p<0.001) (Figure 1). There was also an intermediate significant correlation between FCT and FSS (r=0.65, p<0.001) (Figure 2). FCT and

EDX were significantly correlated (r=0.34, p=0.001) (Table 2). The significant correlation was observed between the FCT and CTS severity (r=0.574, p<0.001).

Table 1. BCTQ and FCT total scores

Hand (n)	BCTQ		FCT
	SSS	FSS	
Right (55)	24.56±7.38	13.62±4.84	51.62±20.81 (6.6-100)*
Left (42)	23.83±6.53	12.79±4.17	50.50±21.02 (11.6-100)*
Total (97)	24.25±7	13.26±4.55	51.13±20.80 (6.6-100)*

Data as mean±SD, (min-max)*
FCT, Full Cup Test; BCTQ, Boston Carpal Tunnel Questionnaire; SSS, Symptom Severity Scale; FSS, Functional State Scale

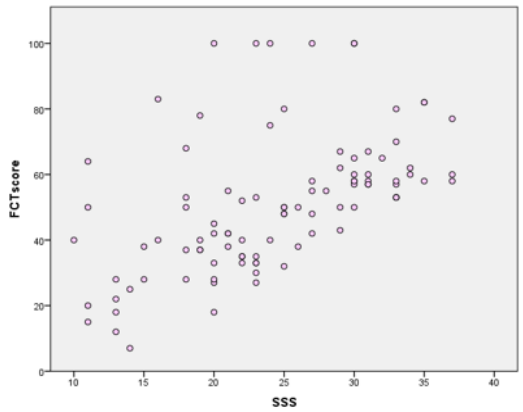

Figure 2. Relationship between the FCT score and SSS score
FCT, Full Cup Test; SSS, Symptom Severity Scale

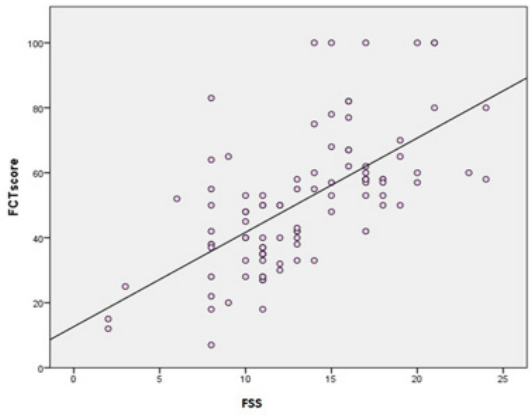

Figure 3. Relationship between the FCT score and FSS score
FCT, Full Cup Test; FSS, Functional Status Scale

Table 2. Correlation between the FCT score and BCTQ scores (SSS, FSS) and electrodiagnostic test

	FCT score	
	Correlation coefficient (r)	p-value
SSS	0.60	<0.001
FSS	0.65	<0.001
EDX	0.34	0.001

p<0.05 SSS, Symptom Severity Scale; FSS, Functional Status Scale; EDX, Electrodiagnostic Test

Analysis of SSS score for right and left hands by FCT revealed a significant correlation in the right side (r= 0.638, p<0.001). There was a significant correlation between FCT and SSS on the left side (r=0.56, p<0.001). There were significant correlations with the first five questions of FCT rating about pain in SSS (nocturnal and day-time pain, pain intensity, duration) and questions 6-10 rating sensory symptoms (r=0.48, p<0.001, r=0.562 p<0.001). The patients with nocturnal pain had a higher FCT score than patients without nocturnal pain and it was significant (53.69±19.05, 46.23±23.35, p=0.019).

FCT score was evaluated according to the side of hand and it was significantly higher in women than men for the right hand (53.82±19.56, 33.17±16.25, p=0.016). There was no significant difference for the left hand in between the women and men (51.14±22.75, 47.71±17.83 p=0.710). The mean FCT and SSS scores were correlated in hands with less education for right and left (r=0.558 p=0.001, r=0.576 p=0.005).

DISCUSSION

Clinical symptom severity is an important parameter for treatment planning for CTS. BCTQ is a test recommended for use to symptoms severity and functional limitation and their follow-up in both clinical practice and clinical studies (7). Its standardization in Turkish is complete and its correlation with VAS was shown (8). BCTQ's SSS primarily rates the presence and severity of pain (nocturnal, daytime) and sensory symptoms (numbness, itching). Furthermore, weakness and difficulty grasping are rated by two additional questions. In the present study, FCT was used to rate neuropathic pain severity in the CTS group and correlated to BCTQ. As disease-specific BCTQ would be more sensitive than the general scales, it was used for the comparison (9). FCT was shown to have a significantly good correlation with BCTQ's SSS. Moreover, it was also noted that FCT was significantly correlated to FSS.

Simple and understandable tools for assessing and measuring pain are important for clinicians and patients. Ergun et al. compared the FCT with the VAS in patients with low education and it was useful in patients with low education (4). In this study, the less education definition was used according to the local education system.

The FCT score was correlated with SSS score in patients with less education. FCT was understood easily in these patients.

Our study demonstrated a better correlation between FCT and SSS for the right hand. Symptom severity in CTS is greater in the dominant hand, including bilateral cases. In the latter, symptoms first, start in the dominant hand and subsequently involve the other hand (10,11). Therefore, test correlation was considered better at the right side in our patient group which had right hand dominance. FCT score between men and women also differed significantly when compared to the right hand. Although it is known that female sex is more sensitive than males in perception of pain, dominant hand affected pain scores in this study (12). Nocturnal pain occurred in another condition that made a significant difference in the FCT score as well as the hand side. The nocturnal pain can be a factor that can disrupt sleep and affect quality of life, it may have made a difference in FCT score (13).

One of the reasons in the etiology of neuropathic pain is CTS, which is one of the compressive mononeuropathies. As in CTS, it is important to define subjective symptoms of the individual and to electrophysiological evaluation, if necessary, in patients with neuropathic pain. There are general screening tools, such as the Neuropathic Pain Scale and the Neuropathic Pain Questionnaire in neuropathic pain but these screening tools fail to identify 10% to 20% of patients (14). On the other hand, the well-known and self-reported scales to an assessment of pain severity are Visual Analogue Scale (VAS), the Numerical Rating Scale (NRS), the Verbal Rating Scale (VRS) and the Faces Pain Scale-Revised (FPS-R) (15,16). VAS and NRS are the most commonly used scales (17). In this study, it was shown that a simple pain tool such as FCT, which was correlated with VAS to an assessment of pain, may be effective to demonstrate symptom severity in neuropathic pain.

An analysis of the correlation between FCT used in the present study and EDX revealed a moderately strong positive correlation. FCT was sensitive for showing the severity of the subjective symptoms of CTS, but it was also found to be correlated to the severity of CTS according to EDX. Electrodiagnostic testing is a study that verifies the diagnosis, provides objective data and indicates CTS's severity in cases considered to have CTS. However, the relationship between clinical presentation and CTS severity has not been fully explained (5). A review of literature data indicates that You et al. and Ilhan et al. demonstrated a significant correlation between clinical and electrophysiological findings among CTS cases assessed by BCTQ; on the other hand, Ortiz-Corretor et al failed to show such a correlation (18-20). In a study where BCTQ and EDX were compared after CTS surgery, Mondelli et al. found a significant correlation but Heybeli et al. did not (21,22). These inconsistencies in CTS have been reported to be possibly related to gender (female) and psychological factors (23,24). In our study, in which female patients were more numerous than males, a significant correlation between FCT and EDX was also noted. On the other hand, the results of studies, which rated clinical symptoms over pain and assessed the relationship of the results with EDX, were more consistent and a positive correlation has been noted (25,26). Conversely, a correlation could not be found between CTS level and total neuropathic pain in EDX among cases where neuropathic pain of CTS was rated by the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS). However, it was stressed that pain and allodynia may be more inter-related with the CTS level (27). Patients enrolled by our study, including those who presented with sensory symptoms, responded positively and reported a level to pain questions in the SSS application. Among that patient population, FCT showed a significant correlation with both question groups assessing pain and sensory symptoms.

CONCLUSION

We believe FCT may be useful for showing clinical symptom severity in CTS, thus it may be of use in treatment planning of such cases. Future studies investigating the use of FCT in neuropathic pain severity are recommended.

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