

Assessment of functional disorders of the upper limb in individuals with carpal tunnel syndrome

Olena Bismak

National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

Carpal tunnel syndrome is the most common form of compression-ischemic neuropathy, found in clinical practice.

Purpose: to evaluate functional disorders of the upper limb in individuals with carpal tunnel syndrome using the Boston questionnaire (Boston Carpal Tunnel Questionnaire, BCTQ).

Material & Methods: analysis and synthesis of data from scientific and methodological literature and the Internet information network were used; survey, medical history, mathematical methods. To assess the functional state of the affected upper limb during the initial examination, we used the Boston Carpal Tunnel Questionnaire (BCTQ), which consists of two scales: the Symptom Severity Scale (SSS) and the Function Status Scale (FSS), which was filled by the patient on his own. The study was conducted on the basis of the Kiev City Clinical Hospital No. 4 in the period from 2017 to 2018. The study involved 37 patients with CTS, of which 21 – women (56,8%) people, 16 – men (43,2%) people.

Results: analyzed pain and sensory disorders on the scale of symptom severity (Symptom Severity Scale, SSS) and functional disorders on the scale (Function Status Scale, FSS) of the Boston questionnaire. During the initial examination of patients with CTS, we found that mainly moderate (24,3%) and severe pain (37,8%) in the affected upper limb prevailed in patients, which over the past 2 weeks led patients to wake up at night: 1 time – 32,4% of patients, 2–3 times – 29,7% of people. During the day, 29,7% of patients complained of moderate pain in the arm and 43,3% of people were worried about severe pain. Most patients (48,7%) indicated that pain lasts from 10 minutes to 60 minutes. For functional disorders, the greatest difficulties for patients occurred when fastening buttons on clothes – 83,8%, opening a bottle – 86,5% and doing homework – 79,9% of people.

Conclusion: an initial examination of patients with carpal tunnel syndrome indicated pain in the affected limb, numbness, decreased sensitivity, muscle weakness on the severity scale of the symptoms of the Boston questionnaire were observed. On the scale of functional impairment, we found difficulties that arose in patients performing everyday activities and self-care.

Keywords: carpal tunnel syndrome, neuropathy, questionnaire, functional disorders.

Introduction

Tunnel neuropathies (tunnel syndromes, compression-ischemic neuropathies, neuropathy / neuralgia traps, trap syndrome – a symptom complex of clinical manifestations (sensory, motor, and trophic) caused by compression-ischemic damage to nerve trunks and blood vessels located in anatomical tunnels (channels) [6].

The prevalence of tunnel neuropathies is higher in individuals engaged in the same type of work: among drivers, musicians, layout designers, gardeners, and stenographers. Also, tunnel neuropathies of the upper limb are often found in office employees, in particular, secretaries, programmers, that is, those who often work at a computer, or who are overly fond of them, etc.

Carpal tunnel syndrome (CTS) is most common in all tunnel syndromes. In people aged 35 years, CTS is found in 3.4% of women and 0.6% of men. Most often, in men, CTS is after 40 years, and in women (especially those engaged in intensive manual labor) – after 50 years, the ratio 1:5 [1; 6].

With this syndrome, compression neuropathy of the fibers of the median nerve or vessels feeding it occurs due to compression in the carpal tunnel, that is, damage to the median nerve occurs in the area of the hand.

The dominant hand suffers, as a rule, more often, in 30–50% of cases of lesion bilateral. Usually, with bilateral carpal tunnel syndrome, especially of professional origin, one arm is first disturbed, and when the other arm begins to disturb, the clinical symptoms remain more pronounced on the arm that began to disturb the first.

A feature of nerve damage due to the tunneling effect is a gradual, long-lasting, imperceptible increase in their compression, which is caused by a thickening of the channel walls. Neuropathy may begin with radicular or tunneling symptoms of irritation and prolapse.

For CTS characteristic symptoms of irritation of the nerve at night and during the day or night - is primarily a burning sensation and numbness, tingling, pins and needles (ie, paresthesia), a heightened perception of normal stimuli (hyperesthesia), increased sensitivity (hyperpathia) against moderate or severe pain syndrome occurs later [3; 8; 11].

Subsequently, it is difficult for patients to perform targeted movements of the hand, which are caused by an insufficient influx of nerve impulses, that is, there is a sensitive neuropraxia (sensitiva – sensitive, praxis – action, movement). Trophic disorders (due to involvement of the vegetative fibers of the nerve) and weakness in the muscles, that is, a decrease in strength in them, in particular, when shaking hands [5; 13]. In this regard, it is important to study the functional state of the

affected limb in CTS.

Purpose of the study: to study the functional state of the upper limb in carpal tunnel syndrome in a hospital.

Material and Methods of the research

To assess the functional state of the affected upper limb during the initial examination, we used the Boston Carpal Tunnel Questionnaire, BCTQ [10; 12], which consists of two scales (Symptom Severity Scale, SSS) and Functional Scale (FSS), which the patient filled out on their own. The study was conducted on the basis of the Kiev City Clinical Hospital No. 4, Kiev During the period from 2017 to 2018, 37 patients with CTS took part in the examination, of which 29 (78,4%) women, 8 (21,6%) men,

Research methods: analysis and synthesis of data from scientific and methodological literature and the Internet information network; survey, medical history, mathematical methods.

Results of the research

Increasingly, physical therapists in Ukraine, in their practical activities, use the International Classification of Functioning, Disability and Health (ICF) to assess the patient's functional state for a certain pathology. The CTS is no exception [4; 7].

According to the International Classification of Functioning, Disability and Health (ICF), with CTS, there is a violation of the structure of the median nerve (compression, ischemia), hand function and activity, and patient participation in everyday life.

When the median nerve is damaged in CTS, the following functions suffer: flexion of the I, II, III fingers and extension of the middle phalanges of the II and III fingers are impaired, palmar flexion of the hand and pronation are weakened. Muscle atrophy in the defeat of the median nerve is most pronounced in the palm, as a result of which there is flattening of the palm and bringing the thumb close and in the same plane with the index, which creates a kind of hand position, which is called "monkey" [6].

Superficial sensitivity is impaired on the hand in the area free from the innervation of the ulnar and radial nerves. Joint-muscle sensitivity is always excited in the final phalanx of the index and third fingers.

Pain with damage to the median nerve, especially partial, frequent and intense, often take the character of burning pain (causalgic) [8].

Also characteristic of the defeat of the median nerve is vasomotor secretory-trophic disorders: the skin, especially the I, II and III fingers, acquires a bluish or pale color; become "dull", brittle and striped nails; skin atrophy, thinning of the fingers (especially II and III), sweating disorders, hyperkeratosis, hypertrichosis, ulcers and other disorders are observed [2; 6; 9].

The main places for determining motor disorders that occur with damage to the median nerve are as follows:

1. When you squeeze your hands into a fist I, II and partially

III fingers do not bend.

2. The bending of the terminal phalanges of the thumb and forefinger is impossible.

3. It is impossible to "scratch" the index finger on the table when the brush fits snugly against it.

4. The patient cannot hold a sheet of paper with his thumb and forefinger bent.

5. The contraposition of I and V fingers is broken [6].

Many questionnaires have been developed for patients with dysfunction of the upper extremities and neuropathic pain [14]. However, the Boston Carpal Tunnel Questionnaire (BCTQ) is the most specific for diagnosing CTS [12]. The questionnaire was designed to standardize the results of a CTS examination by D. W. Levine et al. [12].

This was necessary because the results of surgical treatment of patients were analyzed using instrumental methods, while patients themselves were more interested in assessing the dynamics of subjective symptoms and changes in the functional capabilities of the hand. But an objective diagnostic tool for assessing changes in complaints and symptoms of CTS at that time did not exist. Thus, in 1993, the BCTQ was created in the USA. During its development, the authors consulted with surgeons, rheumatologists and patients, who identified 6 critical points for CTS, namely: pain, paresthesia, numbness, weakness, nocturnal manifestations of symptoms and general functional status. The result of their work was a specialized questionnaire consisting of two scales (Symptom Severity Scale, SSS) and Functional Scale (FSS), which the patient filled out independently. With the help of this questionnaire, it is easy to count points, and it is convenient to use it to assess the effectiveness of the treatment. This explains the widespread prevalence of BCTQ in clinical and research practice. In addition, there are reports in the literature about the use of this questionnaire for other tunnel neuropathies of the upper limb [10; 12].

The symptom severity scale of this questionnaire consists of 11 questions with several possible answers. Scores for answers vary from 1 to 5, depending on the severity of the symptom. Total score on the scale is calculated by calculating an average value.

The scale of functional disorders includes 8 points. The points for the answers range from 1 to 5, where 1 is "no difficulties", 5 "very strong difficulty". The question is about actions daily performed by a wide range of patients, both young and old. Filling out the questionnaire takes no more than 10 minutes and does not burden the doctor and patient.

Analyzing the spectrum of symptom severity (Symptom Severity Scale, SSS), it can be noted that 5 questions on this scale relate to pain in CTS, 4 more – characterize sensitivity disorders, 2 questions clarify the presence of weakness in the affected limb and the state of fine motor skills.

On the symptom severity scale (Symptom Severity Scale, SSS) during the initial examination, we found that mainly moderate (24.3%) and severe pain (37.8%) in the affected upper limb prevailed in patients, which prompted over the past 2 weeks patients wake up at night: 1 time – 32.4% of patients, 2–3 times – 29.7% of people. During the day, 29.7% of patients complained of moderate pain in the arm and 43.3% of people were worried about severe pain. Most patients (48.7%) noted

that the pain lasts from 10 minutes to 60 minutes (Table 1).

An analysis of sensitivity and fine motor abnormalities in pa-

tients with CTS indicated that most patients had a moderate numbness feeling – 40.5% of patients and a pronounced numbness / decreased sensitivity – 27.1% of people, which

Table 1
Analysis of sensation of pain in patients with CTS

Question	Number of patients (n=37)	
	Abs. units	(%)
How much pain do you feel at night in your hand or wrist?		
1. At night, the pain in my arm / wrist does not bother me	2	5,4
2. Light pain	7	18,9
3. Moderate pain	9	24,3
4. Severe pain	14	37,8
5. Very severe pain	5	13,6
How often in the past 2 weeks have you woken up due to pain in your arm / wrist?		
1. Never	6	16,2
2. 1 time	12	32,4
3. 2–3 times	11	29,7
4. 4–5 times	5	13,6
5. More than 5 times	3	8,1
Are you usually bothered by pain in your arm / wrist during the day?		
1. On a day, pain does not bother me	0	0
2. During the day, a slight pain bothers me	4	10,8
3. During the day I am concerned about moderate pain	11	29,7
4. During the day, I am concerned about severe pain	16	43,3
5. During the day, I am concerned about a very strong pain	6	16,2
How often during the day do you feel pain in your arm / wrist?		
1. Never	0	0
2. 1-2 times a day	8	21,6
3. 3-5 times a day	16	43,3
4. More than 5 times a day	7	18,9
5. The pain bothers me constantly	6	16,2
How long does an average day pain episode last?		
1. Afternoon pain does not bother me	0	0
2. Less than 10 min	8	21,6
3. 10–60 min	18	48,7
4. More than 60 minutes	5	13,5
5. Pain bothers me all day long	6	16,2

Table 2
Analysis of impaired sensitivity and fine motor skills in patients with CTS

Question	Number of patients (n=37)	
	Abs. units	(%)
Do you have a feeling of numbness (decreased sensitivity) in your hand?		
1. No	2	5,4
2. There is a slight feeling of numbness / decreased sensitivity	9	24,3
3. There is a moderate feeling of numbness / decrease sensitivity	15	40,5
4. There is a pronounced feeling of numbness / decrease sensitivity	10	27,1
5. There is a very pronounced feeling of numbness / decreased sensitivity	1	2,1
Do you have weakness in your hand / wrist?		
1. No	1	2,7
2. There is a slight weakness	10	27,1
3. There is moderate weakness	16	43,2
4. There is a pronounced weakness	8	21,6
5. There is a significant decrease in strength in the arm / wrist	2	5,4
Does the arm / wrist have a tingling sensation?		
1. No	3	8,1
2. Light tingling	11	29,7
3. Moderate tingling sensation	13	35,2
4. Pronounced tingling sensation.	7	18,9
5. Very strong tingling sensation.	3	8,1
How severe is numbness (loss of sensation) or tingling sensation during the night?		
1. I do not have numbness and tingling at night	3	8,1
2. Easy	10	27,1
3. Moderate	14	37,8
4. Strong	9	24,3
5. Very strong	1	2,7
How many times in the past 2 weeks have you woken up from numbness or a tingling sensation in your hand / wrist?		
1. Never	4	10,8
2. 1 time	10	27,1
3. 2–3 times	16	43,2
4. 4–5 times	6	16,2
5. More than 5 times	1	2,7
Do you feel difficulty taking and using small things (key, pencil)?		
1. No	2	5,4
2. I feel light difficulties	6	16,2
3. I feel moderate difficulties	17	45,9
4. I feel great difficulties	10	27,1
5. I feel very great difficulties	2	5,4

corresponds to the typical clinical picture of CTS. 16 patients (43.2%) complained of moderate weakness in the affected limb. Fine motor skills of the fingers were impaired in almost half of the patients – 45.9% (Table 2).

The Functional Scale (FSS) of the Boston Questionnaire describes the difficulties that arise when certain actions are performed due to problems with the hands or wrists over the past 2 weeks. These actions are determined by the performance of everyday tasks and self-care: writing, fastening buttons on clothes, keeping a book while reading, keeping a telephone handset, opening a bottle, doing homework, carrying food bags, bathing and putting on clothes.

As can be seen from the table 3, the greatest difficulties for patients arise when buttoning buttons on clothes – 83,8%, opening a bottle – 86,5%, and doing homework – 79,9% of people.

All of the above indicates that CTS negatively affects the daily activity of patients and reduces the quality of life.

Conclusions / Discussion

An initial examination of patients with CTS indicated pain in

Table 3
Analysis of functional disorders in patients with CTS

Actions	Number of patients (n=37)	
	Abs. units	(%)
Writing difficulties	29	78,4
Button fastening on clothes	31	83,8
Reading book content	26	70,2
Phone handset content	22	59,5
Bottle opening	32	86,5
homework	34	79,9
Carrying food bags	28	75,7
Bathing and putting on clothes	24	64,9

the affected limb, numbness, decreased sensitivity, muscle weakness on the Symptom Severity Scale (SSS) scale of the Boston questionnaire.

On the scale of functional disorders (Function Status Scale, FSS), we found difficulties that patients experienced when doing everyday tasks and self-care (fastening buttons on clothes, opening a bottle, homework, writing difficulties).

Prospects for further research are to study the quality of life in peripheral neuropathies of the upper limb.

Conflict of interests. The author declares that no conflict of interest.

Financing sources. This article didn't get the financial support from the state, public or commercial organization.

References

1. Belova, N.V. (2015), "Modern understanding of the diagnosis and treatment of carpal tunnel syndrome", *Russian Medical Journal*, No. 24, pp. 1429-1432. (in Russ.)
2. Bismak, O.V. (2019), "Rehabilitation examination of patients with upper limb compression-ischemic neuropathy", *Slobozhans'kij naukovno-sportivnij visnik*, No. 3 (71). pp. 72-76, doi: 10.15391/sns.v.2019-3.012. (in Ukr.)
3. Gilveg, A.S., Parfenov, V.A. & Evzikov, G.Yu. (2018), "The immediate and long-term results of decompression of the median nerve in carpal tunnel syndrome", *Neurology, neuropsychiatry, psychosomatics*, No. 3, pp. 79-85. (in Russ.)
4. Golik, V.A., Moroz, E.N. & Pogorelova, S.A. (2011), "Using the international classification of functioning, disability and health in expert neurological practice". *International Neurological Journal*, No. 5 (43). (in Russ.)
5. Demin, Yu.V. (2010), *Kliniko-neurofiziologicheskaya kharakteristika i metody lecheniya tunnel'nykh kompressionno-ishemicheskikh nevroptiy sredinnogo i loktevoogo nervov: dissertatsiya kand. med. nauk* [Clinical and neurophysiological characteristics and treatment methods for tunnel compression and ischemic neuropathies of the median and ulnar nerves: the dissertation of the medical sciences doctor], Ekaterinburg, 101 p. (in Russ.)
6. Dovhyi, I.L. (2016), *Peripheral nervous system disease*, in 3 volumes, Vol. 1, Kyiv. (in Ukr.)
7. Melnikova, E.V., Buylova, T.V., Bodrova, R.A., Shmonin, A.A., Maltseva, M.N. & Ivanova, G.E. (2017), "Using the International Classification of Functioning (ICF) in outpatient and inpatient medical rehabilitation: a guide for professionals", *Messenger of Recovery Medicine*, No. 6 (82). (in Russ.)
8. Pizova, N.V. & Druzhinin, D.S. (2014), "General and local risk factors for neuropathic pain in carpal tunnel syndrome", *Concilium medicum*, Vol. 16, No. 9, pp. 41-44. (in Russ.)
9. Shavlovskaya, O.A. (2015), "Impairment of the function of the neuromotor apparatus of the upper limbs caused by local vibration", *Neurology, neuropsychiatry, psychosomatics*, No. 7 (2), pp. 67-74. (in Russ.)
10. Yusupova, D.G., Suponeva N.A., Zimin A.A. et al. (2018), "Validation of the Boston carpal tunnel questionnaire in Russia", *Neuromuscular diseases*, Vol. 8, No. 1, pp. 38-45, doi: 10.17650/2222-8721-2018-8-1-38-45. (in Russ.)
11. Chang, Y.-W., Hsieh, S.-F., Horng, Y.-S., Chen, H.-L. & Lee, K.-C. (2014), "Comparative effectiveness of ultrasound and paraffin therapy in patients with carpal tunnel syndrome: a randomized trial", *BMC Musculoskeletal Disorders*, No. 26(15), p. 399, doi: 10.1186/1471-2474-15-399.
12. Levine, D.W., Simmons, B.P., Koris, M.J., Daltroy, L.H., Hohl, G.G., Fossel, A.H. & Katz, J.N. (1993), "A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome", *J Bone Joint Surg Am.*, No. 75(11), pp. 1585-1592.
13. Nourbakhsh, M.R., Bell, T.J., Martin, J.B. & Arab A.M. (2016), "The Effects of Oscillatory Biofield Therapy on Pain and Functional Limitations Associated with Carpal Tunnel Syndrome: Randomized, Placebo-Controlled, Double-Blind Study", *The Journal of Alternative and Complementary Medicine*, Vol. 22, No. 11, doi: 10.1089/acm.2016.0083.
14. Yücel, H. & Seyithanoğlu, H. (2015), "Choosing the most efficacious scoring method for carpal tunnel syndrome", *Orthop Traumatol Turc*, No. 49(1), pp. 23-29, doi: 10.3944/AOTT.2015.13.0162.

Received: 14.07.2019.

Published: 31.08.2019.

Information about the Authors

Olena Bismak: *PhD (Physical Education and Sport), Associate Professor: National University of Ukraine on Physical Education and Sport: Fizkul'tury str. 1, Kyiv, 03150, Ukraine.*

ORCID.ORG/0000-0002-6495-6170

E-mail: ebismak@gmail.com