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The Importance of Physiotherapy in a Conservative Treatment of Carpal Tunnel Syndrome

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Summary

Objective: The main objective of the work is to demonstrate the impact of selected physiotherapy methods in patients with carpal tunnel syndrome in a conservative solution. The assumptions that are examined within the work and serve to verify or refute and are the basis for the research are as follows: We assume that after completing the therapy in patients with carpal tunnel syndrome, pain will be reduced, range of motion of the carpometacarpal joint of the thumb will improve, and hand swelling will decrease.

Methods/ Participants: We conducted the work in a form of an observational study. The group consisted of 8 adult patients aged 39-71 years who met the inclusion criteria, namely that they had been examined and diagnosed with carpal tunnel accompanied by specific symptoms.

Methodology: All patients underwent a physiotherapy examination, which included taking a medical history, measuring upper limb circumferences, goniometric measurement of the upper extremities, and then the patients rated the relevant pain using a numeric rating scale. After the initial examination, we determined a suitable physiotherapy plan, which we implemented over a period of one month with a frequency of visits twice a week and a duration of 50 minutes for each exercise unit. To verify the goals, we analyzed the results using statistical methods of t-test where the alpha significance level for all goals was set at 0.05.

Conclusions: Based on the results of the work, we can confirm a positive effect of physiotherapy in carpal tunnel syndrome. Improvement occurred in all patients, subjectively patients reported a lower level of pain than before the start of the therapy, objectively we managed to achieve a greater range of motion in the carpometacarpal joint of the thumb and swelling also decreased after therapy. Patients were instructed on the importance of regimen measures and we provided them with ergonomic advice.

Keywords Carpal Tunnel Syndrome. Physiotherapy. Nervus Medianus.

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Introduction: Theoretical starting points leading to the implementation of the study

Carpal tunnel syndrome is caused by compression of the nervus medianus, which is located on the volar part of the wrist. It is one of the best-known and most widespread entrapment syndromes. A frequently recorded, dynamic carpal tunnel syndrome in epidemiological conditions is associated with manual work. Idiopathic carpal tunnel syndrome is most common in women (65-80%) and between the ages of 40 and 60, with 50-60% of cases being bilateral. (Chammas et al,

2014) In secondary carpal tunnel syndrome, any condition that modifies the walls of the carpal tunnel can cause compression of the nervus medianus. These include irregularities in the shape or position of the carpal bones. In dynamic carpal tunnel syndrome, the pressure inside the tunnel increases during wrist flexion and extension. This increase is associated with repetitive movements of wrist flexion and extension along with fingers flexion and forearm supination. Acute carpal tunnel syndrome can occur as a result of trauma (displacement of the distal part of the scaphoid or dislocation of the wrist due to fractures), infection, bleeding from anticoagulant overdose or haemophilia, acute thrombosis of the nervus medianus artery, and burns. The diagnosis of carpal tunnel syndrome accounts for up to 90% of the total number of entrapment syndromes. Initially, this syndrome is characterized by:

- Intermittent nocturnal paresthesias and dysesthesias, the frequency of which increases and occur during wakefulness.
- Loss of sensation along with weakness and atrophy of the thenar muscles.
- In severe cases, symptoms may spread proximally to the forearm, upper arm, and sometimes into the shoulder.
- Symptoms on the entire palm surface. (Padua et al, 2016)

Although it is clear that carpal tunnel syndrome is a chronic phenomenon of peripheral nerve compression, in the pathophysiology and specific etiology there is an increase in intracanal pressure. Persistent pressures above 20-30 mmHg can cause damage to the nervus medianus by disrupting blood flow. Several studies confirm that increased pressure in the canal is present in patients with carpal tunnel syndrome and also correlates with clinical symptoms. (Zamborsky et al, 2017) We also focused on diagnostics and treatment procedures in physiotherapy for the selected diagnosis. Given the high frequency of occurrence of this entrapment syndrome, confirmation or rejection of this diagnosis belongs to neurologists. Due to the evaluation of the clinical condition and the use of auxiliary examinations (EMG), establishing or excluding the diagnosis of carpal tunnel syndrome is usually not problematic. Commonly confused conditions include C6 and C7 root lesions and cervicobrachial syndrome with pseudoradicular irritation. Arthralgias and arthropathy of the small joints of the hand or polyneuropathic syndrome can also be included here. Rarely confused conditions include brachial plexus lesions, Dupuytren's contracture, acral vasoneurosis, reflex dystrophic syndrome, and a few others. (Kim et al, 2014) The therapy is expected to improve the primary grip, a strong and precise movement model can be included. Contact with the largest possible surface area of the object is typically achieved with a power grip. This model includes a spherical, hook, and cylindrical grip. Precision grip, which requires dexterity, is used for precise manipulation. This includes the pincer, pinch and key grip. An integral part of the grip is the squeeze. It is necessary that the squeeze is appropriate. Thanks to sensory perceptions and vision, the hand is able to adapt the squeeze to the properties of the object and the given experiences are stored in memory. (Vyskotová et al. 2013) In patients with persistent numbness, neurological deficits, or long-lasting symptoms, surgical decompression is more successful than conservative treatment. For patients with severe carpal tunnel syndrome who do not respond to conservative treatment, it may be the only alternative that provides definitive treatment. (Pourmokhtari et al. 2021)

Objective

The main objective of the work is to demonstrate the effect of selected physiotherapy methods in patients with carpal tunnel syndrome after conservative treatment. The following objectives are to determine the effect of physiotherapy on pain and mobility of the affected hand and wrist and to focus on reducing swelling in the wrist and hand area. Last but not least, the effect of the physiotherapy is to teach the patient proper ergonomics to prevent the recurrence of carpal tunnel symptoms. The assumptions that are examined within the work and serve to verify or refute and are the basis for the research are as follows:

We assume that after completing the therapy in patients with carpal tunnel syndrome, pain will be reduced.

We assume that after completing the therapy in patients with carpal tunnel syndrome, range of

motion of the carpometacarpal joint of the thumb will improve.

We assume that after completing the therapy in patients with carpal tunnel syndrome, hand swelling will decrease.

Methods

We conducted the work in a form of an observational study. The group consisted of 8 adult patients aged 39-71 years who met the inclusion criteria, namely that they had been examined and diagnosed with carpal tunnel accompanied by specific symptoms. All patients underwent a physiotherapy examination, which included taking a medical history, measuring upper limb circumferences, goniometric measurement of the upper extremities using the SFTR method, and then the patients rated the relevant pain using a numeric rating scale. (Janda et al. 1993) (Melzack 1993) After the initial examination, we determined a suitable physiotherapy plan, which we implemented over a period of one month with a frequency of visits twice a week and a duration of 50 minutes for each exercise unit. In physiotherapy, we focused on the use of kinesiotherapy, manual therapy, hand stimulation, application of ultrasound with local action, carrier frequency f=3 MHz, repetition frequency f=50Hz, semi-static application, pulse-pause ratio 1:2, intensity 1.0-1.6 W.cm-2 on the CMC joint of the thumb from the palmar side, and kinesiology taping. (Hagovská, 2016) The results of the work were supported by the method of measuring and comparing input and output values. For the verification of the objectives, we analyzed the results using the t - test methods where the level of significance α for all goals was set at 0.05.

Results

By processing the input and output data of goniometric examination of passive joint mobility in the SFTR in the carpometacarpal joint of the thumb in the sagittal and frontal plane, we have shown a positive effect of physiotherapy to improve mobility in all patients (Table 1). By measuring the circumference of the areas of forearm, wrist and metacarpal heads, we processed a reduction in swelling after therapy (Table 11). With a visual numerical range of pain, we objectified a pain reduction after therapeutic intervention by physiotherapy (Table 8).

Table 1 Input and output values - goniometric examination of passive joint mobility in SFTR in the carpometacarpal joint of the thumb

			Input values		Output values		
Patient	**Area**	**Plane**	**Right UE**	**Left UE**	**Right UE**	**Left UE**	**Difference in values**
1	CMC joint	S	10 – 0 – 30	5 – 0 – 25	10 – 0 – 30	10 – 0 – 30	5
		F	70 – 0 – 50	55 – 0 – 40	70 – 0 – 50	70 – 0 – 45	20
2	CMC joint	S	10 – 0 – 30	15 – 0 – 45	10 – 0 – 35	15 – 0 – 45	5
		F	60 – 0 – 45	80 – 0 – 50	75 – 0 – 50	80 – 0 – 50	20
3	CMC joint	S	10 – 0 – 25	10 – 0 – 40	10 – 0 – 25	10 – 0 – 40	0
		F	55 – 0 – 35	70 – 0 – 50	65 – 0 – 45	70 – 0 – 50	20
4	CMC joint	S	5 – 0 – 25	10 – 0 – 45	10 – 0 – 35	10 – 0 – 45	15
		F	65 – 0 – 45	75 – 0 – 50	70 – 0 – 50	75 – 0 – 50	10
5	CMC joint	S	10 – 0 – 20	15 – 0 – 45	15 – 0 – 35	15 – 0 – 45	20
		F	45 – 0 – 35	70 – 0 – 50	55 – 0 – 45	70 – 0 – 50	20
6	CMC joint	S	5 – 0 – 20	15 – 0 – 45	10 – 0 – 30	15 – 0 – 45	15
		F	50 – 0 – 35	70 – 0 – 50	60 – 0 – 45	70 – 0 – 50	20
7	CMC joint	S	5 – 0 – 40	5 – 0 – 30	5 – 0 – 40	5 – 0 – 35	5
		F	60 – 0 – 50	50 – 0 – 45	60 – 0 – 50	55 – 0 – 50	10
8	CMC joint	S	10 – 0 – 35	10 – 0 – 25	10 – 0 – 35	10 – 0 – 30	5
		F	65 – 0 – 50	55 – 0 – 45	65 – 0 – 50	60 – 0 – 50	10

Table 2 Input values of statistical data - goniometric examination of passive joint mobility in SFTR in the carpometacarpal joint of the thumb in the sagittal plane

Area	Arithmetic mean	Median	Mode	Maximum	Standard deviation
CMC joint on the right	**36,262**	**27,5**	**20, 25, 30**	**40**	**6,5848**
CMC joint on the left	37,521	42	45	45	8,6603

Table 3 Output values of statistical data - goniometric examination of passive joint mobility in SFTR in the carpometacarpal joint of the thumb in the sagittal plane

Area	Arithmetic mean	Median	Mode	Maximum	Standard deviation
CMC joint on the right	**36,295**	**35**	**35**	**40**	**9,0054**
CMC joint on the left	50,631	52,5	60	60	8,8164

Table 4 Statistical result of paired t - test for the range of carpometacarpal joint movement in the sagittal plane according to SFTR

p-value	**0,00291**	**n=8**
p-value < α		**t=37,19**
p 0,001 < 0,05	α = 0.05	

Table 5 Input values of statistical data - goniometric examination of passive joint mobility in SFTR in the carpometacarpal joint of the thumb in the frontal plane

Area	Arithmetic mean	Median	Mode	Maximum	Standard deviation
CMC joint on the right	**105**	**110**	**110**	**120**	**11,9522**
CMC joint on the left	117,5	130	130	135	17,5113

Table 6 Output values of statistical data - goniometric examination of passive joint mobility in SFTR in the carpometacarpal joint of the thumb in the frontal plane

Area	Arithmetic mean	Median	Mode	Maximum	Standard deviation
CMC joint on the right	**112,5**	**112,5**	**110, 120**	**125**	**9,0157**
CMC joint on the left	118,13	120	120	130	7,4717

Table 7 Statistical result of paired t - test for the range of carpometacarpal joint movement in the frontal plane according to SFTR

p-value	**0,00002326**	**n=8**
p-value < α		**t=6,91**
p 0,001 < 0,05	α = 0.05	

By calculating the p-value, we have confirmed that after undergoing therapy in patients with carpal tunnel syndrome, the ranges of movements in both sagittal and frontal plane in the carpometacarpal joint of the thumb will improve.

Table 8 Numeric pain rating scale (0-10)

		Input values	Output values
Patient	**Sex**	**Pain intensity**	**Pain intensity**
1	female	2	2
2	female	4	4
3	male	2	2
4	female	1	1
5	male	4	4
6	female	1	1
7	male	3	3
8	male	4	4

Table 9 Statistical data of input and output values of pain objectivization

Pain	Input values	Output values
Arithmetic mean	**4**	**2,625**
Median	4	2,5
Mode	4, 3, 5	4
Maximum	6	4

Pain	Input values	Output values
Minimum	2	1
Standard deviation	1,2247	1,2183

Table 10 Statistical result of paired t - test of input and output values for pain objectivization

p-value	0,00006782	n = 8
p-value < α		t = 1,37
p 0,001 < 0,05	α = 0.05	

By calculating the p-value, we have confirmed that after undergoing therapy in patients with carpal tunnel syndrome, pain will be relieved.

Table 11 Anthropometric measurement, upper extremities circumference [cm], evaluation of swelling in the hand area (Janda et al. 1993)

			Input values		Output values		Difference in values	
Patient	Sex	Area	Right UE	Left UE	Right UE	Left UE	right	left
1	female	forearm	22	22	22	22	0	0
		wrist	**14**	**15**	**14**	**14**	**1**	**0**
		metacarpal heads	17	17,5	17	17,5	0	0
2	female	forearm	23,5	23,5	23,5	23,5	0	0
		wrist	16	16	16	16	0	0
		metacarpal heads	18	18	18	18	0	0
3	male	forearm	30	30	30	30	0	0
		wrist	**26**	**24,5**	**25,5**	**24,5**	**0,5**	**0**
		metacarpal heads	**28**	**26,5**	**27**	**26,5**	**1**	**0**
4	female	forearm	30	29	30	29	0	0
		wrist	**22**	**20**	**21**	**20**	**1**	**0**
		metacarpal heads	**25**	**23**	**24**	**23**	**1**	**0**
5	male	forearm	24,5	24,5	24,5	24,5	0	0
		wrist	**19**	**18**	**18,5**	**18**	**0,5**	**0**
		metacarpal heads	20	20	20	20	0	0
6	female	forearm	27,5	27,5	27,5	27,5	0	0
		wrist	20	20	20	20	0	0
		metacarpal heads	22	22	22	22	0	0
7	male	forearm	26	26	26	26	0	0
		wrist	21	21	21	21	0	0
		metacarpal heads	24	24	24	24	0	0
8	male	forearm	29	29	29	29	0	0
		wrist	**23**	**24,5**	**23**	**24**	**0**	**0,5**
		metacarpal heads	**25**	**25,5**	**25**	**25**	**0**	**0,5**