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

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Важливість фізіотерапії в консервативному лікуванні синдрому зап'ясткового каналу

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Introduction

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 [1]. 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 [2]. 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 which occur during wakefulness; loss of sensation along with weakness and atrophy of the thenar muscles; spreading of symptoms proximally to the forearm, upper arm and sometimes into the shoulder in severe cases; and symptoms on the entire palm surface [3].

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 [4].

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 [5]. Rarely confused conditions include brachial plexus lesions, Dupuytren's contracture, acral vasoneurosis, reflex dystrophic syndrome, and a few others [6].

The therapy is expected to improve the primary grip, and 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. 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 [7]. 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 [8]. The aspect that has not been sufficiently addressed so far is the objectified effect of a comprehensive, precisely defined one-month physiotherapy programme on pain, thumb joint mobility and swelling in patients with a moderate form of the syndrome treated conservatively, which is the focus of the present study.

The purpose of the research is to demonstrate the effect of selected physiotherapy methods in patients with carpal tunnel syndrome treated conservatively, namely the effect of physiotherapy on pain, on the mobility of the affected hand and wrist and on the reduction of swelling in the wrist and hand area. The study verifies three assumptions: that

after completing the therapy in patients with carpal tunnel syndrome pain will be reduced; that the ranges of motion of the carpometacarpal joint of the thumb will improve; and that hand swelling will decrease. The significance of the study lies in providing objectified evidence for conservative management of a syndrome that accounts for up to 90 % of all entrapment syndromes and represents a frequent cause of temporary work incapacity.

Object, materials and research methods

The research object was the change in pain intensity, in the range of motion of the carpometacarpal joint of the thumb and in the circumferences of the upper extremity in adult patients with a confirmed diagnosis of carpal tunnel syndrome undergoing conservative treatment.

The study was designed and carried out as an observational study. The data were obtained within the bachelor's thesis of V. Máthéová, defended at the Slovak Medical University in Bratislava in 2024 under the supervision of the first author [9]. The group consisted of 8 adult patients (4 women and 4 men) aged 39–71 years, with a mean age of 56.25 years (median 56 years). The inclusion criteria were: adult age, a diagnosis of grade 2 (moderate) carpal tunnel syndrome established by a neurologist, and consent to participation and to anonymous processing of the data. The exclusion criteria were: refusal of participation, minor age, and unwillingness or inability to cooperate during the therapeutic procedures. Patients indicated for surgical decompression and patients after a previous surgical intervention on the wrist were not included.

All patients underwent an entry physiotherapy examination comprising history taking, anthropometric measurement of upper-limb circumferences in the area of the forearm, wrist and metacarpal heads, goniometric measurement of the active and passive range of motion of the carpometacarpal joint of the thumb in the sagittal and frontal planes using the SFTR method [10], and assessment of pain intensity on a numeric rating scale [11].

On the basis of the entry examination an individual therapeutic plan was determined and implemented over a period of one month in 8 sessions (twice a week), each lasting 50 minutes. The programme comprised kinesiotherapy (mobilisation of the wrist, postisometric relaxation of the flexors and extensors of the forearm and fingers, strengthening exercises for the flexors and extensors of the fingers, for the wrist and for the thumb), proprioceptive neuromuscular facilitation of the upper extremities, stimulation of hand sensitivity with a spiky massage ball, soft-tissue techniques, ultrasound with local action applied to the palmar aspect of the carpometacarpal joint of the thumb (carrier frequency f = 3 MHz, repetition frequency f = 50 Hz, semi-static application, pulse-pause ratio 1:2, intensity 1.0–1.6 $W \cdot cm^{-2}$) and kinesiology taping [12; 13]. All patients were instructed to continue with the exercise programme independently at home. The output examination was performed using an identical protocol immediately after the completion of the one-month programme.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved in 2024 by the Ethics Committee for Biomedical Research of the Slovak Medical University in Bratislava. All participants were informed about the aim and the course of the study and signed written informed consent to inclusion in the study and to anonymous processing of their data.

Data processing. The results were evaluated by the method of measuring and comparing input and output values. Descriptive statistics (arithmetic mean, median, mode, maximum, minimum and standard deviation) were calculated for all monitored parameters. For the verification of the assumptions the one-tailed paired t-test was used (df = 7); the level of significance α was set at 0.05 for all assumptions. For the range of motion, the values of both directions of movement in the given plane (extension and flexion in the sagittal plane, abduction and adduction in the frontal plane) were summed and the values of both upper extremities of a given patient were added together, so that each patient entered the test with a single value for each plane; the circumferences were tested in the same way. Statistical processing was performed using Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA, USA).

Research results

By processing the input and output data of the goniometric examination of the carpometacarpal joint of the thumb in the sagittal and frontal planes, a positive effect of physiotherapy on mobility was demonstrated in all patients. The individual passive values are presented in Table 1.

The descriptive statistical characteristics of the passive range of motion before and after the therapy are presented in Table 2 for the sagittal plane and in Table 3 for the frontal plane.

For the verification of the assumption concerning mobility, the values of both directions of movement in the given plane were summed and the total range in the plane was tested. The results of the one-tailed paired t-test are presented in Table 4.

By calculating the p-value we confirmed that after undergoing therapy in patients with carpal tunnel syndrome the ranges of movement of the carpometacarpal joint of the thumb improve in both the sagittal and the frontal plane, for the active as well as for the passive range of motion. The mean total passive range of motion and its change are shown in Figure 1.

Using the numeric pain rating scale, a reduction of pain after the therapeutic intervention was objectified. The values of the individual patients are shown in Figure 2, the descriptive statistical characteristics are presented in Table 5 and the result of the hypothesis testing in Table 6.

Table 1

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

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

Note: CMC – carpometacarpal joint; S – sagittal plane; F – frontal plane; UE – upper extremity. Values are given in degrees according to the SFTR notation (extension – 0 – flexion in the sagittal plane; abduction – 0 – adduction in the frontal plane).

Table 2

Descriptive statistics of passive joint mobility in the carpometacarpal joint of the thumb in the sagittal plane before and after the therapy [°]

Movement	Time	Arithmetic mean	Median	Mode	Maximum	Minimum	SD
Right UE – extension	before	8.13	10	10	10	5	2.4206
Right UE – extension	after	10.00	10	10	15	5	2.5000
Right UE – flexion	before	28.13	27.5	20; 25; 30	40	20	6.5848
Right UE – flexion	after	33.13	35	35	40	25	4.2848
Left UE – extension	before	10.63	10	10; 15	15	5	3.9031
Left UE – extension	after	11.25	10	10	15	5	3.3072
Left UE – flexion	before	37.50	42.5	45	45	25	8.6603
Left UE – flexion	after	39.38	42.5	45	45	30	6.3431

Table 3

Descriptive statistics of passive joint mobility in the carpometacarpal joint of the thumb in the frontal plane before and after the therapy [°]

Movement	Time	Arithmetic mean	Median	Mode	Maximum	Minimum	SD
Right UE – abduction	before	58.75	60	60; 65	70	45	7.8062
Right UE – abduction	after	65.00	65	60; 65; 70	75	55	6.1237
Right UE – adduction	before	43.13	45	35; 50	50	35	6.5848
Right UE – adduction	after	48.13	50	50	50	45	2.4206
Left UE – abduction	before	65.63	70	70	80	50	10.1358
Left UE – abduction	after	68.75	70	70	80	55	7.3951
Left UE – adduction	before	47.50	50	50	50	40	3.5355
Left UE – adduction	after	49.38	50	50	50	45	1.6536

Table 4

Statistical result of the one-tailed paired t-test for the total range of movement of the carpometacarpal joint of the thumb

Plane	Range of motion	n	df	α	t	p-value
sagittal	active	8	7	0.05	6.3549	0.0001917
sagittal	passive	8	7	0.05	3.9104	0.00291
frontal	active	8	7	0.05	11.0000	0.000005688
frontal	passive	8	7	0.05	8.8807	0.00002326

Note: in all four comparisons the p-value is lower than the level of significance α, i.e. the change is statistically significant.

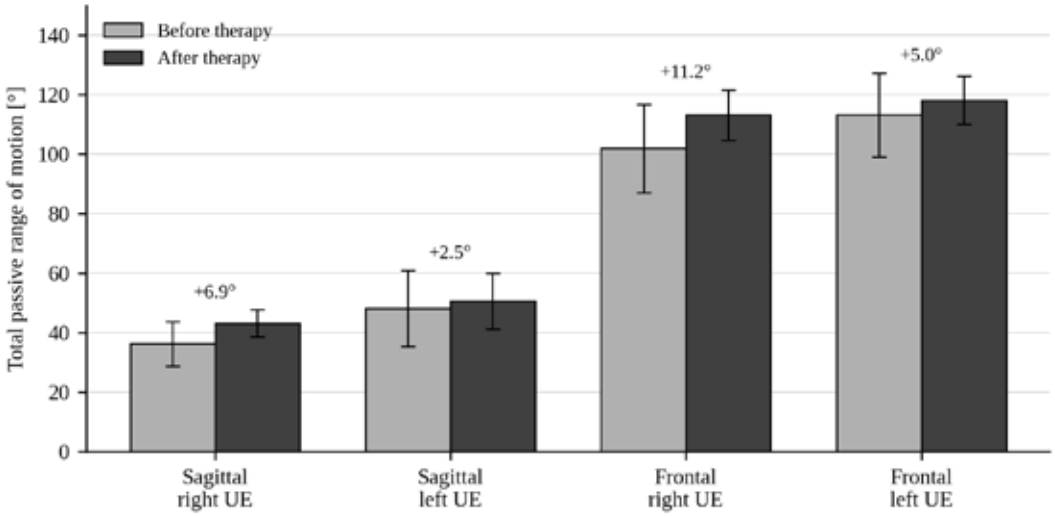


Fig. 1. Mean total passive range of motion of the carpometacarpal joint of the thumb before and after the one-month therapeutic programme (mean ± SD, n = 8). The values above the columns indicate the mean improvement in degrees

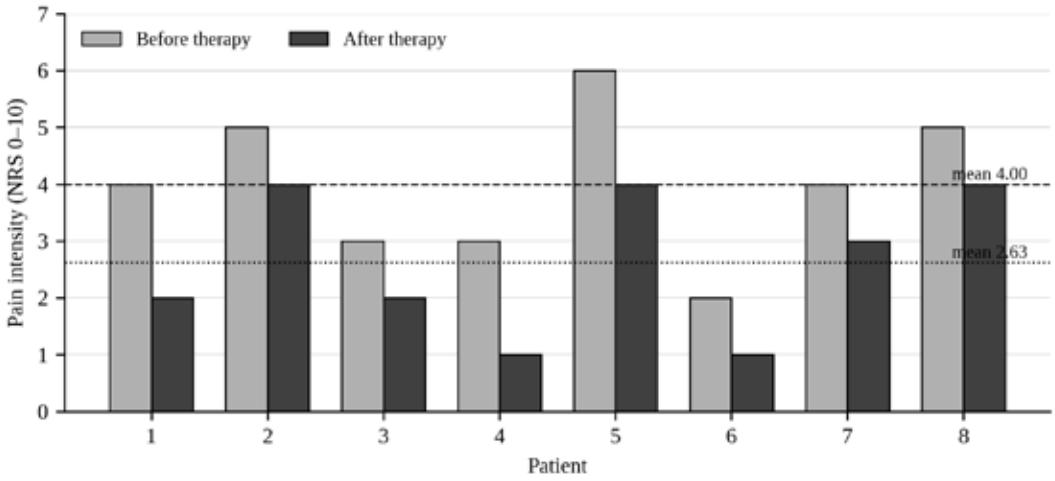


Fig. 2. Pain intensity of the individual patients on the numeric rating scale before and after the therapy (n = 8). The horizontal lines indicate the group means before (4.00) and after (2.63) the therapeutic programme.

Table 5

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	3; 4; 5	4
Maximum	6	4
Minimum	2	1
Standard deviation	1.2247	1.2183

Table 6

Statistical result of the one-tailed paired t-test of input and output values for pain objectivization

n	df	α	t	p-value	Result
8	7	0.05	7.5144	0.00006782	p-value < α → statistically significant

By calculating the p-value we confirmed that after undergoing therapy in patients with carpal tunnel syndrome pain is relieved. A decrease in pain intensity was recorded in all eight patients; in no patient did the pain increase.

Swelling was present in 5 of the 8 patients; it prevailed on the right upper extremity (3 patients) compared with the left one (2 patients). In the wrist area it occurred in all five patients with swelling, in the area of the metacarpal heads in four of them. By measuring the circumferences of the forearm, wrist and metacarpal heads, a reduction of swelling after the therapy was recorded (Table 7).

The statistical significance of the reduction of swelling in the individual measured areas was verified by the one-tailed paired t-test (Table 8); the mean reduction of the circumferences is shown in Figure 3.

For swelling in the wrist area, by calculating the p-value we confirmed that after completing the therapy in patients with carpal tunnel syndrome swelling is reduced. For swelling in the area of the metacarpal heads we likewise confirmed a reduction, although a change was recorded in a smaller number of patients. In the forearm area no change in circumference was recorded during the monitored period.

Discussion of the research results

The most important finding of the present study is that a precisely defined one-month conservative physiotherapy programme produced a statistically significant improvement in all three monitored parameters at the same time – pain intensity, range of motion of the carpometacarpal joint of the thumb and circumference of the wrist and metacarpal heads. The combination of a mechanical effect (kinesiotherapy, manual therapy, kinesiology taping) with a physical modality acting on the deep structures of the carpal tunnel (ultrasound with a carrier frequency of 3 MHz applied from the palmar side) appears to be a possible mechanism of the observed effect: reduction

Table 7

Anthropometric measurement, upper extremities circumference [cm], evaluation of swelling in the hand area

Patient	Sex	Area	Input – Right UE	Input – Left UE	Output – Right UE	Output – Left UE
1	female	forearm	22	22	22	22
1	female	wrist	14	15	14	14
1	female	metacarpal heads	17	17.5	17	17.5
2	female	forearm	23.5	23.5	23.5	23.5
2	female	wrist	16	16	16	16
2	female	metacarpal heads	18	18	18	18
3	male	forearm	30	30	30	30
3	male	wrist	26	24.5	25.5	24.5
3	male	metacarpal heads	28	26.5	27	26.5
4	female	forearm	30	29	30	29
4	female	wrist	22	20	21	20
4	female	metacarpal heads	25	23	24	23
5	male	forearm	24.5	24.5	24.5	24.5
5	male	wrist	19	18	18.5	18
5	male	metacarpal heads	20	20	20	20
6	female	forearm	27.5	27.5	27.5	27.5
6	female	wrist	20	20	20	20
6	female	metacarpal heads	22	22	22	22
7	male	forearm	26	26	26	26
7	male	wrist	21	21	21	21
7	male	metacarpal heads	24	24	24	24
8	male	forearm	29	29	29	29
8	male	wrist	23	24.5	23	24
8	male	metacarpal heads	25	25.5	25	25

Table 8

Statistical result of the one-tailed paired t-test for swelling in the wrist area and in the area of the metacarpal heads

Area	n	df	α	t	p-value	Result
forearm	8	–	0.05	–	not tested	no change in circumference recorded
wrist	8	7	0.05	2.9656	0.01047	p-value < α → statistically significant
metacarpal heads	8	7	0.05	1.9296	0.04749	p-value < α → statistically significant

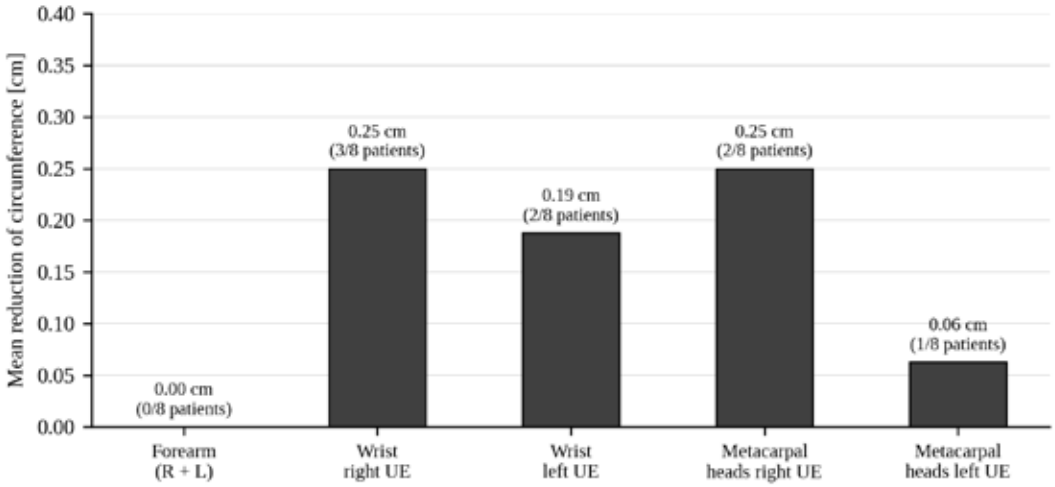


Fig. 3. Mean reduction of the circumference of the upper extremity after the therapy by measured area (n = 8). The values above the columns give the mean reduction in centimetres and the number of patients in whom a change was recorded

of local oedema decreases the pressure inside the canal, and a decrease in intracanal pressure below the threshold at which perfusion of the nervus medianus is disturbed is a prerequisite for the regression of sensory symptoms. This interpretation corresponds to imaging findings describing changes in the shape and position of the median nerve within the canal under increased pressure [14].

The most pronounced changes in our group were recorded in the frontal plane of the carpometacarpal joint of the thumb, which can be explained by the fact that abduction and adduction of the thumb are the movements most restricted by pain and by the protective posture of the hand, and therefore they respond most rapidly to the reduction of pain. In contrast, the forearm circumference remained unchanged in all patients, which supports the assumption that the oedema in carpal tunnel syndrome is localised distally and that the therapeutic effect is targeted rather than general.

Our results are consistent with the conclusions of a systematic review and meta-analysis of kinesiology taping in the conservative treatment of carpal tunnel syndrome, which reported a strong effect on distal sensory latency and a smaller, short-term effect on pain and function [13]. A double-blind randomised clinical trial in manual labourers confirmed that kinesiology taping is a safe and reliable treatment that does not restrict the daily activities of patients and does not cause adverse effects [15]. Comparable short-term effects on clinical symptoms have also been reported for other conservative modalities, in particular acupuncture, both in a randomised controlled trial [16], in a systematic review of manual acupuncture in mild-to-moderate forms of the syndrome [17] and in a meta-analysis of randomised controlled trials, in which acupuncture was more effective than night splinting in relieving pain [18].

The choice between conservative and surgical management remains decisive for the outcome. A systematic review and meta-analysis showed a greater improvement of symptoms and of neurophysiological parameters after surgery at 6 months, whereas at 3 and 12 months the differences between conservative and surgical treatment were not significant; for mild and short-lasting forms the authors prefer conservative treatment [19]. Comparable conclusions were reached for patients with a moderate form of the syndrome, in whom conservative treatment is considered an appropriate choice, while surgery is recommended primarily for severe forms [8]. Our group consisted exclusively of patients with a grade 2 (moderate) form, which corresponds to the indication area in which conservative therapy is expected to be effective.

Compared with the cited studies, the added value of the present work lies in the simultaneous objectification of three independent parameters (pain, goniometry, anthropometry) in one group, which reduces the risk that the observed effect would be attributable to the subjective assessment of pain alone. Instrumented methods of quantitative assessment of hand function, such as gyrosensor measurement [20] or innovative quantitative testing of hand function [21], offer a more sensitive alternative for future studies. The main limitations of our study are the small size of the group (n = 8), the absence of a control group, the absence of long-term follow-up and the fact that a part of the therapeutic effect may be attributable to the independent home exercise programme, whose adherence was not monitored.

Since the development of carpal tunnel syndrome is also related to the professional focus of individuals, a change in work habits is an inseparable part of the therapy; almost all patients in our group reported regular computer work as a part of their profession. The association between prolonged computer work and carpal tunnel syndrome has been demonstrated in a case-control study [22] and in a cross-sectional study of bank employees, in which the prevalence reached 11.7 % and the risk was highest in employees with longer working hours and insufficient ergonomic training [23]. A review with meta-analysis,

however, did not confirm this association and interpreted it more cautiously [24]. In everyday practice it is also necessary to distinguish carpal tunnel syndrome from other lesions of the nerves of the upper extremity, in which the therapeutic procedure differs substantially [25].

Based on our results, the following practical recommendations can be formulated for patients: regular breaks during repetitive stereotyped movements with the inclusion of targeted kinesiotherapy; adjustment of the working environment so as to minimise excessive flexion or extension of the wrist, with the monitor placed at eye level and the keyboard and mouse at an appropriate height; the use of an ergonomic chair with back support, adjustable armrests and a seat that supports the natural curve of the spine; the use of ergonomic aids such as specially shaped orthoses or keyboard and mouse pads, which help keep the wrists in a neutral position; correct holding and use of work tools, avoiding tools with hard and sharp edges or short handles; and elimination of exposure to cold if the working environment allows it. An indispensable part of the procedure is also education of the patient and regular monitoring of the progress of the therapy. These recommendations should be adapted to the individual needs of each patient and implemented under the supervision of a qualified physiotherapist.

Prospects for further research

Further research should verify the demonstrated effect on a larger group of patients with a control group and with follow-up measurements at three and six months after the completion of the therapy, which would make it possible to assess the persistence of the effect. It would also be appropriate to compare the effectiveness of the individual components of the therapeutic programme separately and to supplement the objectification with an electromyographic examination, an instrumented assessment of hand function and a standardised questionnaire of symptom severity.

Conclusions

The positive results of our work confirm the effectiveness of physiotherapy in patients with a moderate form of carpal tunnel syndrome in conservative treatment. After one month of targeted therapeutic intervention we recorded a statistically significant improvement in the active and passive range of motion of the carpometacarpal joint of the thumb in both the sagittal and the frontal plane, a statistically significant reduction of pain intensity (a decrease of the mean value from 4 to 2.625 on the numeric rating scale), and a statistically significant reduction of swelling in the area of the wrist and the metacarpal heads.

All three assumptions established at the beginning of the research were therefore confirmed. The results indicate the possibility of improving patients' hand function in everyday and especially in working life. Given that the development of carpal tunnel syndrome is also related to the professional focus of individuals, a change in work habits together with education in the principles of ergonomics is an essential part of the therapeutic procedure. The findings can be used in the routine practice of outpatient physiotherapy departments as an argument for indicating a comprehensive therapeutic programme before considering surgical decompression in patients with a mild and moderate form of the syndrome.

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Purpose. The purpose of the study was to demonstrate the effect of selected physiotherapy methods in patients with a moderate form of carpal tunnel syndrome treated conservatively and to verify whether a one-month structured therapeutic programme leads to a measurable improvement in pain, joint mobility and swelling of the hand.

Materials and Methods. An observational study was carried out in a group of 8 adult patients (4 women, 4 men) aged 39–71 years (mean age 56.25 years) with grade 2 carpal tunnel syndrome. Each patient underwent an entry examination comprising history taking, anthropometric measurement of upper-limb circumferences in the area of the forearm, wrist and metacarpal heads, goniometric measurement of the active and passive mobility of the carpometacarpal joint of the thumb in the sagittal and frontal planes using the SFTR method, and pain assessment on a numeric rating scale. The therapeutic programme lasted one month and consisted of 8 sessions of 50 minutes; it included kinesiotherapy, manual therapy, proprioceptive neuromuscular facilitation, stimulation of hand sensitivity, ultrasound applied to the palmar aspect of the carpometacarpal joint of the thumb (3 MHz, 50 Hz, pulse-pause ratio 1:2, intensity 1.0–1.6 $W \cdot cm^{-2}$) and kinesiology taping. Input and output values were compared using the one-tailed paired t-test at a level of significance $\alpha = 0.05$.

Results. The range of motion of the carpometacarpal joint of the thumb increased in both planes, for the active (sagittal plane $p = 0.0001917$; frontal plane $p = 0.000005688$) as well as for the passive range of motion ($p = 0.00291$ and $p = 0.00002326$). The intensity of pain decreased from a mean value of 4 to 2.625 ($p = 0.00006782$). The circumferences decreased in the area of the wrist ($p = 0.01047$) and of the metacarpal heads ($p = 0.04749$), while the forearm circumference remained unchanged.

Conclusions. One month of targeted physiotherapy significantly reduced pain and swelling and improved the mobility of the thumb in patients with a moderate form of carpal tunnel syndrome. Conservative physiotherapeutic management combined with education in the principles of ergonomics can be recommended before considering surgical decompression in patients with a mild and moderate form of the syndrome.

Key words: median nerve, entrapment neuropathy, kinesiology taping, goniometry, numeric rating scale, hand function, ultrasound therapy, ergonomics.

Синдром зап’ясткового каналу є найпоширенішим компресійно-ішемічним синдромом периферичної нервової системи; на нього припадає до 90 % усіх тунельних синдромів, і він належить до частих причин тимчасової непрацездатності осіб, робота яких пов’язана з повторюваними стереотипними рухами кисті.

Метою дослідження було продемонструвати ефект вибраних методів фізичної терапії у пацієнтів із синдромом зап’ясткового каналу середнього ступеня тяжкості, які отримували консервативне лікування, а саме оцінити вплив терапевтичного втручання на інтенсивність болю, на обсяг рухів у зап’ястково-п’ястковому суглобі великого пальця та на вираженість набряку в ділянці передпліччя, зап’ястка і головок п’ясткових кісток. Додатковою метою було навчити пацієнтів принципів ергономіки з метою запобігання рецидиву симптомів. Перевірялися три припущення: після завершення терапії зменшиться біль, покращиться обсяг рухів у зап’ястково-п’ястковому суглобі великого пальця та зменшиться набряк кисті.

Матеріали та методи. Дослідження проведено у формі обсерваційного дослідження. Вибірку становили 8 дорослих пацієнтів (4 жінки і 4 чоловіки) віком від 39 до 71 року, середній вік – 56,25 року. Критеріями включення були повнолітній

вік, встановлений неврологом діагноз синдрому зап'ясткового каналу 2 ступеня та згода на участь і анонімну обробку даних; критеріями виключення – відмова від участі, неповнолітній вік і неготовність або неспроможність співпрацювати під час терапії. Усі пацієнти пройшли вхідне обстеження, яке включало збір анамнезу, антропометричне вимірювання обводів верхніх кінцівок у ділянці передпліччя, зап'ястка та головок п'ясткових кісток, гоніометричне вимірювання активної і пасивної рухливості зап'ястково-п'ясткового суглоба великого пальця в сагітальній та фронтальній площинах за методом SFTR, а також оцінювання болю за числовою рейтинговою шкалою. Терапевтичну програму реалізовано протягом одного місяця у 8 сеансах тривалістю 50 хвилин кожен; вона включала кінезіотерапію, мануальну терапію, пропріоцептивну нейром'язову фацилітацію, стимуляцію чутливості кисті, ультразвукову терапію на долонну поверхню зап'ястково-п'ясткового суглоба великого пальця (3 МГц, 50 Гц, співвідношення імпульс–пауза 1:2, інтенсивність 1,0–1,6 Вт/см²) та кінезіологічне тейпування. Пацієнтів проінструктовано щодо самостійного продовження вправ удома.

Обробка даних. Для всіх параметрів обчислено показники описової статистики: середнє арифметичне, медіану, моду, максимум, мінімум і стандартне відхилення. Для перевірки припущень використано односторонній парний t-тест; рівень статистичної значущості становив $\alpha = 0,05$.

Результати. Обробка вхідних і вихідних даних гоніометричного обстеження засвідчила позитивний вплив фізичної терапії на обсяг рухів в усіх пацієнтів як у сагітальній (активний обсяг $p = 0,0001917$; пасивний $p = 0,00291$), так і у фронтальній площині (активний $p = 0,000005688$; пасивний $p = 0,00002326$). За числовою рейтинговою шкалою болю середнє значення знизилося з 4 до 2,625 ($p = 0,00006782$). Набряк був наявний у 5 із 8 пацієнтів, переважно на правій верхній кінцівці; вимірювання обводів показало його зменшення після терапії, статистично значуще в ділянці зап'ястка ($p = 0,01047$) та головок п'ясткових кісток ($p = 0,04749$), тоді як обвід передпліччя залишився незмінним, що підтверджує припущення про дистальну локалізацію набряку та цілеспрямований характер терапевтичного ефекту.

Висновки. Отримані результати підтверджують ефективність фізичної терапії у пацієнтів із синдромом зап'ясткового каналу середнього ступеня тяжкості в межах консервативного лікування; усі три вихідні припущення були підтверджені. Цілеспрямоване втручання протягом одного місяця сприяло зменшенню болю та набряку, а також покращенню обсягу рухів у зап'ястково-п'ястковому суглобі великого пальця, що створює передумови для покращення функції кисті у повсякденному й насамперед професійному житті. З огляду на зв'язок розвитку синдрому із професійною діяльністю невід'ємною частиною терапії є зміна робочих звичок: регулярні перерви під час повторюваних стереотипних рухів, модифікація робочого середовища, використання ергономічних засобів і правильне тримання робочих інструментів. Рекомендації слід добирати відповідно до індивідуальних потреб кожного пацієнта та впроваджувати їх під наглядом кваліфікованого фізичного терапевта.

Ключові слова: серединний нерв, компресійно-ішемічна невропатія, кінезіологічне тейпування, гоніометрія, набряк, функція кисті, ультразвукова терапія, ергономіка.

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