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EFFICACY OF NEURAL MOBILIZATION AND MID-CARPAL MOBILIZATION IN THE TREATMENT OF CARPAL TUNNEL SYNDROME

SKUTECZNOŚĆ NEUROMOBILIZACJI ORAZ MOBILIZACJI STAWU ŚRÓDNADGARSTKOWEGO W LECZENIU ZESPOŁU KANAŁU NADGARSTKA

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SUMMARY

Introduction: Carpal Tunnel Syndrome (CTS) is a cause of functional impairment and chronic wrist pain of the hand. It results from compression of the median nerve as it passes through the carpal tunnel.

Purpose: The purpose of this study was to determine the effect of a manual therapy techniques (median nerve neural mobilization and wrist traction) on measures of pain and hand function in individuals with carpal tunnel syndrome.

Material and methods: 36 patients of ages between 35-50 years with clinical and electrodiagnostic evidence of carpal tunnel syndrome, as well as positive Phalen test participated in this study. Subjects were randomly assigned to one of the two physiotherapy intervention groups: Group I - only median nerve neuromobilization was applicated. Group II - median nerve neuromobilization technique with additionally performed mid-carpal distraction using manual therapy technique. Psychometric measures, Boston Carpal Tunnel Questionnaire (BCTQ), The Disabilities of the Arm, Shoulder and Hand (DASH) and Visual Analogue Scale (VAS) were used.

Results: Both methods were very effective in the treatment of CTS. The results of the study demonstrated that a combination of neuromobilisation and mid-carpal distraction brought slightly greater gains in outcome measures: symptom severity, hand functional status and pain intensity, than neural mobilization single performed. although in some cases the differences were not statistically significant.

Conclusions: It is concluded that the combination of these two techniques may be effective in the treatment of CTS, especially in second degree of CTS where patients have persistent numbness in the area supplied by the median nerve. However, further clinical studies are needed.

Key words: carpal tunnel syndrome, neural mobilization, mid-carpal distraction.

INTRODUCTION

Carpal tunnel syndrome (CTS) is a constellation of signs and symptoms resulting from compression of the median nerve at the wrist, what lead to considerable discomfort and pain, limitation of activities of daily living, loss of sleep and work disability [1]. Combination of clinical findings with electrodiagnostic study is the most valid way of CTS diagnosing [2].

There are several possible causes of carpal tunnel syndrome, but most cases are idiopathic [3]. The cause of compression of the median nerve at the carpal tunnel is the result of a discrepancy between the volume of the contents of the canal and its relative size. Normal pressure of the carpal tunnel has been defined as a range of 2–10 mm, and wrist flexion increases this pressure 8-fold, while extension increases it 10-fold [4]. Repetitive flexion and extension in the wrist significantly increase the fluid pressure in the tunnel through thickening of the synovial tissue that lines the tendons within the carpal tunnel [5].

The median nerve can usually move up to approximately 9.6 mm to allow the wrist to flexion, and to a lesser extent during extension. Long-term compression of the median nerve can inhibit nerve gliding, which may lead to injury and scarring. When scarring occurs, the nerve will adhere to the tissue around it and become locked into a fixed position, so that less movement is apparent [6]. The primary aim of the neural mobilization is a restoring the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces, thereby allowing reduced intrinsic pressures on the neural tissue and thus promoting optimum physiologic function [7]. Findings from previous studies support the use of traction/distraction manual therapy technique to decrease intra-articular pressure [8].

PURPOSE OF THE STUDY

The purpose of this study was to determine the effect of a manual therapy techniques (median nerve neural mobilization and wrist traction) on measures of pain and hand function in individuals with carpal tunnel syndrome. Hypothetically, individuals receiving a neural mobilization technique to stress the median nerve with wrist traction to decrease carpal tunnel pressure would demonstrate greater improvements in clinical pain and hand function, than those receiving only a neural technique.

MATERIAL AND METHODS

36 patients (46 hands being analyzed) of ages between 35-50 years with clinical and electrodiagnostic evidence of carpal tunnel syndrome were randomly assigned to one of the two physiotherapy intervention groups:

Group I (n=18, % females; mean age:): only median nerve neuromobilisation technique based on upper limb tension test (ULTT1) was performed.

Group II (n=18, % females; mean age:): median nerve neuromobilisation technique based on upper limb tension test (ULTT1). Additionally mid-carpal distraction using manual therapy technique were performed.

In patients with a two-handed CTS, clinical symptoms and efficacy of rehabilitation was evaluated in both hands, however, one of the hands was included to group I, second hand was undergoing to intervention assigned to the group II. All patients were also instructed to do self-mobilisation of the median nerve as home exercise. They were asked to place their hand flat on a wall with fingers pointing backwards, elbow stretched, and shoulder lowered (kept down by the other hand) and if possible flex the head away from the arm for approximately 20 seconds. This exercise were performed once a day.

The CTS for each patient was classified as one of three stages: mild, moderate, or severe. There were no differences between groups due to age, sex, time since CTS diagnosis. There was no evidence of muscle wasting or diminished grip strength in any of the patients. Criteria of exclusion included: presence of metabolic disorders (Diabetes mellitus, Thyroid disease), Rheumatoid Arthritis, cervical radiculopathy, pregnancy, peripheral neuropathy, and history of steroid injection to carpal tunnel.

Sequence for Median Nerve Neuromobilisation were as follows: shoulder depression and abduction (110º), wrist extension, supination, shoulder lateral rotation, elbow extension, neck lateral bending to opposite side. A technique includes 3 sets of 10 repetitions in each set, at a moderate pace and a 3 second hold at the final stretched position were utilized. In case of Mid-Carpal distraction, the stabilizing hand was placed over the styloid processes and the mobilizing hand was placed over the distal carpal row. Distraction was imparted using the mobilizing hand, maintained by 20 second and repeated 10 times.

Measures

Following questionnaires were used in this study:

1. Boston Carpal Tunnel Questionnaire (BCTQ) - is a self-applied measure that has been developed specifically for patients with CTS. It has two distinct scales, the Symptom Severity Scale

(SSS) which has 11 questions and uses a five-point rating scale and the Functional Status Scale (FSS) containing 8 items which have to be rated for degree of difficulty on a five-point scale. Each scale generates a final score (sum of individual scores divided by number of items) which ranges from 1 to 5, with a higher score indicating greater disability. In case of a patient with bilateral CTS, two questionnaires were applied, one for each hand [9,10].

2.The Disabilities of the Arm, Shoulder and Hand (DASH) - was developed by the American Academy of Orthopedic Surgeons as a region-specific instrument for measuring upper-extremity disability and symptoms. The main part of the DASH is a 30-item disability/symptom scale concerning the patient's health status. The items ask about the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item has 5 response choices, ranging from “no difficulty or no symptom” to “unable to perform activity or very severe symptom”, and is scored on a 1- to 5-point scale. The scores for all items are then used to calculate a scale score ranging from 0 (no disability) to 100 (severe disability). The score for the disability/symptom scale is called the DASH score [11].

3.Visual Analogue Scale (VAS) - originated from continuous visual analog scales developed in the field of psychology to measure well-being. It is often used in epidemiologic and clinical research to measure the intensity or frequency of various symptom such as pain intensity. The most simple VAS is a straight horizontal line of fixed length, usually 100 mm. The ends are defined as the extreme limits of the pain. A higher score indicates greater pain intensity [12].

Statistical analysis

Each subject was evaluated at the 0 day (baseline data) and on 21st day (after end of rehabilitation. Obtained data were analyzed using the Statistica StatSoft version 10.0. Comparisons between mean scores were conducted using the non-parametric Wilcoxon signed-rank test. In case of qualitative (binary) variables McNemar test were used. Statistical significance was set at $P<0,05$.

RESULTS

Clinical characteristics of both groups is presented in table 1. The data from the BCTQ, DASH and VAS scale measured before as well as after physiotherapy intervention were shown in table 2.

Table 1. Clinical characteristics of samples and level of differences between groups

Variables	Group I n=18	Group II n=18	Differences p value
Dominant hand: right left	 16 2	 17 1	 0,958
Total number of wrists	23	23	0,713
Duration of CTS in months (Mean±SD)	8,6±3,1	9,5±3,4	0,425
Work: manual labor menatl labor	 12 6	 13 5	 0,885
tingling	18	15	0,459
Morning stiffness	11	12	0,937
Weakness of sensation	10	10	1,000

Table 2. BCTQ, DASH and VAS: descriptive statistics and level of differences (p) before and after physiotherapy intervention

VARIABLES	Group I			Group II		
	x±SD		p	x±SD		p
	before	after		before	after	
BCTQ - FSS	3,1±0,8	1,6±0,5	**0,011***	3,0±0,9	1,4±0,6	**0,008***
BCTQ - SSS	3,0±0,7	1,6±0,5	**0,018***	2,8±0,7	1,3±0,5	**0,012***
DASH	46,4±14,7	35,5±13,2	**0,036***	45,9±14,1	33,4±13,0	**0,006***
VAS	4,2±1,5	1,3±0,5	**0,014***	4,4±1,1	1,0±0,7	**0,000***

Notes: BCTQ-FSS: Boston Carpal Tunnel Questionnaire Functional Severity Scale; **BCTQ-SSS**: Boston Carpal Tunnel Questionnaire Symptom Status Scale; ***statistically significant differences

As a last stage of analysis, efficacy of treatment was compare between groups due to presence of selected clinical symptoms of CTS. Results are presented in Table 3.

Table 3. Clinical symptoms: descriptive statistics and level of differences (p) before and after physiotherapy intervention

VARIABLES	Group I (n=18)			Group II (n=18)		
	Number of subjects		p	Number of subjects		p
	before	after		before	after	
positive Phalen test	23	6	**0,011***	23	4	**0,003***
tingling	18	5	**0,000***	15	3	**0,007***
morning stiffness	11	1	**0,000***	12	1	**0,000***
weakness of sensation	10	0	**0,000***	10	0	**0,000***

Notes: *statistically significant differences

In the next stage, patients in each group were divided into subgroups based on their severity of disease as follows: patients with only intermittent paraesthesias (CTS I degrees), with persistent numbness in the area supplied by the median nerve (CTS II degrees), and with paresis of the thenar muscles (CTS III degrees). Due to lack of subjects with III degree of CTS, this group was not took into account in further statistical analysis. Results are given in table 3 and table 4.

Table 4. Group I: BCTQ, DASH, VAS - efficacy of median nerve neuromobilziation due to severity of CTS. Mean (x), standard deviation (SD) and level of differences (p)

VARIABLES	CTS degree I (n=10)			CTS degree II (n=8)		
	x±SD		p	x±SD		p
	before	after		before	after	
BCTQ - FSS	2,7±0,9	1,5±0,5	**0,046***	3,2±0,8	1,8±0,5	**0,027***
BCTQ - SSS	2,6±0,7	1,4±0,6	**0,043***	3,1±0,9	1,7±0,6	**0,031***
DASH	45,2±14,3	34,2±12,6	**0,031***	47,8±15,0	37,3±13,4	**0,047***
VAS	3,9±1,2	0,8±0,3	**0,012***	4,4±1,3	1,5±0,8	**0,022***

Notes: BCTQ-FSS: Boston Carpal Tunnel Questionnaire Functional Severity Scale; **BCTQ-SSS**: Boston Carpal Tunnel Questionnaire Symptom Status Scale; ***statistically significant differences

Table 5. Group II: BCTQ, DASH, VAS - efficacy of median nerve neuromobilziation with mid-carpal distraction due to severity of CTS. Mean (x), standard deviation (SD) and level of differences (p)

VARIABLES	CTS degree I (n=9)			CTS degree II (n=9)		
	x±SD		p	x±SD		p
	before	after		before	after	
BCTQ - FSS	2,6±0,9	1,3±0,5	**0,040***	3,2±1,2	1,6±0,6	**0,025***
BCTQ - SSS	2,5±1,0	1,2±0,4	**0,041***	3,0±1,1	1,4±0,5	**0,009***
DASH	44,5±14,1	32,9±12,2	**0,024***	46,7±14,8	34,8±13,1	**0,011***
VAS	4,1±1,4	0,7±0,3	**0,003***	4,6±1,4	1,2±0,5	**0,002***

Notes: BCTQ-FSS: Boston Carpal Tunnel Questionnaire Functional Severity Scale; **BCTQ-SSS**: Boston Carpal Tunnel Questionnaire Symptom Status Scale; ***statistically significant differences

DISCUSSION

The goal of treatment for carpal tunnel syndrome is to allow to return to normal function and activities and to prevent nerve damage and loss of muscle strength in fingers and hand. There is a strong or moderate evidence on efficacy of local and oral steroids, splints, and NSAIDs as well as limited or conflicting evidence of diuretics and yoga [13]. Non-surgical managment includes also physiotherapy. However, due to a numerous of physiotherapeutic approach in treatment of CTS, comparision of results obtained between selected methods are needed. Futhermore, use of a new methods or/and combinations of existing methods should be also conducted in clinical studies.

The present study was designed to determine whether a clinical benefit of median nerve neural mobilization is greater when midcarpal bone distraction is also attached to physiotherapy intervention. Results of the study presented here demonstrate a substantial improvement effect of both methods seen across all outcome measures. Comparisons across groups suggest a slightly more benefit of neural mobilization, when the rehabilitation process is supplemented by mid-carpal bone distraction technique.

The data presented in table 2 showed a significant differences between pre-treatment and post-treatment values. In the Boston Questionnaire Symptom Severity Scale and Functional Status Scale obtained level of differences were similar in both groups. However, after three weeks of treatment in VAS score and DASH score, more improvement was seen in the group II

Given the severity of CTS efficacy of median nerve neural mobilization versus efficacy of median nerve neural mobilization with mid-carpal distraction in BCTQ-Functional Severity Scale were similar or quite slightly better in favor of the second group. Comparison between groups, in case of BCTQ-Symptom Status Scale, demonstrated better results in this subscale when mid-carpal bone distraction were applied. The same relationships were observed in VAS score and DASH score. However, should be pay attention to one important fact. In group II, better improvement were obtained in patients with more advanced clinical status of CTS. From other side, in group I in BCTQ questionnaire better results of treatment were noted in patients with II degree of CTS than with I degree, but significantly greater improvement in DASH scale and VAS scale was received in patients with less advanced symptom severity. This results suggest that It is likely that patients with second degree of CTS would be more benefitted on mid-carpal distraction to improve hand function than subjects in less advanced of symptoms, when single neural mobilization seems to effective.

This study have some limitations. First of all, in this study I have no patients with third degree of CTS and further studies should be extended to this group of patients. Secondly, the study should cover a larger population of patients. Despite this limitations, at this stage of research, it appears that mid-carpal dostraction may be important element of treatment of patients with advances symptoms of CTS.

CONCLUSIONS

It is concluded that the combination of these two techniques may be effective in the treatment of CTS, especially in second degree of CTS where patients have persistent numbness in the area supplied by the median nerve. However, further clinical studies are needed.

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