COMBINED METHODS OF PHYSIOTHERAPY IN CASE OF CARPAL TUNNEL SYNDROME

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ABSTRACT
Purpose: This study aims to compare the efficacy of two different physiotherapy methods for relieving the symptoms of carpal tunnel syndrome (CTS), to supplement already imposed methods, and to summarize a new methodology for prevention.
Relevance: Improving the overall physical condition of patients, combating a sedentary lifestyle, and training in the correct body position is the way to prevent the disease. Our study provides scientific evidence to justify the role of physiotherapy for the treatment and prevention of relapses in this condition. Subjects: The randomized controlled trial has been conducted since January 2016 in a private physiotherapy practice. A total of 111 patients with clinically confirmed idiopathic CTS were divided in two groups of treatment. Interventions consisted of 15 physiotherapy sessions for at least 10 weeks and with two different physiotherapy programs -Group A (68 patients) and Group B (42 others). Material and methods: Manual muscle stretching and relaxation techniques, joint mobilization therapy and active exercises, strengthening program, soft tissue mobilization therapy, and mobilization of the nervous system in the wrist, and forearm area were already part of their treatment program. When contingent and conducting tests for functional examination showed us the presence of Upper cross syndrome in over 75% of cases participants. Manual therapy on the "Manuthera" table and the combination of active training with Electro Muscle Stimulation to overcome muscle dysbalance. Results: Analysis of the results so far shows that the findings are empirical data difference is not random, so the methodology has a proven effect.
During the experiment, the experimental group realized statistically significant results related to the symptoms and complaints typical of the syndrome. Conclusion: The results showed great statistical significance in proving the effect from the conducted experimental methodology.

Keywords*: EMS Training, „Manuthera" treatment table, Upper Cross syndrome,*

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common nerve compression condition in the body, affecting one or more peripheral nerves and resulting in numbness or weakness in the affected area. On average, at least 3.8% of people who complain of pain, decreased fine motor skills, and an itchy feeling in their hands have CTS (Kozak, Schedlbauer, 2015).

Carpal tunnel syndrome is the most common disease associated with the compression of nerves in the upper extremities. The most common treatment for this condition is surgery at the base of the wrist, to release the compression (in the United States, 463,000 operations are performed per year). CTS accounts for the longest periods of absence from work due to health reasons. The post-operative recovery period lasts up to 2 months (Brotzman, 2000).
In the research conducted, we try to include patients of different ages with carpal tunnel syndrome to prove the efficacy of combining conservative methods of physiotherapy. Certainly, we have considered the individual condition and needs of each patient.

Here we combine some already proven methods in the complex treatment and rehabilitation of patients with carpal tunnel syndrome. We apply manual mobilizations of the spine, and techniques to improve the muscular imbalance of the back and strengthen the musculature of the body, driven by the objective to look at the initial onset of the disease from a different side. The goal is to apply all our knowledge and skills to build a complex methodology with the maximum effect of treatment and prevention.

Sedentary lifestyle and lack of motor activity, postural changes, and muscle imbalance lead fast to diseases of the musculoskeletal system, like Cervical syndrome, Impingement syndrome, Radiculopathies, Upper cross syndrome, Carpal tunnel syndrome, "Maus Hand" syndrome, etc. These are diseases that occur as a result of reduced joint mobility and limited range of motion. That is why we emphasized the use of manual therapy in combination with EMS training and physical exercises, in search of a solution to the problem.

Aim and objectives of the study

So far, the study covers a 6-year period (from January 2016 till today), 111 persons participated, diag-

nosed with carpal tunnel syndrome. Prior to proceeding with data collection, an information sheet detailing the research was provided to the participants and informed written consent, approved by the Department of Theory and Methods of Physiotherapy, NSA, Sofia, Bulgaria, was obtained from all the participants.

What was common for 89 of the 111 patients who took part in the study is that they already had a course of physical therapy treatment without a long-term result, after that an operative intervention was recommended, which the patients refused (Table 1). For fear of the operation and possible complications, the long recovery period, etc. The remaining 22 cases are in the post-operative period of treatment, with CTS symptoms, which are still present.

Table 1. *Characteristics of the patient` contingent*

	Control group/ 48 participants		**Experimental group / 63**	
Sex	man 19	woman 29	man 27	woman 36
Age (years)	≤ 40 20	≥40 28	≤40 22	≥ 40 41
Profession	on a desk 41	heavy physical work 7	on a desk 54	heavy physical work 9
Experience (years)	≤20 12	≥20 36	≤20 16	≥20 47
In able-bodied age	≤ 60 years old 37	≥ 60 years old 11	≤60 years old 59	≥60 years old 4
Disease stages	preoperative 38	postoperative 10	preoperative 51	postoperative 12
Onset of symptoms	overnight 30	during the day 27	overnight 38	during the day 39
Practicing sport	less than 2 times 44	more than 2 times 4	less than 2 times 56	more than 2 times 7

From Table 1 we can see that over 60% of the patients who took part in the study were women. More than 65% do not exercise or exercise less than twice a week. Most of the participants, namely about 63%, are over 40 years, with many years of professional experience, but still active in their profession. Only 15% of the participants are over 60 years and only 3% are over 70.

The etymology of CTS has not been clarified, but it is assumed that heavy physical work is the main reason for the onset of the disease. In our research, we found that the professions of the participants were different, but nearly 54% worked at a desk – in a sitting or standing position, but mostly static and in one place (teachers, musicians, working on a computer, hairdressers).

This distribution of the contingent and the conducted tests showed us the presence of Upper Cross Syndrome in more than 75% of the participants. That is the reason that we conducted treatment of the experimental group to improve muscle imbalance and postural control.

METHODS

In our research, we used a combination of many different treatments, but in the experimental methodology, we applied two methods, which have not been used in the treatment of CTS so far– EMS whole body training and manual therapy on the "Manuthera" treatment table.

The Electro-muscular stimulation of the whole body aims at of strengthening the weak muscles as quickly as possible, improving muscle balance and position. Our methodology is based on the negative influence of weak back muscles and incorrect body position during a large part of everyday life - during rest or travel in public transport, during work on a computer, or during telephone calls, etc. (Figures 1-3).





Figures 1, 2, 3. *An incorrect body position*

Muscular strength and optimal physical endurance play the most important role in the overall physical condition and correct body position. The deep stabilizers are those muscle groups that are difficult to be trained with conventional methods. Specific for the EMS training is the stimulation of the entire muscle system in the body, which in turn brings quick results in a shorter time, without the risk of muscle imbalance and one-sided loading, which often occurs in common fitness training. With proper execution of the EMS training, we manage to stimulate all muscle fibers at the same time. Through the so-called "random selection" of electrical stimulation, both muscle fibers (fast and slow) are stimulated. EMS training can be effectively combined with active movements, which additionally saves time for stretching and muscle development (Kemmler, Teschler, 2015). According to data from international studies, it is proven that in 83% of the participants back pain is significantly reduced. The frequency and duration of pain were found to be reduced by 80%. More than 40% of participants complained of persistent back pain at the start of the study. The number of people with complaints dropped to 9% after 6 weeks of training. The pain completely disappears in 44% of patients with chronic problems. The duration of typical back pain in daily life (lifting heavy loads, walking, bending, heavy physical work, sports, driving, or prolonged sitting) was reduced by 30% (Kemmler, Teschler, 2015).

The main problem that arises with the methodology carried out in the control group is precisely lack of time and persistence among the patients. Physiotherapy twice a week turns to be too short time for strengthening the muscles when the patients do not practice at home. This leads to loss of interest and lack of significant improvement in symptoms. This turned out to be the biggest problem in choosing the right methodology.

The proven effectiveness of the EMS device against back pain led us to test its effectiveness in combating upper cross syndrome by combining physical therapy exercises to affect muscle imbalances. As shown in Figure 4, we emphasized the importance of correct position of the head and neck during loading, isometric exercises, and mainly the use of light weights so as not to induce compensation. The emotional state is also positively affected, as well as motivation, which turned out to be a key factor for the overall therapy.

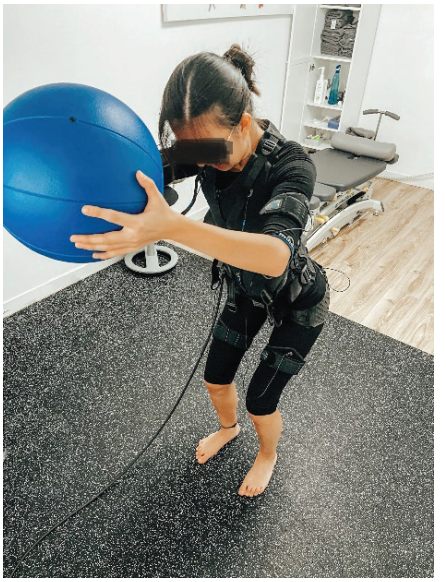

Figure 4. *EMS training*

The second treatment method that we used is *manual therapy on the „Manuthera" treatment table.* "Manuthera" treatment aims to relieve blocks in a joint, pinched nerve root, muscle, and tendon. Applying this innovative, extremely pleasant and safe method, releases tension in the tissue, improves blood circulation, thus reducing pain and increasing mobility and general functionality of the body. Due to the 3D functions, it is the first treatment table in the world of physiotherapy that allows easy access to the problem area even in an acute condition. In acute and subacute conditions, the excellent efficacy of "Manuthera" in combination with other physiotherapy methods, such as functional magnetic stimulation, Kinesio taping, and electrotherapy has been proven.





Figures 5, 6. *Thoracal flexion-extension mobilization on "Manuthera" treatment table*

With the help of the "Manutera" treatment table (Figure 5-6), we significantly improve the

quality of the treatment, because through the moving segments, we have the opportunity to reach the deep musculature and by using massage techniques and passive stretching, we influence the affected musculature extremely quickly. It results in deep manual mobilization of the cervical and thoracic vertebrae which influences and releases the nerve roots. Techniques from the lying position are used to start the procedure by gently massaging the neck and neck muscles to warm up the muscles and preparation for the manual mobilizations.

Mobilizations include neck traction and lateral flexion from a light traction position. After that, mobilizations are performed in the laying on the back position, in the head rotation direction, passive stretching of supraspinatus and trapezius muscles, and neck flexion with active assisted nodding motion.

Then we worked on the lateral inclinations of the body in the thoracal area. It is important that patients are as relaxed as possible, which makes the procedure much more effective. After performing the manual mobilizations of the cervical part and the lateral inclinations in the thoracal part of the spine, we proceed to the movement in the flexion and extension direction of the thoracal part. We have to support and push caudally the spinous process (Figures 5-6) Mobilization in the direction of extension of the spine is extremely important because it relaxes the tension between the vertebrae, prepares the thoracal part for the correct execution of exercises, improves the range of motion and performs deep stretching of the muscles.

RESULTS

The analysis of the results so far shows that the empirically determined difference is not accidental and that the conducted methodology has a proven effect.

During the study, *the experimental group* realized statistically significant results related to the symptoms and complaints typical of carpal tunnel syndrome:

- Dynamometry – an average increase of 1.24 kg or 3.86%, which is statistically significant (t_{temp}=7,20 > $t_{0,05}$=2,00).
- Pain improvement by 2.38 or 64.85% points, which result is also statistically significant (t_{temp} = 10,99 > $t_{0,05}$=2,00).
- Motor activity – an improvement of 1.38 points or 19.03%, (t_{temp} = 10,72 > $t_{0,05}$ = 2,00).
- Boston Carpal Tunnel Syndrome Questionnaire (BSTQ) – shows an improvement of 15.61 points or 32.80% (t_{temp} = 11,23 > $t_{0,05}$ = 2,00).

For the control group, we used standard methods of physiotherapy with an already proven effect to influence the symptoms, which also shows positive results. Dynamometry shows an average increase of 0,79 kg and the pain improvement is 1,29 or 33, 51% which is also a statistically significant result and proves the positive influence of physiotherapy. The conducted scientific research and the systematization, processing, and comparing of the results between the control and experimental group showed great statistical significance in proving the effectiveness of the conducted experimental methodology. Looking at the problem from another point of view, it turned out that, with the development of the technical side of business and industry, it leads to negative consequences. That is why it is necessary to simultaneously maintain and develop the mobility and the physical condition of the body for the prevention of various diseases, which can also include Carpal Tunnel Syndrome.

DISCUSSION

To look for new methods, a combination of methods and development of the knowledge is our aim. That is why we tried a new way to see the CTS, to understand why more and more people have the problem and to try to find a treatment and prevention. The combination of innovative methods and our aim to see the body as a whole system, pushed us to look for new ideas. This study is the first one to examine the psychological effects of EMS training in combination with manual therapy to improve Upper cross syndrome, followed by an improvement in CTS.

In their publication, Heena, Pratik, and Waquar (2022) state that several studies have found a high prevalence of upper cross syndrome in a symptomatic population such as students, desk job workers, dentists, laundry workers, etc. However, upper cross syndrome occurs due to assuming static posture for a prolonged period and can lead to symptoms such as chronic cervical pain, headache and in long term, it can also result in degenerative changes in the cervical spine. Thus, it is very important to look for signs of Upper cross syndrome (Heena, Patrik, 2022). Another cross-sectional overview which includes 244 physiotherapy undergraduates was done for determining occurrence plus risk factors in the development of the upper cross syndrome. There were 57 participants who were having pain in the neck in the passive range of motion during flexion and 187 were not having neck pain. There were 60 participants having thoracic pain during active range of motion during flexion and 184 had no thoracic pain in active range of motion during flexion (Deshmukh, Phansopkar, 2020). One publication presented Namita, Pratik (2021) a study where 30% of the participants with neck pain, rounded shoulder

and flexion posture with a considerable amount of pain over the thoracic area are mainly prone to UCS.

All that information brings us to combinate innovative methods and try to see a new point of view when we work with CTS. More than 75% of the participants in our study have the upper cross syndrome. We aim at treating the bigger problem zone and trying to prevent an eventual compression of nerve or instability in the neck. After several procedures, we received positive feedback and a weakening of the symptoms of the CTS.

A publication by Harvey, Bradley, and Aronica from 1992 examined the psychological effects of functional EMS in patients with spinal cord injuries. The functional EMS served to train the mobility and function of muscles atrophied because of spinal cord injury. In addition to the improvement of physiological parameters, a possible psychological benefit in spinal cord patients was discussed in the study (Harvey, Bradley, 1992).

Compared to standard resistance training, EMS has the advantage of being more time efficient. Kemmler have shown that EMS training is an effective, time-saving form of strength training that, when performed regularly, can achieve comparable results to conventional strength training (Kemmler, Teschler, 2016a).

All the studies analyzed reported a statistically significant improvement in the variables of pain and cervical disability index in the manual therapy intervention group, regardless of the protocol and the manual therapy technique applied. The manual therapy techniques of choice were divided among cervical manipulations, thoracic manipulations, cervical mobilization towards the intervertebral foramen opening, cervical traction, and neural mobilizations. The techniques with the best results were those whose objective was to increase the intervertebral foramen area by transverse mobilizations in the indicated segments. These techniques had been applied with positive results in 4 of the studies (Ojoawo, Olabode, 2018; Prabhkar, 2011; Shafique, Ahmad, 2019).

The classified information and our research show us the new opportunity to combinate methods and knowledge to reach the goal of prevention and therapy of the CTS.

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