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PHYSICAL THERAPY IMPLICATIONS IN THE REHABILITATION OF NERVE COMPRESSION SYNDROME PATIENTS

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Abstract: *Nerve compression syndromes are medical conditions caused by direct pressure on a nerve; they manifest clinically through symptoms such as pain, diminished muscle strength, and paresthesias. Carpal tunnel syndrome is one of the most frequently encountered neuropathies nowadays, being also the most studied neuropathy of the hand because of is high prevalence, high social, medical, and economic costs. This paper presents a physical therapy intervention protocol for the rehabilitation of patients with nerve compression syndrome. The author also thinks that a treatment of this type is necessary for reestablishing the lost functions of the hand, especially the distal segment, but also for the socio-professional integration of the patient.*

Keywords: *rehabilitation, nerve compression syndrome.*

1. Introduction

The hand can be considered a cortical organ, because the manual act actually translates a mental act into its manual expression. The hand can perform the most complex human motor acts. A motor deficit in the hand affects very much the performance of daily tasks. Considering that the upper limb, and especially the hand, is important for both the anatomical complexity of the individuals and their full social integration, any incident perturbing its functionality must be taken very seriously.

Nerve compression syndromes are medical conditions caused by direct pressure on a nerve; they manifest clinically through symptoms such as pain, diminished muscle strength, and paresthesias. Carpal tunnel syndrome is one of the most frequently encountered neuropathies nowadays, being also the most studied neuropathy of the hand because of is high prevalence, high social, medical, and economic costs.

The evolution stages of the nerve compression syndromes are determined by the diagnosis of the carpal tunnel syndrome as described by Dembe. In

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1833, Ormerond gave a clinical description of a patient performing manual labor, who complained of nocturnal pains and digital paresthesias. In 1876, E. Onimus described three cases in laborers of what he called *professional muscular atrophy*. Later, in 1880, J. Putman, and in 1893, L. Hirt, reported multiple cases of a disorder called night paralysis *angioneurosis*, more prevalent in women. In 1911, R. Hunt described professional paralysis as being caused by motions repeated in one's workplace, and B. Brouwer, in 1920, called the disorder the *median nerve neuritis* of manual laborers (Dembe, A.E., 1997, as cited in S. Ursu, 2017, p. 18).

In 1861, the French urologist F. Guyon described for the first time the passage of the ulnar nerve in the fist. A detailed description was given in 1908 by Hunt, while Du Pont proposed for the first time in 1965 the term of *ulnar tunnel syndrome*. In 1969 Shea and McLain, and later in 1985, Gross and Gelberman have described three types of compression of the ulnar nerve in Guyon's canal (Bachoura, A.E., Jacoby, S.M., Chen, S.H., et al., as cited in Ursu, S., 2017, p. 19).

Recent studies show that the highest incidence of carpal tunnel syndrome is among middle age and older women. The prevalence in the general population is in the middle age individuals (30-60 years old) - 0.6% in men and 5.8% in women, this percentage being increased up to 10% according to the occupation, area and socio-economic development. The predominant patients are women between the age of 45 and 64, with a ratio of 3:1 up to 10:1. The prevalence of Guyon's canal syndrome (also called ulnar tunnel syndrome) is currently unclear, being mentioned by most authors of case studies [5].

2. Objectives, Causes, and Hypothesis

The purpose of this paper is to study the ulnar and carpal tunnel syndromes, as well as the sequelae they cause in regard to the functionality of the hand. This spawns an important objective - the emphasis of the role played by physical therapy in the rehabilitation of these disorders through specific means.

The research tasks consisted in highlighting the role played by physical therapy in the rehabilitation of an ulnar and carpal tunnel syndrome patient through the use of specific physical therapy means.

In the case of an ulnar and carpal tunnel syndrome, the adjacent structures suffer during the production mechanism and during the surgery. The articular system and muscles go through a degradation process - the mobility is lost, the strength, stability and integrity of the limb are affected.

Taking into account all of these aspects, the author believes that physical therapy is necessary, considering its effectiveness and the benefits that it can bring to the improvement of the functionality in the injured limb. Thus, the following hypothesis was elaborated:

- *presumably, by following a physical therapy intervention program, one can help rebuild the functionality of the hand after an operated ulnar or carpal tunnel syndrome.*

3. Materials and Methods

The research was conducted on a 52 year-old male patient with the clinical diagnosis of ulnar and carpal tunnel syndrome in his left hand.

The first step one must take in order to centralize the gathered data and information is to measure the various parameters. By measuring one understands the process consisting in getting a description, often numerical, of the degree in which an object, an individual, or a group possesses a certain characteristic [1].

The assessment of the subject consisted of:

- **anamnesis**, getting information directly from the subject in regard to the history of the disorder, general clinical symptoms.
- **inspection and palpation** - through the inspection of both sides of the hand, the examiner checked for bumps, muscle hypotrophy, skin changes. Palpation has revealed also changes in the local temperature, the consistency of certain bumps and certain modifications in the patient's sensitivity.
- **pain assessment** - was done with the help of the Visual Analogue Scale (VAS), which consists of a 10 cm horizontal line that the patient cuts with a vertical line (between 0-10) where he thinks the degree of pain is at that moment.
- **sensitivity assessment** in the distal segment was done using sensitivity tests (pain, tactile, thermal).
- **range of motion** in the left fist joints and in the metacarpophalangeal joints (MCP), using a goniometer.
- **muscle strength** assessment is relatively subjective, consisting in the patient performing a motion against the examiner's resistance, who evaluates the patient's strength according to the resistance level.
- **thumb assessment** was done by asking the patient oppose his thumb according to the specific functional scale, from 0 to 8.
- The functional evaluation consisted in the application of a functional test - the **Michigan Questionnaire** (based on Balint T., Cruceanu I., Moise A., 2007).

In order to get the aimed results, the author established the following specific physical therapy means and objectives:

1. Diminishing the pain – hand relaxing massage [3], antalgic postures, physiotherapy (http://www.csid.ro/boli-afectiuni/neurologie/sindromul-de-tunel-carpian-12801542/)

- Rebuilding the sensitivity - ice massage, ice stimulation, pressures;
- Improving the joint mobility in the fist joints, the metacarpophalangeal joints (MCP), inter-phalangeal joints and thumb joints - postures, stretching, passive mobilizations, self-passive mobilizations, free active motions with objects, facilitation techniques (rhythmic initiation, rhythmic rotations, slow reversal, slow reversal hold, hold-relax) [4].
- Increasing the flexor muscle strength in the fist and hand - isometric and isotonic contractions, facilitation techniques, prehension exercises, exercises with objects;
- Improving the manual dexterity and coordination, muscle balance - facilitation techniques (alternating isometrics, rhythmic stabilization, resisted progression, exercises with objects);
- Socio-professional re-insertion.

4. Results

Various assessments were conducted over the course of the research, in order to present the subject's progress.

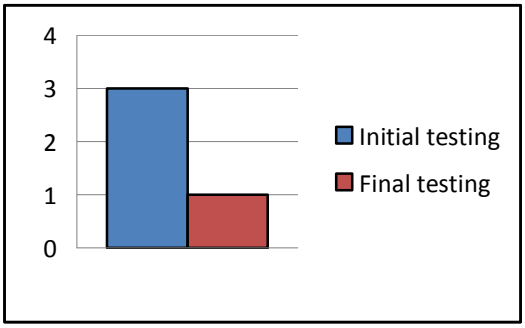

Fig. 1. *Dynamics of pain according to the VAS*

Figure 1 presents the progress of the pain in the distal segment, from the initial to the final testing.

Assessment test for the distal segment sensitivity Table 1

Types of sensitivity	Pain	Tactile	Thermal
Initial testing	hypoesthesia	hypoesthesia	hypoesthesia
Final testing	normal	normal	normal

Table 1 shows the progress of the pain in the distal segment, from the initial to the final tests.

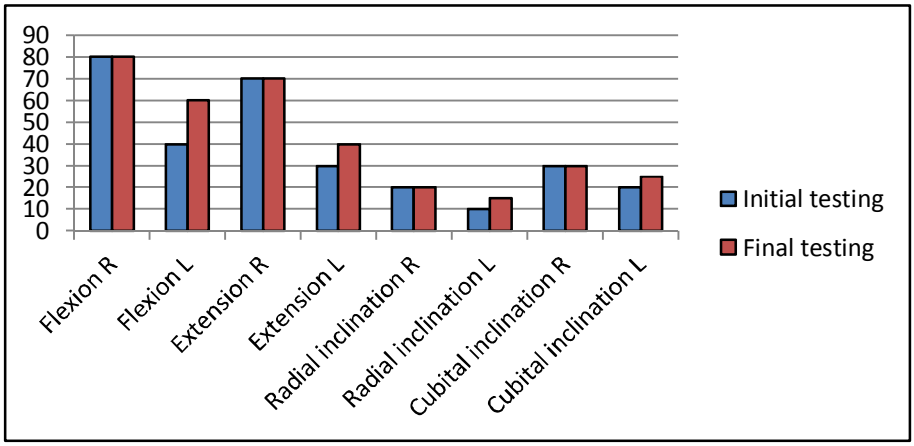

Fig. 2. *Dynamics of range of motion for the fist joint*

Figure 2 shows the progress of the range of motion in the fist joint, through flexion, extension, radial and cubital inclination.

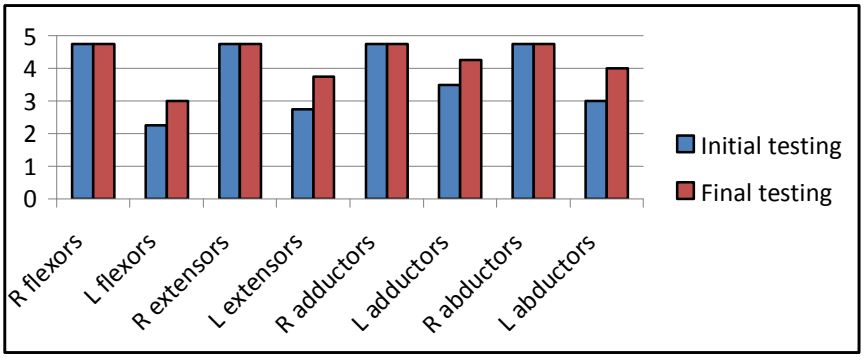

Fig. 3. *Dynamics of muscle strength of the fist*

Figure 3 shows the progress of muscle strength in the flexor, extensor, adductor and abductor muscles of the fist, from the initial to the final testing.

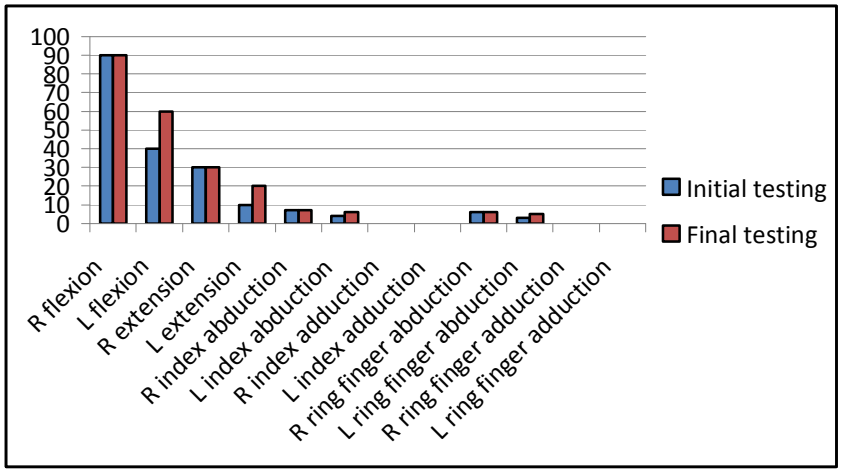

Fig. 4. *Dynamics of range of motion for the MCP joint*

Figure 4 shows the progress of the range of motion in the MCP joint during the flexion, extension, abduction and adduction movements of the index, abduction and adduction of the ring finger, from the initial to the final testing.

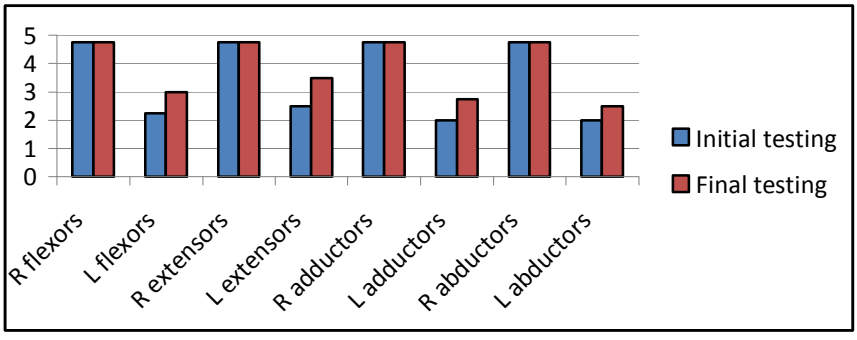

Fig. 5. *Dynamics of muscle strength in the MCP joint*

Figure 5 shows the progress of muscle strength in the flexor, extensor, adductor and abductor muscles in the MCP joint, from the initial to the final testing.

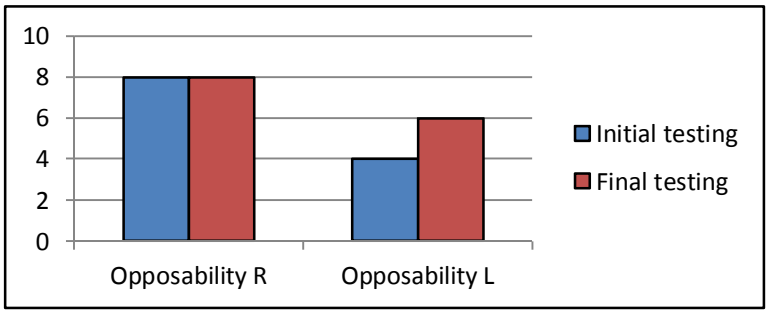

Fig. 6. *Dynamics of the thumb opposability*

Figure 6 shows the progress of the thumb opposability, from the initial to the final testing.

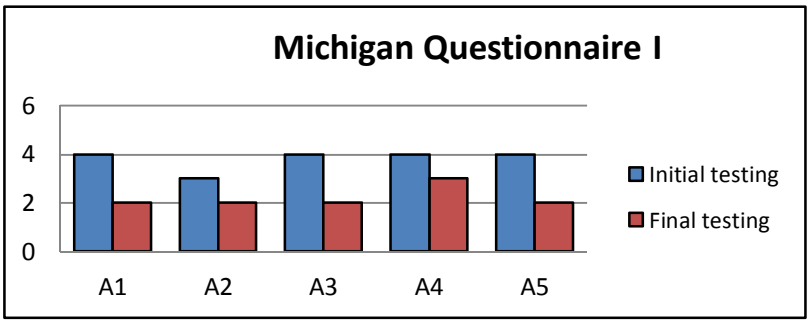

Fig. 7. *Dynamics of the functional test*

Figure 7 shows the progress of the functionality in the left hand, according to the Michigan questionnaire.

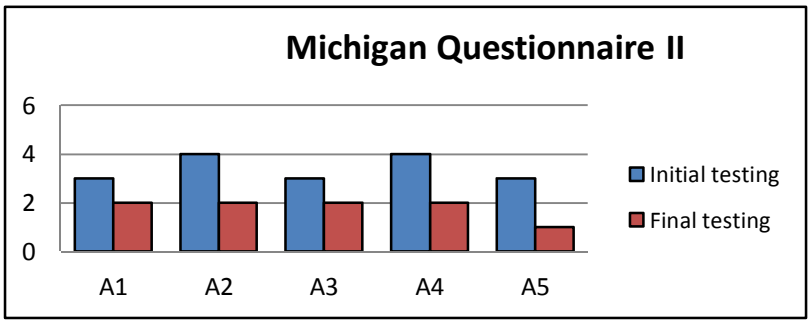

Fig. 8. *Dynamics of the functional test*

Figure 8 shows the progress of the left hand's dexterity in performing various tasks.

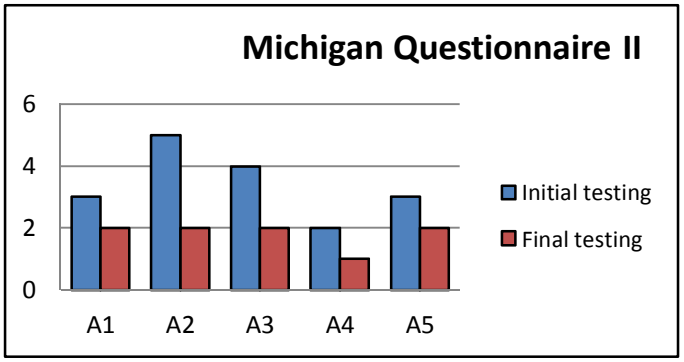

Fig. 9. *Dynamics of the functional test*

Figure 9 shows the progress of both hands' dexterity in performing various tasks.

5. Discussions

Based on the assessments conducted before and after the rehabilitation program, the results were interpreted as follows:

As shown in figure 1, the pain in the distal segment was diminished from 3 to 1.

As shown in table 1, in regard to the sensitivity of the distal segment, there was a progress of the pain, tactile and thermal sensitivity, from the initial to the final tests.

As shown in figure 2, there was a positive progress of the range of motion in the injured fist, through flexion, extension, radial and cubital inclination motions, from initial results of 40^0, 30^0, 10^0, 20^0 to final ones of 60^0, 40^0, 15^0 and 25^0.

Figure 3 shows the progress of strength in the injured fist, which initially was for the flexors F2+, extensors F3-, adductors F3++, abductors F3, and finally, for the flexors F3, extensors F4-, adductors F4+, abductors F4.

As shown in figure 4, there was a positive progress of the range of motion in the MCP joint, through flexion and extension motions, from initial results of 40^0, 10^0 to final ones of 60^0, 20^0, through index finger and ring finger abduction motions, from initial results of 4 cm and 3 cm to final ones of 6 cm and 5 cm.

Figure 5 shows a positive progress of muscle strength for the flexors, extensors, adductors and abductors in the MCP joint, from initial results of F2+, F3--, F2, F2 to final ones of F3, F4--, F3-, F3--.

As shown in figure 6, there was a progress in the thumb opposability, from an initial result of 4 to a final one of 6.

Figure 7 presents the progress of the functionality in the left hand, from the initial to the final testing.

Figure 8 presents the progress of the dexterity in the left hand in performing various tasks, from the initial to the final testing.

Figure 9 presents the progress of the dexterity in both hands in performing various tasks, from the initial to the final testing.

6. Conclusions

At the end of the physical therapy intervention and based on the recorded results, the following conclusions can be drawn:

The physical therapy means used in the subject's functional rehabilitation of his hand proved to be effective and optimal.

In regard to the hypothesis, it can be noted that indeed, by following a physical therapy intervention program, one can help rebuild the functionality of the hand after an operated ulnar or carpal tunnel syndrome.

The following points were observed:

- the pain diminished within 2 weeks;
- the mobility had a favorable progress, but it still does not allow the normal range of range of motion for the injured limb;
- the muscle strength was improved, but it is still below F5 for all of the hands' muscle groups;
- the fine and gross prehension is still damaged;
- the daily life activities are performed with difficulty, the patient needing help for certain actions.

The role played by the physical therapy intervention in the functional rehabilitation of the injured hand becomes primordial, because as a result of these injuries, the adjacent structures were also damaged, the articular and muscular systems went through a degradation process, and the mobility and strength were lost.

In this sense, the hypothesis has been confirmed, and also the role played by physical therapy in the rehabilitation of the nerve compression syndrome patients was highlighted.

It is fundamental for this kind of treatment to be started early on, in order to increase the patient's quality of life and for a better socio-professional reinsertion.

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