

**MINISTRY OF EDUCATION
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Abstract of the doctoral thesis:

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Title of the thesis: *Contributions regarding evaluation and functional recovery in cerebral palsy in children with chronological age 0-4 years*

Keywords: *infantile cerebral palsy, evaluation, functional recovery, DinaCord*

Introduction

Upper motor neuron injury is any injury to motor neurons located in layers III, V and VI of the cerebral cortex; they continue to the level of the motor nuclei of the cranial nerves and to the anterior horns of the spinal cord through the axons that synapse with the peripheral motor neurons. The set of symptoms that define central motor neuron injury is called central motor neuron syndrome (cmns). the etiology is varied and involves strokes, myelitis, spinal cord and brain tumors, or trauma.

In children, it is influenced by prenatal, perinatal, and postnatal factors, including premature birth, intrauterine infections, poisoning, asphyxia or other complications during birth, brain trauma, meningitis, and cardiorespiratory arrest. Usually, the initial symptomatology involves the flaccid state of the affected muscles, later this evolves into a spasmodic state, with exaggerated reflexes, decreased muscle strength and contracture.

Cerebral palsy is the most common type of upper motor neuron injury and the most common cause of disability in children. Depending on the form of paralysis and severity, cerebral palsy is classified into hemiplegia (affecting a single hemibody), diplegia (affecting the 4 limbs, prevalent in the lower limbs) and tetraplegia (affecting the 4 limbs, prevalent in the upper limbs).

Motivation and purpose

I chose as a theme the complex medical recovery treatment after upper motor neuron injury at chronological age 0-4 years and motor age 0-2 years because cerebral palsy, the most common type of central motor neuron injury, is the most common cause of disability at children. The diagnosis and the application of an early physical therapy program in the case of upper motor neuron are necessary in the formation of neuromuscular relationships and the recovery of motor deficiencies.

Following more than 10 years of activity in the field of neurological and orthopedic medical recovery of children aged 0-18 years, this work represents a natural step in personal evolution.

Theoretical, methodological and operational framework of the research

The research undertaken in this thesis was achieved under the aegis of the National University of Physical Education and Sports in Bucharest, within the Doctoral School. The thesis was structured in three parts.

The theoretical background

There are a wide variety of programs and approaches to upper motor neuron syndrome worldwide, but there are still difficulties in anticipating the results, the continuity during and after treatment of adapted physical exercises, as well as the efficiency of an individual's functionality in relation to their own motor possibilities.

In the majority of studies that refer to the medical recovery of patients diagnosed with upper motor neuron syndrome, various methods and strategies for addressing the symptomatology are described over a period of at least 3 months.

The strong recommendations by specialists for affected components after a upper motor neuron syndrome diagnose are related to motor functionality and cognitive development.

All the studies concluded that it is necessary for therapeutic intervention to begin at the first signs of cerebral palsy or immediately after the child is diagnosed to benefit from the greatest degree of plasticity of the neuromotor system.

Conclusions

Cerebral palsy, the most common type of central motor neuron injury, is the most common cause of disability in children. The incidence at the national level is between 2 - 2.5 per 1000 births, and at the international level it is between 1.5 - 4 cases per 1000 births.

Annual medical costs for treating children with cerebral palsy are at least 1000% higher than for children without cerebral palsy (16721 \$ compared to 1674 \$). For children who are also diagnosed with mental retardation, costs are 2600% higher than for children without cerebral palsy (43338 \$ compared to 1674 \$).

The GMFM-66 scale, most frequently applied at the national and international level, is limited to the assessment of subjects from a motor point of view.

Part II of the thesis

The purpose of the research

The specific premises of the preliminary research led us to the purpose of this research, namely to test the instruments of the complex assessment scale proposed DinaCord by comparison with the classical neuromotor assessment scale GMFM-66 recognized and used at national and international level.

The objectives of preliminary research

- Identifying the limits of the classic GMFM-66 neuromotor assessment in the case of children with chronological age 0-4 years and motor age 0-2 years with cerebral palsy and trying to improve it by developing a more effective assessment scale.
- The development of an effective original complex evaluation scale that objectively goes through the complexity of the diagnosis of cerebral palsy at the chronological age of 0-4 years and the motor age of 0-2 years.
- Obtaining conclusive data to demonstrate the effectiveness of the neuromotor assessment, especially regarding the specificity of age and the predictability of symptoms.

Hypothesis of preliminary research

The original DinaCord complex assessment scale is able to establish more precisely the level of somato-functional development of the child with cerebral palsy (at chronological age 0-4 years), compared to the GMFM-66 scale used in this pathology.

We note that the GMFM-66 scale is the most widely used assessment scale for children with cerebral palsy at the national and international level.

Subjects, place and duration of preliminary research

The preliminary research was carried out in the Regina Maria Cotroceni and Floreasca Medical Clinics, in the Pediatric Physiotherapy Department. The case report of central motor neuron injury was evaluated and treated kinetically in both locations.

Between October 2017 and May 2019, we constituted a group of 20 subjects based on the informed consent of the parent or guardian. The selection of participants for the preliminary research was carried out following a somatic, motor and myofascial and osteoarticular mobility assessment to appreciate the level of impairment and the motor capacity of the subjects.

Subject inclusion criteria were as follows:

- diagnosis of upper motor neuron lesion (infantile cerebral palsy);
- motor age of 0-2 years;
- chronological age of 0-4 years;
- parent or guardian compliance;
- subjects below and above the 20th percentile of physical growth and development;
- similarities of the clinical picture.

Subjects' exclusion criteria were as follows:

- diagnosis that excludes central motor neuron injury;
- motor age > 2 years;
- chronological age > 4 years;
- lack of parent or guardian compliance.

Preliminary research conclusions

- Through the DinaCord evaluation method, we detected increased potential for performing some motor actions.
- The DinaCord rating scale is more complex than the GMFM-66 rating scale. Although both have a similar structure of the motor test scoring system, the DinaCord scale additionally contains:
 - 2 evaluation methods - myofascial and osteoarticular mobility;
 - somatic.

- 2 parameters - the percentage score that represents the ratio between the total score obtained in the 48 motor tests performed by subject and the maximum possible score;
- motor age which is expressed according to the value of the total score obtained.
- The GMFM-66 scale applies to subjects with upper motor neuron syndrome with a chronological age of 0-18 years, without considering motor age. The DinaCord scale is a specific and complex scale that also applies to children with upper motor neuron syndrome, with a motor age of 0-2 years and with maximum fidelity for the chronological age of 0-4 years.
- The complexity of the DinaCord scale requires the creation of a recovery program whose effects can be monitored based on the complex assessment (motor, myofascial and osteoarticular mobility and somatic assessment) and the evolution of the total score, the motor age and the percentage of motor development, which captures aspects limited to the chronological age of 0-4 years, which for practitioners ensures a faithful monitoring of the evolution under the applied therapy.
- The obtained results confirm the hypothesis of the preliminary research, namely that the original DinaCord complex assessment scale is able to establish more precisely the level of somato-functional development of the child with cerebral palsy (at chronological age 0-4 years), compared to the GMFM scale- 66 used in this pathology and highlights the fact that the rating scale proposed by us represents a viable alternative to the classic GMFM-66 rating scale.

Part III of the thesis

Purpose of basic research

The research carried out is of an applied type, its purpose being to determine:

- the formation of the motor scheme, which reduces the gap between chronological and motor age;
- improving soft tissue tension;
- maximizing motor functionality.

Research hypotheses

An original program of functional education/re-education, consisting of active physical exercises at a higher level than the detected motor level, preceded by the application of some myofascial relaxations and the improvement of intra-articular tensions, can lead to the acceleration of the neuromotor development process in children with cerebral palsy.

Subjects, place and duration of research

The research was carried out in the Regina Maria Cotroceni and Floreasca Medical Clinics, in the pediatric physiotherapy department, Recumed Medical Center and in the Psihologoland Center. Case reports of central motor neuron injury were evaluated and treated kinetically in all locations.

Between October 2017 and February 2021, we constituted a group of 51 subjects based on the informed consent of the parent or guardian. The selection of research participants was carried out following a functional, myofascial and osteoarticular evaluation to assess the level of impairment and motor capacity of the subjects.

Subject inclusion criteria were as follows:

- diagnosis of central motor neuron injury consisting of infantile cerebral palsy;
- motor age of 0-2 years;
- chronological age of 0-4 years;
- parent or guardian compliance;
- subjects below and above the 20th percentile of physical growth and development;
- similarities of the clinical picture.

Subjects' exclusion criteria were as follows:

- diagnosis that excludes central motor neuron injury;
- motor age > 2 years;
- chronological age > 4 years;
- lack of parent or guardian compliance.

They were divided into two groups:

- experimental group - 31 subjects;
- control group - 20 subjects.

Research results

We used active physical exercises of a higher level than the motor level evaluated through an original sheet, designed by us, developed from the review of the specialized literature and from our own experience. We found that in the case of children with upper motor neuron syndrome, the application of exercises in accordance with the motor level induces the improvement of motor deficits by increasing muscle control, inhibiting spastic muscles and reducing the difference between chronological and motor age.

We found that the level of neuromotor development is higher after the proposed recovery program in which we included active physical exercise, myofascial relaxations and the improvement of intra-articular tensions.

Conclusions drawn from the research

- The analysis of the processed data in the case of the percentage score obtained between the initial and final assessments shows a superior efficiency of the DinaCord functional program (the difference in the value of the percentage score obtained between the initial and final assessments is 21.1) compared to the classic program for stimulating neuromotor development (the difference of the percentage score obtained between the initial and final evaluations is 7.9).
- The experimental group obtained a functional level with a higher value as a result of the application of the original DinaCord treatment method (the difference in the value of the total score obtained between the initial and final evaluations is 51), compared to the control group (the difference in the value of the score the total obtained between the initial and final evaluations is 19.1), where the classic method of stimulating neuromotor development was applied. The quantification tool was the DinaCord rating scale. Thus, we conclude that the DinaCord program, as a functional recovery method in which myofascial manipulations and intra-articular tension relief are applied, is more effective than the classical methods proposed.
- Through the DinaCord evaluation method, we detected increased potential for performing some motor actions. Through groping, we implemented physical exercises with a higher difficulty coefficient compared to the detected motor age.
- In the evaluation of motor activity of walking type specific to the age of 1-2 years, 7 subjects partially recovered, and 5 subjects fully recovered in the experimental group, and 4 subjects partially recovered and no subject fully recovered in the control group. The DinaCord recovery program, having among the specific elements the techniques of myofascial manipulation and the improvement of intra-articular tensions, which increase the amplitude of movements and facilitate muscle coordination by potentiating active functional recovery, is significantly more effective compared to the classic methods of stimulating the development of neuromuscular development.
- The application of the t-test on the total score values obtained within the experimental group demonstrates a statistically significant difference in the neuromotor evolution between the initial assessment (mean = 88.45) and the final one (mean = 139.42). The probability threshold has the value <0.001 , so the null hypothesis is rejected.
- Applying the t-test to the percentage score values within the experimental group demonstrates a statistically significant difference in the prediction of motor progress between the initial assessment (mean = 36.42) and the final assessment (mean 57.58). The probability threshold has the value <0.0001 , so the null hypothesis is rejected.

- The results of the Wilcoxon test applied to the total score values in the control group demonstrate a statistically significant difference between the initial assessment (mean = 84.4) and the final assessment (mean = 103.5). The size of the effect is very large ($r = 0.87$) and the probability threshold is <0.01 , so the null hypothesis is rejected.
- The results of the Wilcoxon test applied to the percentage score values within the control group demonstrate a statistically significant difference between the initial assessment (mean = 34.7) and the final assessment (mean = 42.7). The size of the effect is very large ($r = 0.87$) and the probability threshold is <0.001 , so the null hypothesis is rejected.
- The application of the intergroup t-test on the values of the final total score demonstrates a statistically significant difference between the motor evolutions of the subjects of both groups. The probability threshold value ($p = 0.008$) rejects the null hypothesis. Thus, the DinaCord method is superior to classic recovery methods in terms of the recovered motor level and the required recovery period.
- The results confirm the hypothesis of the actual research, namely that an original program of functional education/re-education, consisting of active physical exercises at a higher level than the detected motor level, preceded by the application of some myofascial relaxation and the improvement of intra-articular tensions, can lead to accelerating the process of neuromotor development in children with cerebral palsy, and highlights the fact that the original program proposed by us is a viable alternative to the classic recovery program.