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**CLINICAL AND FUNCTIONAL ASPECTS OF EVALUATION AND
REHABILITATION OF SPASTIC UPPER LIMB IN CHILDREN WITH
INFANTILE CEREBRAL PALSY**

ABSTRACT

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INTRODUCTION

From all the neuro-motor disabilities in children, those generated by infantile cerebral palsy (ICP) are the most frequent and difficult. In the field of neuromuscular rehabilitation, a growing concern regarding children with ICP was noticed in last years in famous rehabilitation schools from different countries.

As a consequence of studying specialized literature worldwide we found relevant to align and standardize the clinical and functional assessment methodology, the methodology of complex rehabilitation and evaluation of the therapeutic results in children with ICP in Romania.

Infantile cerebral palsies are represented by a heterogeneous group of stable and non-progressive motor and posture permanent disorders that determine activity limitations and occur during the fetal or infant brain development.

Besides motor disorders, ICP is also characterized by sensory, perception, cognitive, communication and behaviour disorders, as well as epilepsy and secondary musculoskeletal impairments.

Although the lesion is static (is not progressing in time) the dysfunctions resulting from the muscle imbalance, combined with the secondary characteristics of cerebral palsy, may contribute to worsening the child's disability as he grows.

Cerebral palsy affects variably the upper limb's fine and gross motor functions. The result is reflected on neuromotor development, especially on voluntary mobility, as well as motor learning processes, based on lack of experience.

Deformation of the upper limb in cerebral palsy is the result of the imbalance between spastic and paretic muscles, often acting on unstable joints. Neurologic injury will slow the typical movement patterns, mostly as a result of asymmetrical positions and limited movement amplitude.

The present thesis," Clinical and functional aspects in evaluating and rehabilitation of spastic upper limb in children with infantile cerebral palsy" contains 165 pages: 50 pages of general aspects and 115 pages representing the personal contribution.

The importance of this issue arises from the need for ways of assessing upper limb functionality, in order to ensure and monitor the changes, as well as evaluating the performance especially during or after a rehabilitation treatment. Although setting

objectives is different from one case to another, our final aim is obtaining an optimum functionality and independence for most of the daily actions.

The first part of the thesis, divided into four chapters, makes a review of the current data in epidemiology, classification, spastic upper limb specific deformations management, focusing on electric stimulation as an attractive way to rehabilitation in children with ICP.

The second part of the thesis - personal contributions - represents more than two thirds of the thesis and contains 41 tables and 26 figures.

Given the diversity of the studied parameters and for providing an overview of the clinical, functional and rehabilitation aspects, I preferred the presentation of our data in two separate studies.

The first study refers to the clinical and functional evaluation of the spastic upper limb in children with ICP, whereas the second study refers to the rehabilitation process of the upper limb. There are six important chapters: Objectives, Research methodology, Results obtained for each study, Statistic data, Discussions, Conclusions, References and Annexes.

The main aim of this paper consists of making the spastic upper limb's rehabilitation treatment in children with ICP more efficient, by carrying of a meaningful assessment.

The first study: „**Aspects of clinical and functional evaluation of upper limb in a lot of children with ICP**”, aims to: present the benefits and specificity of the assessment tools, as well as the evaluation scales of the upper limb in children with ICP, the upper limb deformity types and frequency representative for ICP, the interrelation between the MACS functional level and ICP's topographic form, the connection between MACS functional level and the functional activity.

Through the second study „**Comparative study of the electrical stimulation of the spastic upper limb in children with ICP**” we investigated and also compared the electric stimulation's effects on the function of the spastic upper limb starting from the premise that electrical stimulation along with a conventional program of kinetic therapy will have long time superior effects according to the functional parameters.

The first study, a non-experimental descriptive one, consisted of a group of 72 children diagnosed with ICP, with the motor disorder type diagnosed according to Surveillance of Cerebral Palsy in Europe Group from 2007 standards, that were included in a complex rehabilitation program held in Neuro-motor Rehabilitation

Centers for Children with Disabilities within the General Directorate of Social Assistance and Child Protection Dolj. All of them who met the selection criteria and whose parents agreed on their participation in the study represented the sample basis.

This study describes the design of the groups involved in the research as well as the measuring instruments and used methods. In this part we discuss the characteristics of each studied group, the size of the lots and the methods of research data collection.

We investigated the ICP repartition according to clinical aspects, sex, age group, urban or rural area of origin and the repartition according to spastic syndrome topography, as well as functional aspects (Abilhand Kids, Melbourne și MACS) in rehabilitation management.

We used descriptive analysis in order to determine the extent of upper limb disorders and the manual ability of children suffering from spastic ICP. The most common deformities encountered in the upper limb and its function are described using Tonkin, Zancolli and House clasifications and correlated with the topography of the affected areas in children with ICP.

The second study- „Comparative study on the electrical stimulation of the spastic upper limb in children with ICP” an observational longitudinal, prospective and non-experimental study consisted of a group of 37 children diagnosed with ICP, with central neurological spastic dysfunction of the upper limb (unilateral or bilateral), selected from the initial group of 72 children.

They were between 7 and 14 years old at the beginning of our study. We also explained the treatment applied to the studied group and the kinetic program. We also performed a thorough analysis of the upper limb functional parameters, following global methodologies and standardized clinical scales, useful for functional staging and also for designing the rehabilitation methods and evaluation of results,

The specific objectives of this research were to assess the role of electrical stimulation for a period of six months in the management and decreasing spasticity, increasing passive articular mobility ROM parameters of the upper limb joints and the improvement of manual ability.

We converted the score of methods used for evaluation and comparison into a standardized score according to the normative data available in the medical literature.

RESULTS:

After a statistical analysis, the resulting data were included and discussed in tables and graphics assembled around each hypothesis or group of hypotheses. The results of the statistics were included in 41 tables and 26 graphics and diagrams, that illustrate both the descriptive picture of the assessment and the correlations between various studied parameters. Our evaluation study revealed some pronation deformities of the forearm according to Tonkin classification in 33% of the children, different stages of wrist and fingers extension limitations using Zancolli classification in 24% of the cases and a volar thumb deformity according House classification in 14% of the studied subjects.

We also determined correlations between MACS levels, Abilhand and Melbourne scores which pointed us to the following results: in children with spastic ICP MACS levels III-V have a significantly lower Abilhand and Melbourne score than the children with MACS levels I-II ($p < 0,05$).

The results we obtained in the second study allowed us to infer a greater functional improvement in reducing muscle spasticity ($p < 0,05$) and range of motion in the shoulder, elbow and wrist joint ($p < 0,05$) in the tested subjects.

Depending on the type of applied therapy (conventional physical therapy or added electrical stimulation for a period of six months), we detected a significant functional progress regarding the manual abilities of the child suffering from spastic ICP at the end of the rehabilitation program. We must state that this improvement was more significant on the children from the electrical stimulation group than on the children from the control group.

DISCUSSIONS rising from each study assess the research results in relation to the national and international references in the field.

CONCLUSIONS:

The two studies allowed us to draw the following conclusions:

1. In our country, an effective medico-social logging and monitoring system for the children with ICP is required due to the reduced addressability of the families from the rural areas. Therefore, creating specialized centres with multidisciplinary

teams where the main focus is the child with ICP and his family will only be beneficial for his evolution.

2. An effective implementation of the rehabilitation services for children with ICP required an analytical and functional evaluation, as well as estimating the actual rehabilitation needs and developing a rehabilitation program focused on both the deficit and the functional potential.

There is currently no standard rehabilitation program for children suffering from ICP, therefore it is important to determine the individual disorders and then to select the most effective treatment methods.

3. The clinical and functional assessment of the upper limb in the studied group included the types and frequency of spastic upper limb characteristic deformities, revealing a net dominance in children with severe bilateral upper limb dysfunctions.

The most common deformities were found in children with upper limb bilateral impairment from tetraplegia, that affected both the forearm and the hand, in some cases one upper limb being more affected than the other.

4. Nowadays, new ways of functional examination of the upper limbs are required in order to monitor the changes in evolution. Our study aims to introduce certain instruments of classification of the upper limb function used worldwide such as MACS and to establish the interrelation between MACS functional level and ICP's topographic form as well as between MACS functional level and the functional activity using Melbourne and Abilhand Kids questionnaires.

According to the MACS scale, classification of the functional level of ability, related to the topographic form of ICP, revealed that the highest MACS levels (level I-II) were encountered in the patients suffering from diplegia and spastic hemiplegia and the lowest MACS scores(level III-V) were identified in children suffering from spastic tetraplegia. We also found correlations between MACS levels I-II and III-V and the Abilhand Kids and Melbourne scores for the affected upper limb.

5. The beneficial results of complex rehabilitation therapy - electrical stimulation associated within 6 month kinetic treatment - are outlined in our second study.

The results of this study were less evident on some analytical parameters evaluated (reflectivity), but encouraging for other parameters evaluated, suggesting that an electrical stimulation program associated with kinetic treatment can lead to significant progress in improving the range of motion after 6 month (the abduction of the shoulder, elbow and wrist extension, wrist supination), significantly higher in children who undergo this treatment protocol compared with those treated only by kinetotherapy.

Following electrical stimulation and physical-kinetic therapy we achieved a slight reduction of the affected upper limb muscle spasticity, especially in children that have undergone 4 sessions of electrical stimulation a week for 6 month in a row.

The beneficial results of electrical stimulation therapy were outlined also after evaluating the upper limb's global abilities, a higher percent of children in the studies group presenting a superior MACS functional level besides the control group.

6. Neuromuscular electrical stimulation therapy is an effective aid in rehabilitation of the spastic upper limb in children diagnosed with ICP. Therefore, we consider this combined therapy (neuromuscular electrical stimulation associated with kinetic treatment) as a good approach in rehabilitation management of the spastic upper limb.

7. Our study results are comparable to those found in the specialized literature regarding the influence that the electrical stimulation program associated with kinetic treatment has on the children suffering from spastic ICP.

We also collected additional data regarding the program's influence on the upper limb's functionality. We mention that we did not find any similar data in other studies performed in children with ICP in our country.

8. By developing and perfecting the methods of application, this rehabilitation program will certainly become one of the main components in treating children with ICP.

The main objective that all the specialists have in treating children with ICP is reducing the consequences of this disease, and this is why we try to replace "there is nothing to do" with "there is always something you can do."

We believe that these results could be useful for both doctors and medical rehabilitation specialists as well as physiotherapists in order to recover the patients

as early as possible, reducing the evolution of secondary complications (reducing the prevalence of chronic disability by reducing functional deficits), by therapeutic means that aim to control the evolution of the disease, its stabilization and eventual rehabilitation of the upper limb's functions.

We believe that future studies on electrical stimulation and its effects on the rehabilitation of the upper limb in children with spastic ICP should be extended, possibly on larger groups of patients for consideration and confirmation of the results obtained by us and for promoting the use of low frequency neuromuscular electrical stimulation.