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Efficacy of Early Integrated Rehabilitative Treatment in Children with Cerebral Palsy: A Longitudinal Study.

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ABSTRACT

Introduction: cerebral palsy (CP) is a condition determined by a damage occurred in the developing brain of children during the first year of life, resulting in cognitive alterations and motor disorders like spasticity. It is known in Literature the efficacy of integrated rehabilitative treatment for CP. The aim of this study, conducted in the Chair of Physical Medicine and Rehabilitation at University "G. D'Annunzio" of Chieti - Pescara, was to demonstrate the importance of an early integrated rehabilitative treatment as affirmed in Literature for patients affected by CP. Materials and Methods: 20 patients with CP were recruited, aged between 2 and 7 years old, of both sexes. Data were collected at the beginning of the treatment (T0), at 3 months (T1), at 6 months (T2) and 12 months (T3) using the Gross Motor Function Measure, the WeeFIM and the Barthel Index. Patients performed 3 weekly therapeutic sessions, each one lasting 1 hour, for a total of 6 months and 1 weekly session for the remaining 6 months. Each session consisted of a set of proprioceptive and stretching exercises. Conclusions: at time T2, patients showed an increase in their motor and cognitive abilities. All patients maintained their improvements at the end of the follow-up (T3). These improvements resulted in a greater independence of patients from caregivers and in an overall better quality of life.

·· INTRODUCTION

Cerebral palsy (CP) was first described in 1862 by an orthopedic surgeon named William James Little. A motor disorder resulting from a non-progressive (static) insult to the developing brain. In fact, CP is a clinical presentation of a wide variety of cerebral cortical or subcortical insults occurring during the first year of life. Preterm infants are at the highest risk for developing CP1). Children with CP suffer from multiple problems and potential disabilities that require the provision of family-centered services that make a difference in the lives of these children and their families2). The worldwide incidence of CP is approximately 2 to 2.5/1000 live births. The incidence is strongly associated with gestational age, occurring in 1 of 20 surviving preterm infants3). Authors in a recent review used two U.S. nationally representative surveys, the 2011–2012 National Survey of Children's Health (NSCH) and the 2011–2013 National Health Interview Survey (NHIS), to determine the prevalence of CP and ID based on parent report among children aged 2–17 years. CP prevalence was 2.6 (95% confidence interval [CI]: 2.1–3.2) per 1000 in the NSCH and 2.9 (95% CI: 2.3–3.7) in the NHIS. ID prevalence was 12.2 (95% CI: 10.7–13.9) and 12.1 (95% CI: 10.8–13.7) in NSCH and NHIS, respectively. For both conditions, the NSCH and NHIS prevalence estimates were similar to each other for nearly all sociodemofic subgroups examined4). Neff has noted that in the general population, approximately 10% of children use the largest majority of medical services and that the majority of these children have one or more severe chronic illnesses5). The basic treatment goals include parent education, facilitation of normal motor development and function, prevention of secondary complications such as

deformities and disabilities and improvement of functional acquisition, community integration, and family adjustment.6),7) Physical therapists focus on gross motor skills, including sitting, standing, walking, wheelchair mobility, transfers, and community mobility.8) Specific treatment options for children with CP include physical and occupational therapy, drug treatments for spasticity (local, intrathecal and systemic), and orthopedic and neurosurgical interventions. Most patients require combinations of these therapies, but physical therapy is always essential.9) Therefore, spasticity management must be goal specific, such as to assist with mobility, reduce or prevent contractures, improve positioning and hygiene, and provide comfort.10)

·· AIM OF THE STUDY

It is known in Literature the efficacy of integrated rehabilitative treatments of spasticity in Cerebral Palsy patients. Goldberg has summed up the present state of affairs best when he noted that "the care of children with cerebral palsy involves treatment by multiple disciplines. It is clear that many interventions make patients different. So, it is not clear which is the gold standard".11) The present study was conducted at the Chair of Physical and Rehabilitative Medicine of "Gabriele d' Annunzio" University, Chieti-Pescara (Italy), in collaboration with the "Papa VI" Foundation of Pescara, with the aim to show how an early integrated rehabilitative treatment can play an important role in the maturation of motor patterns and how from these abilities can spring an evolution from a cognitive and autonomy point of view. These outcomes were chosen because of the controversy literature about the greater efficacy of an early stage therapeutical intervention, especially during a preschool age.12) The gap between research and practice has been well documented in systematic reviews across multiple diagnoses, specialties and countries. Surveys confirm that, unfortunately, the research–practice gap occurs within the cerebral palsy (CP) field to the same degree.12) In the absence of clear research evidence, the systematic application of sensitive outcome measures is required to confirm treatment effects and generate new evidence.13),14) In another study has been observed that Interventions to treat CP should be initiated as soon as possible in order to restore the nervous system to the correct developmental trajectory. One drawback to this approach is that interventions have to undergo exceptionally rigorous assessment for both safety and efficacy prior to use in infants.15)

·· MATERIALS AND METHODS

The sample of the study was composed of 20 patients with diagnosis of Cerebral Palsy (CP), with hemiplegia/hemiparesis (12) and spastic diplegia (8), aged between 2 and 7 years old, of both sexes. 15 of the 20 subjects where preterm born. The rehabilitation protocol, lasting 12 months, foresaw 3 weekly outpatient sessions each lasting 1 hour for 6 months, the remaining 6 months patients performed one session a week as maintenance treatment. Every subject was evaluated at T0, before the beginning of the protocol, at T1 after 3 months, at T2 after 6 months and at T3 after 12 months. Every patient underwent a physiatric examination at time T0. The following rating scales were used for the evaluation: the Gross Motor Function Measure (GMFM), the Wee FIM (Functional Independence Measure) and the Barthel Index. The GMFM scale16) is made of 88 items divided into 5 groups (indicated with a letter from A to E), relative to the 5 different motor stage considered:

ITEM DIMENSION A: it evaluates the ability to keep the supine and pronated position and the ability to roll

- ITEM DIMENSION B: it evaluates the ability to keep the sitting position
- ITEM DIMENSION C: it evaluates the ability to crawl and walk on knees
- ITEM DIMENSION D: it evaluates the ability to keep the standing position
- ITEM DIMENSION E: it evaluate the abilities in walking, running and jumping

The score ranges from 0 to 3 points for each item, assigned in relation to the following criteria:

0 – the patient cannot perform the function;
1 – the patient can only start the function (less than 10% completed);
2 – the patient can partially complete the function (more than 10% but less than 100%); 3 – the patient can complete the whole function.

The WeeFIM (Functional Independence Measure for children) was stated as a useful tool for assessing functional status in children with neurodevelopmental disabilities.17) It is referred to two areas, the functional one and the activities one, and represents a useful indicator for the establishment of the disability grade, in terms of assistance necessary to complete the normal activities of daily living. It's a scale that can be administered from 6 months old to 7 years old children. Every activity can receive a score ranging from 1 (complete dependence) to 7 (complete self-sufficiency). The cumulative scores produce a quantitative index of the subject's disability. The Barthel Index scale is used to measure the functional independence in the fields of self care and motility. In particular, it measures the self care, the sphincterial function, loads transfers and the locomotion. It is also used to evaluate the activities of daily living of personal care and motility before the hospitalization. It is composed by 10 to 20 items. Each one measures a single activity of daily living. It includes 10 personal activities: alimentation, toilette usage, WC transfers, self washing, dressing and undressing, bladder control, intestinal control, bed and wheelchair transfers, walking on a flat surface and using stairs. Each item is evaluated in relation to the autonomy of the patient and its ability to complete an action in a dependent, partially dependent or independent manner (score from 0 to 2). The therapeutic treatment started with stretching and joint mobilizations. This therapeutic choice was made because scientific literature indicates that kind of intervention for CP outcomes treatment.18) Joint mobilizations in our study were made in a passive manner, in order to prevent muscular retractions, increase blood flow and avoid edemas and give good proprioceptive input and motor patterns, as highlighted in literature.19)-24) At the end of the session there were executed proprioceptive and sensorimotor exercises for the recovery of the balance between spastic agonist muscles and antagonist ones, remembering that the therapeutic activity is not only aimed at the compensatory symptoms, but also at the primary reflex tonic activity with abnormal distribution of muscular tone. Stretching was performed in order to reduce tensions and shortenings of hypertonic muscles. In the antagonist muscles stretching was used for muscular strengthening and to counteract atrophies caused by continuous lengthening.25)-28) The proprioceptive and sensorimotor exercises were performed with visual feedback provided by the usage a mirror, useful for the self-correction and memorization of the suggested movement. When each motor stage was reached, before proceeding to the next one, specific exercises for balance and symmetry of posture through the maintenance of prolonged position and through destabilization, were performed.29) With the youngest patients the clinician followed a play-kind approach, in order to accentuate their participation and, in this case, the attention was focused on reaching the motor stages typical of the first years of life, while with the older patients the aim was mainly reaching a good grade of autonomy and reducing the dependence on the family members and caregivers, through a functional activity of recovery and rehabilitation.

·· RESULTS

The first evaluation was done at time 0 (T0), before the beginning of the protocol, the second one after 3 months (T1), the third one after 6 months (T2) and the last one after 12 months (T3). The results obtained at the Gross Motor Function Measure were the following:

4.1.ITEM DIMENSION A: SUPINE POSITION, PRONE POSITION AND ROLLING

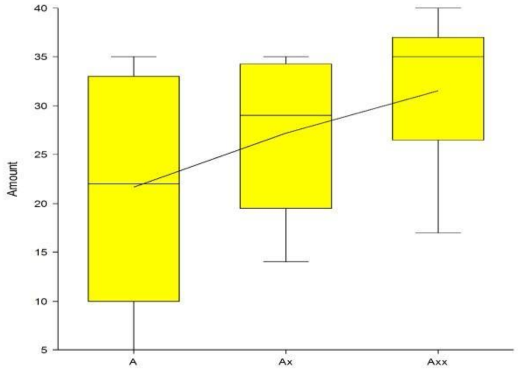

Fig.1. Item Dimension A at T1, T2 and T3.

The Fig.1 shows minimum values, maximum values, standard deviation and median (Y axe) for the evaluation at 3, 6, and 12 months obtained administering items of the Item Dimension A. Each value increases, manifesting an increase of motor abilities concerning rolling and movements from the supine to the prone position. The study of the results at Item dimension A has the aim of verifying progress obtained in the ability to roll and move between supine and prone positions. 70% of patients shows a statistically significant increase, the 30% of them had less remarkable progress, so a greater involvement of the physiotherapist was required in order to obtain the rolling movement. Datas results anyway statistically significant (P=0,00227).

4.2. **ITEM DIMENSION B: SITTING POSITION**

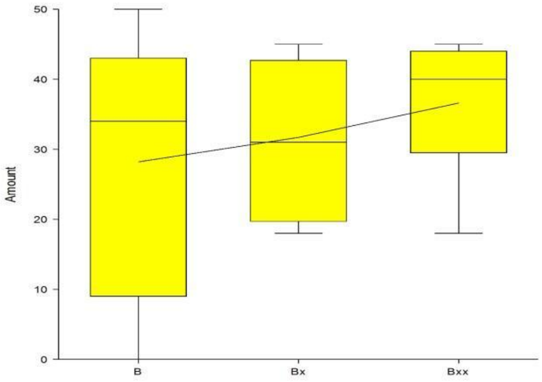

Fig.2. Item Dimension B evaluation at T1, T2, T3.

The major difficulties highlighted by these results is the control of trunk and the prolonged maintenance of the sitting position, which required a longer amount of time to get reached, showing better results at time T3.

4.3.**ITEM DIMENSION C: QUADRUPEDAL AND KNEE WALKING**

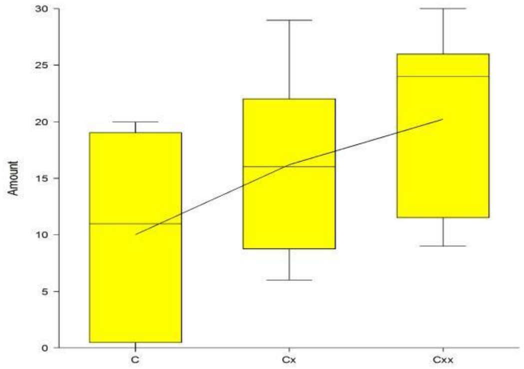

Fig.3. Item Dimension C evaluation at T1, T2, T3.

70% of patients at Item Dimension C evaluation showed a substantial improvement of their score, showing a greater motor learning margin in the kneeling position, thanks to a greater control of the trunk and the head. The remaining 30% also showed an improvement but not statistically significant. Generally, datas resulted statistically significant (P=0,00225).

4.4.**ITEM DIMENSION D: STANDING POSITION.**

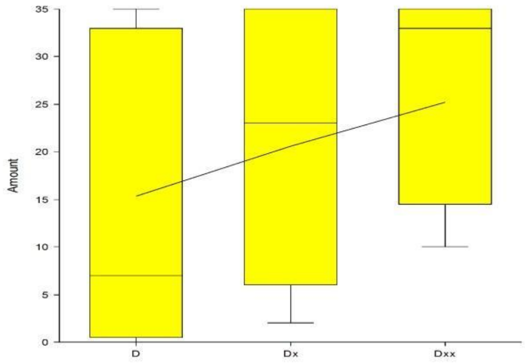

Fig.4. Item Dimension D evaluation at T1, T2, T3.

The Item Dimension D evaluation showed an increase of the lower and median values. In some patients, in particular those affected by spastic diplegia, showing an impairment of both lower limbs, standing position was possible only using orthosis and leverage points. It was observed that orthosis like hips braces and ankle braces or legs retractors, permitted to patients the overcoming of the spastic hypertonia (flexion, abduction, internal rotation and equinism of the foot). Diplegic patients showed greater difficulties respect to other patients that showed an improvement in all evaluation parameters. Generally datas resulted statistically significant (P=0,00325).

4.5.ITEM DIMENSION E: WALKING, RUNNING AND JUMP.

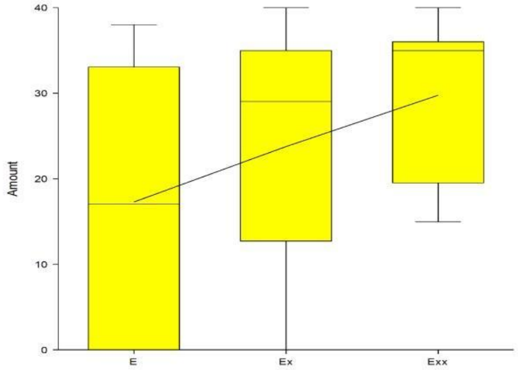

Fig.5. Item Dimension E evaluation at T1, T2, T3.

The Fig.5 shows that patients with lower score reached the walking function, even without a complete autonomy. Patients were able to complete sufficient distances for domestic trips, tough with the support of the physiotherapy or instrumental aids. Datas resulted statistically significant (p=0,01122). 30% of patients, those affected by spastic diplegia, did not reach the walking stage, while 70% showed improvements, even if not statistically significant.

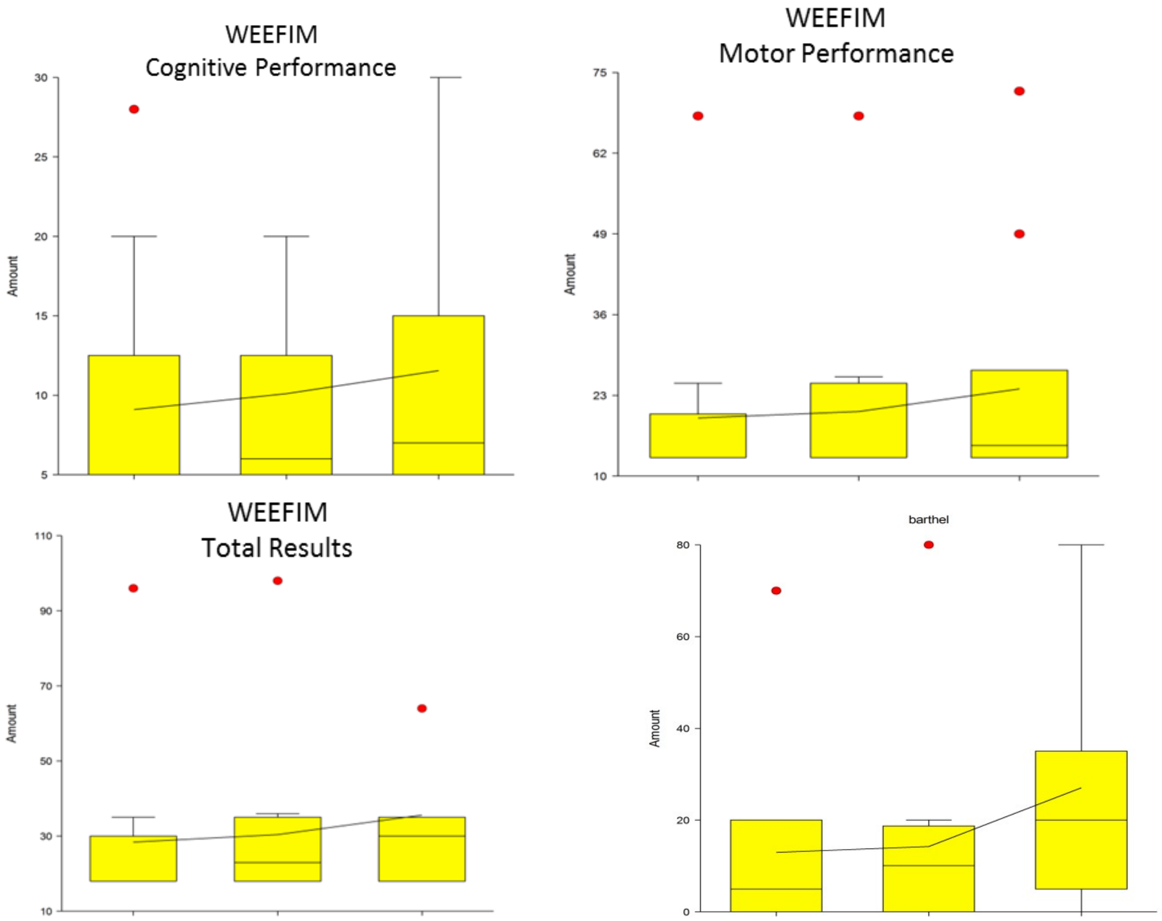

Fig.6, 7, 8, 9. Results for the WeeFIM and the Barthel Index

Regarding the results obtained at WeeFIM and Barthel Index, the Fig. .. s 6, 7, 8 and 9 show an increase in the cognitive-motor performance that promoted a greater independence, proving that cognitive and motor abilities have a real impact in the personal autonomies of daily living of the patient and of his caregivers.

·· DISCUSSIONS

In Literature effectiveness of early treatment in patient with Cerebral Palsy is controversial.12) Nevertheless, different studies underline that interventions for cerebral palsy treatment should be initiated as soon as possible in order to restore the nervous system to the correct developmental trajectory. One drawback to this approach is that interventions have to undergo exceptionally rigorous assessment for both safety and efficacy prior to use in infants.30) Early treatment is important because of the great adaptability and plasticity of the infantile brain. The child can only use what he knows-that is, what he has felt, what he has experienced and what he can remember. If, as is the case with a child with cerebral palsy, sensorimotor experience has been abnormal from the beginning, he will only be able to make use of his abnormal sensorimotor patterns. The intelligent child, if not too severely affected, will adapt these abnormal patterns for some functional use and in this way perpetuate and reinforce them. In time this will lead to contractures and structural deformities, an outcome which could, in most cases, be avoided by very early treatment.31) Dimitrijević et Al affirm that treatment should start only when signs of abnormal tonus and movement patterns are seen. In most babies, this happens after a 'silent' period, during which no treatment is necessary, but if suspicious signs develop, treatment must start immediately.32) In a review, results indicate that the levels of evidence for physiotherapy interventions, particularly strengthening and to a lesser extent functional training, in school aged children with CP has improved; however, further high level evidence is needed for other interventions.33) The results of the present study show how the early treatment of CP patients improve in a short period of time, 6 months, with a maintenance of the results at 12 months. An early therapeutic approach can give great benefits like an increasing of ROM, of muscular elasticity, improvement of the autonomy in postural changes, from sitting to standing position and even during walking. All patients, in particular at the end of the study, showed a better vivacity, collaboration and motivation, due to an improvement of cognitive and psychological functions as shown by results. Those acquisitions were obtained and implemented in the right amount of time and in good circumstances. So it can be said that as highlighted in different studies early rehabilitation is important to improve and promote a global and adapted development of the child as stated by the results of all scale selected that show improvement in all analyzed items. It should be underlined that It would be useful and desirable to carry out more in depth case studies with larger cohorts of participants.

·· CONCLUSIONS

In Cerebral palsy motor patterns like walking and standing constrain the subject to realize functional compensation which can, however worsen spasticity, deformity and retraction during the time (due to a stiffening of the lower limb because of the excessive usage of the upper ones). For this reason, we need to educate the patient, in a multidisciplinary point of view, reaching the highest grade of autonomy, but avoiding the overloading of the body system, sometimes preferring the usage of wheelchairs and braces, not looking at these aids as a defeat or a regression respect to the results obtained. Each patient involved in this study obtained an improvement, according to his residual motor competence. The rehabilitative path of the patient affected by Cerebral palsy is a long-life program, not just for the pathology evolution but also in regards to the maintenance of the reached goals and the delaying of typical complications manifesting at a visual, muscular, tendinous and neurosensorial level. So the proposed therapeutic approach surely represents a valid testimony in the treatment of these syndromes and the criticalities emerged will permit to refine even more the approach in a multi specialized direction, where the Figure of a physiotherapist surely plays an important and fundamental role.

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