Analysis Of The Physiotherapeutic Treatment For Cerebral Palsy Based On The Bobath Neurodevelopmental Treatment Through The Gmfm

BATISTA[1], João Pedro Euriques
SOUZA[2], Denize Moura de
GHATTÁS[3], Vanessa
BERNARDINO[4], Gabrielle
FONTENELLE[5], Rafael Silva
[1 2 4] Physiotherapists from University of the Itajaí Valley – UNIVALI, Itajaí-SC, Brazil
[3] Physiotherapist and Professor at University of the Itajaí Valley – UNIVALI, Master of Health and Work Management, Itajaí-SC, Brazil
[5] Physiotherapist and Professor at University of the Itajaí Valley – UNIVALI, Itajaí-SC, Brazil

ABSTRACT

INTRODUCTION: Cerebral palsy (CP) is characterized by postural, functional and tonus dysfunctions due to lesions in the Central Nervous System in the maturation phase. Physiotherapy inserts itself in the treatment of CP aiming to normalize dysfunctions, providing higher quality of life and autonomy. One of the most used methods for the treatment of these patients is the Bobath Neurodevelopmental Treatment (NDT). The prognosis and efficacy of treatment can be measured through instruments such as GMFM. OBJECTIVES: To evaluate the physiotherapeutic treatment based on NDT through the GMFM-88 scale in children with CP before and after intervention, quantitatively observing the evolution. METHODOLOGY: 8 patients were submitted to the GMFM scale before and after physiotherapeutic treatment. The treatment was carried out in the discipline of Pediatrics of a Community University. Quantitative data were tabulated and analyzed using simple descriptive statistics and GMAE-2 Software. RESULTS: A general evolution was observed in the neuropsychomotor development of patients or the maintenance of their condition. CONCLUSION: The results demonstrate that the physiotherapeutic treatment based on the Bobath Neurodevelopmental Treatment is effective for the evolution or maintenance of the gross motor function of the patients and that the GMFM instrument is effective in showing these results quantitatively.

KEYWORDS: motor activity, cerebral palsy, proprioception, physiotherapy.

INTRODUCTION

Cerebral palsy, also known as chronic non-progressive encephalopathy (NPE), is characterized by a group of postural, functional and muscle tone dysfunctions and changes that result from permanent lesions of the Central Nervous System (CNS). In addition to functional dysfunctions, NPE usually involves sensory, behavioral and communicative dysfunction, as well as social interaction and integration, and cognitive dysfunction.[1]

NPE is a new term used to replace the nomenclature of cerebral palsy (CP), since the later is not considered correct because it characterizes and gives the idea of a cerebral lesion whose clinical condition is characterized by the total loss of cerebral functions. However, cerebral palsy is still the term usually used.[2]

Considered one of the most incident and important neurological lesion, NPE occurs during the brain maturation phase and can be classified according to the period of incidence of the etiologic agent on the CNS: it may be prenatal, perinatal or postnatal, and may be caused endogenously or exogenously.[3,4.]

The clinical condition of the lesion is usually characterized by spasticity and hyperreflexia, having impact on the patient's musculoskeletal system in different ways. This spasticity can be observed through hemiplegia, quadriplegia and/or diplegia, the first being the most common. In addition to these conditions, NPE may also be characterized by dyskinesia, ataxia, hypotonia and mixed symptoms, which are more rare.[5,6.]

The alterations and functional deficiencies due to the NPE are aggravated by the lack of a professional treatment that seeks improving the patient's quality of life. The patients, as they grow and develop, suffer consequences from their limited routine of activities and muscle stimuli and lack of physical activities that act on the improvement of the musculoskeletal system. [5,6.]

NPE treatment requires a multiprofessional team formed by a neuropediatrician, orthopedist, physiotherapist, speech therapist, among other professionals, working on the most precocious stimulation so that the child can perform their activities of daily living, as well as performing stretching and strengthening exercises of the musculature, and adapting of means of communication and locomotion if necessary.[6]

Physiotherapy is inserted into the treatment aiming to improve mobility, give range of motion and strength in order to regulate the abnormal muscle tone that the patient presents. Therefore, the role of physiotherapy is to normalize the dysfunctions, providing the patient functional independence and greater autonomy whilst performing their daily activities.[5]

One of the most effective and most used methods by the physiotherapist in the treatment of this dysfunction in children is the Bobath Neurodevelopmental Treatment (NDT). This method, created by Berta and Karel Bobath in the 1940s, consists of encouraging the functionality of the child's movements from adjusting muscle tone, influenced by the manipulation of control key-points, facilitating the establishment of normal postural patterns, patient's motor coordination, and, thereby, reducing their functional limitations.[7, 8.]

The Bobath Neurodevelopmental Treatment is a method of physiotherapeutic treatment already known worldwide, developed initially around 1940 and used until today, that has undergone alterations in order to adapt to the present demands, being updated the face of new discoveries and advances of the physiotherapy.[4] However, through such adaptations that this method suffered and suffers, recent scientific research with relevance that proves its effectiveness in a quantitative way is scarce, which raises controversial discussion about its use and effectiveness. Thus, the researchers' intention with the present study was to contribute to the bibliographic collection, discussing the competence of the physiotherapeutic treatment following the precepts of this method.

The prognosis of gross motor function in children with NPE is variable. Therefore, the assessment of the level of functionality has a predictive value to quantify gross motor skills. One way to assess a child with NPE's motor skills is by using Gross Motor Function Measure (GMFM). The GMFM scale was developed by a group of Canadian researchers and is a standardized instrument that measures the change in gross motor function over time on the quantitative aspect.[9]

This scale consists of 88 items of different motor activities grouped into 5 dimensions: lying and rolling; sitting; crawling and kneeling; standing; and walking, running and jumping. Each item is scored in a scale from 0 to 3, being 0 "does not initiate", being 1 "initiates", being 2 "partially completes" and 3 "completes", according to the skills and age of the patient. The final result is obtained through the sum of the dimension scores divided by the total number of dimensions (5).[9]

Using the GMFM scale, the objective was to evaluate the results of the physiotherapeutic treatment, with duration of six months, based on NDT in 8 children diagnosed with chronic non-progressive encephalopathy. For that, it was verified if there was alteration of the scores of the GMFM scale between the application pretreatment and post-treatment.

METHODOLOGY

The present study has a quantitative character, since it measures the evolution of gross motor function by the score of the domains of the GMFM-88 scale, before and after physiotherapeutic treatment. It was done in a descriptive and cross sectional way. The research was carried out in the Teaching Clinic of a community university in the south of Brazil, with 8 children attended in the discipline of pediatric practice during the period from July to December 2017, under the authorization of parents or guardians through the Informed Consent Term. Still, patients agreed to study participation through a video stating their assent. In addition, ethical procedures were respected in accordance with Resolution nº466/12 of the National Health Council (CNS). The study was approved by the Research Ethics Committee (CEP) of the University of Vale do Itajaí through ordinance nº 2.247.140. The identity of the participants was kept confidential and the term "patient" with crescent numbers was used for each participant.

The sample was obtained obeying the inclusion and exclusion criteria. Included in the study were children with NPE diagnosis and children in the age group between 6 months and 16 years of age. Patients with diagnoses other than NPE were excluded from the study, as well as patients who did not have cognitive function preserved according to their diagnosis and who did not fit within the inclusion age range.

The data and the application of the scale were obtained under the supervision of the researchers involved during the physiotherapeutic care. For the purposes of data collection, the GMFM-88 scale was used due to the fact that this version of the scale is the most complete one. The application of the GMFM-88 scale aimed to evaluate the motor function and to what extent the child was able to perform a certain activity, in addition to being used to make a comparison of this motor function at the beginning and end of the physiotherapeutic care period, thus evaluating the proposed treatment. In order to carry out the activities proposed by the scale, it was necessary equipment such as carpet, toys, benches, chronometer, pole, steps, measuring tape, among others. The application of the scale lasted an average of 45 to 60 minutes, done in a spacious, warm, comfortable room with a firm and flat surface. The parents were able to accompany the

application of the scale, but without influencing it. The children who were part of the research were wearing as little clothing as possible and were barefoot.

From the first application of the scale the physiotherapeutic treatment was started. The treatment was based on the Bobath Neurodevelopmental Treatment method and carried out by the students of the discipline of pediatric practice. From the NDT integration into the physiotherapeutic treatment plan, a proposal was developed that involved the following therapeutic measures such as: stimulating the puppy position; lateral protection reaction stimuli; rolling; unilateral weight-training workout; proprioceptive training, including postural reorganization, gait training in instability and balance; trunk control and cervical control training; changing decubitus, from dorsal decubitus to lateral decubitus, from sitting to kneeling and semi-kneeling, progressing to orthostatic position and gait training. For these conducts, key points were used to facilitate the movement and perform them in a functional way. The conducts were performed individually according to the need of each patient and adapted according to the patient's GMFCS classification level, motor impairment and age range.

After the semester of physiotherapy intervention based on the aforementioned conducts, the GMFM-88 scale was reapplied to re-evaluate the patients, thus being able to have a comparison of the motor gains reached. From the two applications of the scale, the quantitative data were tabulated and analyzed through the Excel program, using simple descriptive statistics composed by frequency distribution and averages. Quantitative results were presented in the form of tables and graphs. The Gross Motor Ability Estimator Software (GMAE-2) was used to construct the graphs that demonstrate the patient's initial situation and his progress in neuropsychomotor development during the semester through age percentiles.

This software builds such charts using original data from the GMFM-88 scale, the GMFCS level of the patient, the patient's date of birth, and the type of the patient's impairment. In addition, the software analyzes the data obtained with the original GMFM-88 application and calculates a new score, equivalent to GMFM-66.

Due to the time of application of the scale of this research, the risk assumed was that the participating children would not tolerate the entire application of the scale in a single moment. However, there were no such situations with the participants of this research. Regarding the patient's risk of withdrawal and abandonment of treatment, there were no ways to minimize it, since the patient and / or caregiver was free to do so without any financial or moral implications under their decision .

The application of the GMFM scale has the benefit of being a low-cost tool that provides an overview of the patient's motor function, helping to enhance the goals of his treatment and to evaluate his prognosis. On the other hand, NDT brings benefits to the treatment of tonus normalization and movement facilitation, preventing deformities, bringing the patient the fastest daily activities of life, increasing the functionality, coordination and quality of life of the patient.

RESULTS AND DISCUSSION

In this study eight children with a diagnosis of NPE were evaluated, four of them female and four males, aged 1 year to 14 years, where two children are 0-2 years old, two 2-4 years old , one child aged 4-

6 years, two children aged 6-12 years and one in the group over 12 years, who underwent physiotherapeutic treatment based on NDT, from March to July 2017, once a week.

The GMFM scale was used, which is an instrument to evaluate the motor function of children with motor disorders. The choice is due to the fact that the scale fulfills the criteria of reliability and validity with regard to responsiveness to functional change over time. Patient evolution analysis was performed individually and according to the age group of the participants, their motor impairment and GMFCS classification.

All the evaluated patients received, after the initial evaluation, NDT-based physical therapy, in order to potentialize neuropsychomotor development. The 8 patients reevaluated after the half-year of treatment showed an improvement in the gross motor function, although for some patients the improvement was minimal, be it by the severe commitment of the patient or because it is a patient with well developed gross motor capacity. This improvement can be observed in table 1.

Table 1 - List of patients by age demonstrating results obtained in the application of GMFM in each dimension and in total, pre and post physiotherapeutic intervention

PATIENT	AGE - GMFCS	IMPAIRMENT	GMFM - 88	A %	B %	C %	D %	E %	TOTAL %
1	1 - V	QUADRIPLEGIA	**PRE**	35,29	1,66	0	0	0	7,39
			POST	47,05	38,33	9,52	0	0	18,98
2	1 - V	QUADRIPLEGIA	**PRE**	27,45	28,33	0	0	0	11,15
			POST	43,13	30	0	0	0	14,62
3	2 - II	HEMIPLEGIA	**PRE**	68,62	90	78,57	25,64	9,72	54,51
			POST	96,07	100	88,09	71,79	31,94	77,58
4	3 - III	DIPLEGIA	**PRE**	100	96,66	100	51,28	50	79,58
			POST	100	100	100	56,41	50	81,28
5	4 - I	HEMIPLEGIA	**PRE**	100	100	90,47	89,74	76,38	91,32
			POST	100	100	97,61	94,87	87,5	95,99
6	6 - I	HEMIPLEGIA	**PRE**	100	100	95,23	100	98,61	98,76

PATIENT	AGE - GMFCS	IMPAIRMENT	GMFM - 88	A %	B %	C %	D %	E %	TOTAL %
			POST	100	100	97,61	100	100	99,52
7	10 - III	DIPLEGIA	**PRE**	100	93,33	100	92,3	95,83	96,29
			POST	100	100	100	94,87	97,22	98,41
8	14 - V	QUADRIPLEGIA	**PRE**	19,60	6,66	0	0	0	5,25
			POST	54,90	13,33	0	0	0	13,64

GMFM-88 dimensions, represented by A% = lying and rolling; B% = sitting; C% = crawling; D% = standing; E% = walking, running, jumping.

Participants aged 0-2 years, responded satisfactorily to the treatment, evolving from score 1 to score 2 in several items in the lying and rolling and sitting dimensions. Regarding the total earnings of this age group, it can be observed that the dimensions increased considerably during the semester, with dimension A going from a total of 31% to 45%; dimension B going from 15% to 34%; dimension C going from 0% to 4%. In general, a motor gain of about 7% was observed with these patients, since the mean GMFM percentage of this group increased from 9% to 16% (table 2).

Participants aged 2-4 years had gains in all dimensions. It evolved from score 1 to score 2 and 3 into many evaluated items. Dimension A went from 84% to about 98%, showing an almost complete gain of this scale dimension; the B-dimension went from 93% to 100%; C-dimension went from 89% to 94%; dimension D went from 38% to 64% and dimension E, 30% to 40%. In general, a total motor gain of about 12% was observed with these patients, since the mean GMFM-88 percentage of this group increased from 67% to 79% (table 2).

The 4-6 year-old age group had only one participant, in whom there was no improvement in the first dimensions, A and B, since the patient had already total motor function evaluated in them, and it should be noted that the complete percentage was maintained during the semester. It was observed an improvement in the C, D and E dimensions, with the gain in relation to the C dimension being 7%, from 90% to 97%; dimension D going from 90% to 95% and dimension E from 76% to 87%. In general, a total motor gain of about 5% was observed with these patients, since the average GMFM-88 percentage of this group went from 91% to 96% (table 2).

In relation to participants aged 6-12 years, these two patients had the lowest gain compared to the other groups. This is because the gross motor function of these patients was almost total. This group showed an improvement in dimension B from 96.5% to 100%; in dimension C, went from 97.5% to 99%; in dimension D, went from 96% to 97.5% and in E it went from 97% to 98.5%. Dimension A remained at 100% and in total this group had a gain of about 2.5% (as shown in table 2).

In the group over 12 years old, with only one patient, a considerable gain was observed in A and B dimensions of the scale, but without alteration of the other dimensions due to the significant motor impairment of the patient tested. However, the motor gain resulting from the physiotherapy semester in these dimensions was about double the initial score, and a change from 20% to 55% in dimension A and from 6.5% to 13% in dimension B could be observed. Overall, a total motor gain of about 8% was observed with these patients, since the mean GMFM percentage of this group increased from 5.35% to 13.64% (Table 2).

Table 2 - Sample of the study divided by age group with their respective results in the test and retest

AGE GROUP (y.o)	PATIENTS	TEST %	RE-TEST %	EVOLUTION %
0 - > 12	8 (100%)	55,5	62,5	7
0 - 2	2 (25%)	9,3	16,8	7,5
2 - 4	2 (25%)	67,1	79,4	12,3
4 - 6	1 (12,5%)	91,3	96,0	4,7
6 - 12	2 (25%)	97,5	99,0	2,5
> 12	1 (12,5%)	5,3	13,6	8,3

Regarding the motor impairment of the participants, the group was divided according to its diagnosis of cerebral palsy in hemiplegic, diplegic and quadriplegic, in order to analyze if these characteristics can interfere in motor learning and neuropsychomotor development. Among the participants, three are part of the hemiplegic group, two of the diplegic and three of the quadriplegic.

The group of diplegics started the semester being the less compromised, reaching 87.94% on the GMFM-88 scale and its progress during the semester was the lowest compared to the other two groups. The initial GMFM score was 87.94% and the final score was 89.85%, with a gross motor function gain of 1.91% (Table 3).

Regarding the hemiplegics, they started the semester reaching 81.53% in the GMFM-88, taking into account the average among the three participants. Thus, this was the group that had the greatest gain in gross motor function, to 91.03% on the GMFM-88 scale average, totaling a gain of 9.5% (Table 3).

Concerning the group of quadriplegic patients, they started the semester with the most severe motor impairment, as expected, with an average of 7.93% in the GMFM group. At the end of the semester, there

was an important gain in gross motor function, reaching 15.75% in the GMFM scale, totaling a gain of 7.82% (table 3).

MOTOR IMPAIRMENT	Test %	Retest %	Evolution %
DIPLEGIC (n=2)	87,94	89,85	1,91
HEMIPLEGIC (n=3)	81,53	91,03	9,5
QUADRIPLEGIC (n=3)	7,93	15,75	7,82

Table 3 - Sample of the study divided by type of impairment with its respective results in the test and retest.

Therefore, it is possible to observe a general evolution in the neuropsychomotor development of the patients, either in a grouped manner (by age, by motor involvement) or also when we analyze the progression of the patients separately.

Through the GMAE-2 software, the graphical arrangement of the advance in the neuropsychomotor development of each patient through the percentiles by age was made, thus, better illustrating the result of the research. The age percentiles are reports that indicate the patient's position on the curves of gross motor function according to their level of GMFCS[10]. In addition, the software analyzes the data obtained with the original application of GMFM-88 and calculates a new score, equivalent to GMFM-66, indicated above the curves and next to the age of the patient.

When analyzing the individual GMAE-2 graphs, all the patients showed an advance of gross motor function within their respective percentiles. Patient 2, however, did not obtain graphic improvement but physical therapy for this patient provided the maintenance of his condition.

It is important to put in perspective that the literature often shows that motor development and motor learning, translated into the way patients respond to physiotherapeutic treatment, goes according to the aforementioned characteristics (motor impairment, GMFCS and age group) , that is, that some groups will have a better response to treatment than others. The results of this study show that there is some corroboration with this idea, however there are several factors and more characteristics that involve each patient and this, in its entirety, will develop differently from the others, regardless of the group in which fits.

This can be observed when comparing the results of patient 1 with patient 8 (table 1). Their age groups disagree with each other, yet both had significant gains from treatment. When comparing patients 1 and 8 with patient 3 (table 1), there is a large GMFCS level difference. However, there was a significant evolution of gross motor function for all three.

It is widely agreed by several authors that the earlier the physiotherapeutic intervention, be it NDT-based or not, the greater the gains in gross motor function and motor development in PNE patients.[11]

Since important results have already been achieved with the intervention of this study, being only once a week, it is possible to correlate and emphasize that intensive or more frequent treatment would bring even more promising results.

The results of the research show that the lower the level of patient impairment and dependence, according to GMFCS, the higher the motor development provided by the physiotherapeutic performance. This can be observed when comparing the percentage of evolution of diplegic or hemiplegic patients in relation to quadriplegics, or in a comparison between the evolution from the lower levels of GMFCS to the higher levels.

This observation is in accordance with studies that compared the impact of neuromotor gravity on the functional profile of children with NPE, where thirty-six children were classified by GMFCS according to levels of neuromotor impairment (mild, moderate or severe) . These three groups were evaluated by the PEDI test, which reports on the functional abilities and independence of the child in the areas of self-care, mobility and social function, in which they concluded that the greater the patient's neuromotor impairment, the greater the number of factors that will limit his functional capacity and independence. Thus, it can be considered that this is true for the physiotherapeutic treatment and its evolution: the greater the motor impairment, the greater the barriers to the success of the intervention and, thus, the lower the result.[12]

In contrast, our study shows that patients with high motor impairment (GMFCS V) had significant gains, as did patients with low motor impairment (GMFCS I and II). This is because there is a wider range of motor milestones to be achieved with more severe patients.

In addition, it is important to note that although the gains of patients with more severe neuromotor impairment are smaller and more difficult to achieve, physiotherapy and its NDT-based interventions are effective in treating these patients, since it provides them the evolution that keeps them within normal range of the neuropsychomotor development for their age group or, still, keeps them in the way to achieve evolution.

These small gains, as seen in relation to patient 2 of this study, corroborate with the literature that presents results of an intervention that combines different approaches, including NDT, with 4 children with NPE, and although the progress achieved is not statistically significant, there was improvement in motor development through GMFM and evolution sufficient to reach the goals proposed for each patient through the Goal Attainment Scale (GAS).[13]

CONCLUSION

We can conclude that the results found in our research were satisfactory, since the patients presented gains in the motor development and improvement of the gross motor function. According to results obtained, it is suggested that GMFM-88 is useful as a result measurement tool to detect changes in gross motor function in children with NPE undergoing physiotherapeutic interventions.

It should be emphasized that GMFM is an effective tool when used to assess the child's motor function in a quantitative way, not replacing a physical therapy evaluation and the association of other assessment instruments that evaluate smaller motor gains and make qualitative analysis of gross motor function . However, we can say that the GMFM evaluation instrument performs satisfactorily what it is meant to do.

The results of this study show the efficacy of the physiotherapeutic treatment, which used interventions based on the NDT to facilitate and encourage the neuropsychomotor development of the patient. Because it is a method that requires specialized training, it is possible to attest that even using only the principles of

this method is possible to obtain satisfactory results, either for the evolution of the patient or the maintenance of his / her condition.

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