

The Effects of Neuro-Developmental Treatment Based Rehabilitation on Gross Motor Function in Children with Spastic Cerebral Palsy

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Spastik Serebral Palsili Çocuklarda Nörogelişimsel Tedaviye Dayalı Rehabilitasyonun Kaba Motor Fonksiyon Üzerine Etkisi

ABSTRACT

Objective: The aim of the study was to assess the effects of neurodevelopmental treatment-based rehabilitation on gross motor function in children with spastic cerebral palsy.

Method: Out of 30 patients with spastic cerebral palsy (diplegia, quadriplegia) aged 2-5 years, 15 patients were assigned to neurodevelopmental treatment-based rehabilitation group (Group A), whereas 15 patients to convansional home exercises program (Group B). The neurodevelopmental treatment-based rehabilitation group received three sessions of neurodevelopmental treatment 60 minutes a day, three times a week, for 3 months in an outpatient setting. The intervention program was administered for 3 months. Gross motor function was assessed using the Gross Motor Function Measure 88 (GMFM-88), before and after treatment.

Results: At baseline, there were no statistically significant differences between the two groups with respect to age, sex, clinic type and GMFM-88 values. After 3 months; there were no significant differences between two groups regarding the total scores of GMFM-88 ($p>0.05$) whereas significant difference was found between the sitting, crawling and kneeling, standing, walking-running-jumping dimensions of the groups ($p<0.001$). After 3 months, all dimensions of GMFM-88 were significantly increased in Group A ($p<0.001$). Standing, walking-running-jumping dimensions showed no statistically significant difference in Group B ($p>0.05$).

Conclusion: The neurodevelopmental treatment contributes to all areas of rough motor function in children with spastic cerebral palsy. Neurodevelopmental treatment is promising and further randomized controlled studies are needed for rehabilitation technics.

Keywords: Cerebral palsy, gross motor function, neurodevelopmental treatment, rehabilitation

ÖZ

Amaç: Bu çalışmada spastik serebral palsili çocuklarda nörogelişimsel tedaviye dayalı rehabilitasyonun kaba motor fonksiyona etkilerini araştırmak amaçlandı.

Yöntem: Çalışmaya katılan 2-5 yaşları arasında 30 spastik serebral palsili (SP) (dipleji, kuadripleji) çocuğun 15'i 3 ay boyunca haftada üç gün 60 dakika nörogelişimsel tedaviye dayalı rehabilitasyon programına (A grubu) 15'i konvansiyel ev egzersiz programı (B grubu) alındı. Bütün olgular tedavi öncesi ve sonrası kaba motor fonksiyon ölçümü-88 (KMF-88) ile değerlendirildi.

Bulgular: Çalışmanın başlangıcında iki grup arasında yaş, cins, klinik tip ve KMF-88 değerleri açısından istatistiksel olarak anlamlı fark yoktu ($p>0,05$). İki grup karşılaştırıldığında 3.ayda KMF-88 toplam puanları arasında istatistiksel olarak anlamlı fark bulunmazken ($p>0,05$) oturma, emekleme-diz çökme, ayakta durma, yürüme-koşma-sıçrama alanlarında istatistiksel olarak anlamlı fark bulundu ($p<0,001$). A grubunda 3.ayda KMF-88 tüm alanlarında istatistiksel olarak yüksek anlamlı fark bulunurken ($p<0,001$) B grubunda ayakta durma, yürüme-koşma-sıçrama alanlarında istatistiksel olarak anlamlı fark bulunmadı. ($P>0,05$)

Sonuç: Nörogelişimsel tedavinin spastik serebral palsili çocukların kaba motor fonksiyonun tüm alanlarına katkısı olduğu sonucuna varıldı. Nörogelişimsel tedavisi umut vericidir ve randomize kontrollü çalışmalara gereksinim vardır.

Anahtar kelimeler: serebral palsi, kaba motor fonksiyon, nörogelişimsel tedavi, rehabilitasyon

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INTRODUCTION

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture causing activity limitation, that are attributed to non-progressive disturbances occurring in the developing fetal or infant brain ⁽¹⁾. At least three factors can be held responsible for disability in children with CP. The first is the primary central nervous system lesion affecting the motor control; the second is disruption of muscle and bone development; and the third is compensatory movement patterns learned ⁽²⁾. The content of these factors affects physical capacity and gross motor function.

There are a wide range of therapeutic approaches for the children with cerebral palsy using different methods. However, it is not clear which method is more effective ⁽³⁻⁵⁾. The studies on this subject will provide useful information for the rehabilitation team. The aim of the present study was to evaluate the results of neurodevelopmental treatment (NDT)-based rehabilitation for children with CP.

MATERIAL and METHODS

This is a retrospective study involving thirty children between the ages of 2 and 5 years who were diagnosed with CP by an experienced specialist in pediatric neurology and referred to our clinic for physical medicine and rehabilitation at Behçet Uz Children's Hospital between September 2016-September 2018.

Patients with spastic quadriplegia or diplegia without any other severe abnormalities were included in the study. Patients receiving medical procedures likely to affect motor functions such as botulinum toxin injections and orthopedic surgery were excluded from the study. Participants were divided into a NDT group (Group A, 15 subjects) and a control group (convansional home exercises program group, Group B, 15 subjects). The gross motor functions of the patients were evaluated according to Gross Motor Function Measure-88 (GMFM-88). No statistically significant differences in physical and clinical characteristics of both groups were found before

treatment ($p>0.05$). The Group A that participated in the study underwent neurodevelopment treatments which were administered by a physiotherapist. Group A received three sessions of physical therapy per week (three sessions lasting 1 hour per therapy) for 3 months in an outpatient setting.

In NDT sessions, position transitions such as turning from supine to prone or from prone to supine, from sitting to standing were facilitated according to the needs of the child. Balance reflexes were attempted to be stimulated using CP ball. Ambulation training, appropriate to the child's motor development was given. Additionally, passive stretching of spastic muscles reduces spasticity and facilitate motor functions ^(6,7). Families practiced the exercises every other day when they were not attending NDT sessions.

The Group B consisted of children with CP who were followed by a home program and family education, because they could not be taken into rehabilitation program since they lived outside the city. The Group B practiced exercises (stretching, passive range of motion, and active range of motion) at home with their parents and under the guidance of a physiatrist ⁽⁸⁾.

Gross Motor Function Measure (GMFM): Motor function was assessed using the Gross Motor Function Measure (GMFM) at baseline and during follow up period. GMFM is appropriate for evaluating changes in gross motor function in children with CP aged 5 months to 16 years ⁽⁹⁾. It is a useful method for determining the prognosis of children with CP, arranging the treatment plan and demonstrating the effectiveness of the applied treatment ⁽¹⁰⁾.

GMFM consists of 88 items grouped into five functional dimensions: GMFM-A: lying and rolling (17 items); GMFM-B: sitting (20 items); GMFM-C: crawling and kneeling (14 items); GMFM-D: standing (13 items); and GMFM-E: walking, running, and jumping (24 items). The 88 items of the GMFM are measured by observation of the child and scored on a 4-point ordinal scale (0=does not initiate, 1=initiates 10% of activity, 2=partially completes 10% to ,100% of activity, 3=completes activity). Each item was measured by observation and scored on a 4-point ordinal scale.. A percentage score was calculated for

each dimension and for the total score of 5 dimensions^(11,12).

Ethical Approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee as well as the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by the Ethics Committee of Dr. Behcet Uz Children’s Disease and Surgery Training and Research Hospital (approval number 2019/258).

Statistical analysis

SPSS version 22.0 for Windows was used for all statistical analyses with P-values less than 0.05 considered statistically significant. Normally distributed data (Kolmogorov-Smirnov test, P>0.05) were reported as mean±standart deviation (SD). Chi-square test was used for comparison of categorical variables of two groups. Pre-, and post procedural results in each group were compared by paired T-test. The comparison of two study groups was done by independent T-test.

RESULTS

A total of 30 children with spastic diplegic and quadriplegic CP were initially included in this study. There were a total of 15 children in the NDT group (7 girls, 8 boys; age range 2-5 years, mean age 3.13±0.91 years) and 15 children in the control group (8 girls, 7 boys; age range 2-5 years, mean age 3.40±1.05 years).

The genel characteristics of the both groups are presented in Table 1. At baseline, there were no significant differences between two groups.

Measurements done before and after the NDT, in the NDT group revealed quite significant differences in GMFm-88 scores in lying and rolling, sitting, crawling, standing, and walking skills (p<0.001) Nevertheless; in the control group, significant improvement was noted in only rolling, sitting, crawling and kneeling skills (p<0.05). Tables 2 and 3 present the scores for pre, and post-treatment GMFm-88

Table 1. Comparison of the general characteristics of the two groups.

The characteristic	Group A n=15	Group B n=15	P-value
Age (mean±SD)	3.13±0.91	3.40±1.05	p>0.05
Females/males	7/8	6/9	P>0.05
Quadriplejik/diplejic	7/8	8/7	P>0.05

There were no istatistical significant differences between the two groups at baseline; p<0.05, nonsignificant.

Table 2. Comparisons of mean scores of all dimensions of the GMFM-88 in group A at baseline, at 12 weeks.

Dimensions	Baseline	12 weeks	P-value between baseline and 12 weeks
Lying and Rolling	43.00±25.8	65.33±25.5	p<0.001
Sitting	23.86±25.1	45.46±29.4	p<0.001
Crawling and kneeling	16.93±24.6	35.13±28.4	p<0.001
Standing	3.53±6.6	7.6±8.3	p<0.001
Walking, running and jumping	1.46±2.9	6.0±5.8	p<0.001
Total score	17.53±16.0	31.6±18.7	p<0.001

Highly significant differences can be between baseline and 12 weeks in group A after intervention; P<0.001.

Table 3. Comparisons of mean scores of all dimensions of the GMFM-88 in group B at baseline, at 12 weeks.

Dimensions	Baseline	12 weeks	P-value between baseline and 12 weeks
Lying and Rolling	46.93±30.17	54.06±32.1	p<0.001
Sitting	23.33±22.34	25.53±23.1	p<0.05
Crawling and kneeling	15.53±13.14	17.40±14.6	p<0.05
Standing	1.26±2.1	1.86±2.7	p>0.05
Walking, running and jumping	1.13±1.9	1.46±2.1	p>0.05
Total score	17.23±13.2	19.86±14.0	p<0.05

P<0.05 significant, p>0.05 non significant, p<0.001 highly significant.

Table 4. Comparison of changes in mean score of gross motor function measure-88 in both groups at 12 weeks.

Dimensions	Group A	Group B	P-value
Lying and Rolling	65.33±25.5	54.06±32.1	p>0.05
Sitting	45.46±29.4	25.53±23.1	P<0.05
Crawling and kneeling	35.13±28.4	17.40±14.6	P<0.05
Standing	7.6±8.3	1.86±2.7	P<0.05
Walking, running and jumping	6.0±5.8	1.46±2.1	P<0.05
Total score	31.6±18.7	19.86±14.0	P>0.05

P<0.05 significant, p>0.05 non significant.

measures for groups.

After 12 weeks, there were no significant differences between two groups regarding the total scores of GMFM-88 ($p>0.05$) whereas significant differences were found sitting, crawling and kneeling, standing, walking, running, and jumping dimensions ($p<0.05$, Table 4).

At the beginning of the NDT treatment, 15 children needed support for standing and walking. On the 3rd month of the therapy 4 children could stand and walk without support. Similarly, before NDT treatment, 12 children could not sit without support. After 3 months of treatment, 7 children could sit independently.

This result indicates that rehabilitation during NDT was effective at improving gross motor function in children with spastic CP. Comparison of 2 homogeneous groups with respect to sex, age, GMFCS level and distribution of impairment constituted the strength of our study.

DISCUSSION

NDT is an important component in the treatment of children with spastic CP, however there still is little research evidence regarding its efficacy in Turkey. There is controversial research on the effectiveness of NDT approach in the treatment of children with CP. A unified consensus does not exist on the effectiveness of NDT and debates are continuing about its effectiveness⁽¹³⁾. In their recent review, Anttila et al.⁽¹⁴⁾ concluded that there is conflicting evidence concerning Bobath interventions in children with cerebral palsy. One of the limitations of the previous study was the heterogeneous patient population. The present study, therefore, is designed to clarify the effectiveness of Bobath for children with spastic CP.

The purpose of this article is to present the improvement of motor function in NDT initiated for the rehabilitation of children with spastic CP. The Bobath treatment, also known as the NDT, is one of the major approaches used to rehabilitate patients. The primary purpose of the Bobath approach is to correct abnormal postural tone and to facilitate normal movement patterns for performing performance

skills. Treatment programmes within the Bobath concept are goal focused^(6,15).

The results of this research showed positive change in rolling and lying, sitting, crawling, standing and walking skills in children with spastic cerebral palsy after NDT programme. However, in the second group, which did not receive neurodevelopmental treatment, there was significant improvement in only rolling and lying, sitting, crawling. At the beginning of the NDT treatment, 15 children needed support to stand and walk. On the 3rd month of the therapy 4 children could stand and walk without support. Similarly, before NDT treatment, 12 could not sit without support. After 3 months of treatment, 7 children could sit independently. This result showed that the levels of motor development increased and the levels of disability decreased in patients enrolled in the rehabilitation program based on NDT.

Both groups benefited from treatment in the sitting dimension; however, when the difference between the groups was evaluated, it was seen that the improvement in NDT group was higher than the other group. This study showed the effect of NDT for acquisition of independent sitting. Achieving functional ability in sitting is important for children with CP since they spend a significant amount of time sitting even if they have not acquired any other form of mobility⁽¹⁶⁾. It should be taken into consideration that early physiotherapy approaches will produce more positive results in children with CP since the symptoms worsen with age and abnormal postures and movement patterns begin to settle.

Mayo⁽¹⁷⁾; conducted study to investigate the development of postural reactions and inhibition of primitive reflexes in 29 children with spastic CP. The experimental group consisting of 17 patients underwent a weekly intensive NDT-based program for 6 months and control group consisting of 12 subjects had monthly non-intensive treatment program including home exercises. The subjects in the experimental group practiced exercises for inhibiting primitive reflexes and increasing balance. After 6 months, it was shown that inhibition of primitive reflexes and development of postural reactions improved in the experimental group than in the control group.

In a study conducted by Trahan et al. ⁽¹⁸⁾, gross motor functions of a group of children with different types of CP were monitored for changes during an eight-month-period. A total of 50 patients including 24 quadriplegic, 16 hemiplegic and 10 diplegic children, aged between 12 and 79 months were included in the study. In that study, it was reported that gross motor function measurements significantly improved in children after NDT application. The results of Trahan's study ⁽¹⁸⁾ about the improvements in GMFM level with NDT, are parallel to our study.

Ketelaar et al. ⁽¹⁹⁾ showed significant difference in rolling, sitting, and kneeling abilities after neurodevelopmental intervention. In this present study positive changes were noted in lying and rolling, sitting, crawling- kneeling, standing, walking abilities after NDT intervention. Park et al. ⁽²⁰⁾ examined the effect of physical therapy based on NDT on gross motor functions in children with CP. NDT significantly improved gross motor functions for crawling and kneeling as well as standing. One study with a six-week NDT treatment period reported significant improvement in gross motor functions of children with CP (15 CP children, aged 2 to 16 years). Additionally, it was noted that self-care skills of the patients improved and they were mobilized with less support ⁽²¹⁾.

Tsorkakis et al. ⁽²²⁾ reported greater effect of intensive therapy in patients with the diagnosis of CP aged 3-14 years receiving treatment 5 times weekly as opposed to 2 times weekly in the non-intensive group, on GMFM scores after 16 weeks of treatment. The results of our study support the effectiveness of NDT and emphasize the need for intensive treatment. In the study of Tsorkakis, it was also emphasized that the progress in the younger age group was higher than the older age group. Participants of their study had a variety of motor impairment (i.e. hemiplegia, diplegia, and quadriplegia) and high GMFCS levels. Patients with spastic hemiplegia have unilateral motor impairments and a higher gross motor function so that patients with spastic hemiplegia should be analyzed separately. We did not include hemiplegic patients in our study. Our study provided homogeneity between the two groups with respect to sex, distribution of impairment and with only

small differences in age. The improvement in GMFM scores was significant in both groups but the improvement in the NDT group after treatment was significantly higher. In addition, both groups in our study received treatment. It is unethical not to give any treatment so that the control group in our study received family training. This family training program was prepared in accordance with the individual needs of each patient. Accordingly, the family was trained and follow-up was carried out. But educational, economic and socio-cultural levels of the families, and age of the patients, might have affected success rates.

In conclusion, this study showed that neurodevelopmental treatment-based rehabilitation improve lying and rolling, sitting, crawling and kneeling, and standing, walking skills of children with spastic cerebral palsy. However, walking, running and jumping skills of children with spastic cerebral palsy did not improve with conventional physiotherapy techniques

If the larger randomized control trials confirm the results of the current study, then it can provide useful information to empower choosing appropriate treatment and raise the awareness of the physician group directing the physiotherapy and rehabilitation team.

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Ethics Committee Approval: S. B. University of Health Sciences, İzmir Approval was obtained from Behçet Uz Pediatric Diseases and Surgery Training and Research Hospital, Clinical Research Ethics Committee (31 / 14.02.2019).

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Informed Consent: Since our study was retrospective, informed consent was not obtained.

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