

# Rehabilitation Outcomes of Children with Cerebral Palsy

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**Abstract.** [Purpose] To evaluate the results of Bobath-based rehabilitation performed at a pediatric cerebral palsy (CP) inpatient clinic. [Subjects and Methods] The study subjects were 28 children with CP who were inpatients at a pediatric service. Inclusion criteria were: being an inpatient of our hospital aged 2–12 with a diagnosis of CP; having one permanent primary caregiver; and the caregiver having no medical or psychotic problems. All of the patients received Bobath treatment for 1 hour per day, 5 days a week. The locomotor system, neurologic and orthopedic examination, Gross Motor Function Measure (GMFM) of the patients, and Short Form-36 (SF-36) of permanent caregivers were evaluated at the time of admission to hospital, discharge from hospital, and at 1 and 3 months after discharge. [Results] Post-admission scores of GMFM at discharge, and 1 and 3 months later showed significant increase. Social function and emotional role subscores of SF-36 had increased significantly at discharge. [Conclusion] Bobath treatment is promising and randomized controlled further studies are needed for rehabilitation technics.

**Key words:** Cerebral palsy, Rehabilitation, Bobath

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## INTRODUCTION

Cerebral palsy (CP) describes a group of permanent disorder of the development of movement and posture causing activity limitation, that are attributed to non-progressive disturbances that occurring in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, behavior, epilepsy, and secondary musculoskeletal problems<sup>1)</sup>.

CP is accompanied by a wide range of problems and has a broad spectrum of symptoms, making evaluation of the patient and setting of rehabilitation goals difficult. In the evaluation of a child with CP, the type of involvement is identified, the functional condition and secondary deformities are assessed, the needs of the patient are identified and a rehabilitation program is designed<sup>2)</sup>.

Rehabilitation programs for children with CP should be appropriate for the age and functional condition of the patients. The aim of CP rehabilitation should be to minimize disability and to promote independence and social partici-

pation<sup>2)</sup>.

Although the concept of CP rehabilitation has changed in recent years to focus on patient participation in everyday activities, the neurophysiological approach is still used within the combined therapy methods. The neurophysiological approach is a specific strategy based on the fact that sensory stimuli sent by various methods cause reflex motor responses. Facilitation or inhibition of muscle groups via the stimulation of exteroceptors and proprioceptors is the aim of this approach<sup>3)</sup>. The Bobath technique is the most common method of motor stimulation and it is used worldwide. In this technique, a child is positioned in reflex-inhibiting postures (RIP) to reduce spasticity. Then, specific reflexes and reactions are stimulated to improve normal movement sense. Therapists stimulate key control points in the body, triggering reflexes that provide head and body control<sup>2)</sup>.

The primary aim of the present study was to evaluate the results of Bobath-based rehabilitation for pediatric CP inpatients. This study also evaluated some clinical characteristics of the patients.

## SUBJECTS AND METHODS

The study subjects were 28 children with CP who were inpatients at a pediatric rehabilitation inpatient clinic. Inclusion criteria were: being an inpatient of our hospital aged 2–12 with a diagnosis of CP; having one permanent primary caregiver; and the caregiver having no medical, chronic or psychotic problem.

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A CP evaluation form was completed during detailed locomotor system, neurologic and orthopedic examinations prior to the rehabilitation program. The Gross Motor Function Measure (GMFM) was evaluated and the scores of the patients were recorded. The patients were categorized according to Gross Motor Function Classification System (GMFCS). GMFCS is a standard 5-level system used to classify the gross motor functions of children with CP, which was developed by Palisano et al. in 1997<sup>4)</sup>. The reliability of the Turkish version of the scale was previously demonstrated<sup>5)</sup>.

GMFM is a standardized observational test used to measure temporal changes in gross motor functions of children with CP. A manual and CD of the criteria were prepared, with the approval of Russel et al., and were brought to the study sessions, and patients were scored according to this manual<sup>6)</sup>.

All of the patients received Bobath treatment, administered by a physiotherapist, for 1 hour per day, 5 days a week. Patients with limited joint movement also performed stretching exercises. Assistance and orthoses were provided according to clinical, neurological and orthopedic evaluations. Furthermore, during the hospitalization period the patients' permanent caregivers were informed about CP and were given instruction in a home exercise program.

The locomotor system, neurologic and orthopedic examination, GMFM, and GMFCS evaluations, were evaluated at the time of admission to hospital, and again at discharge from hospital, and at 1 and 3 months after discharge. The duration of hospitalization was determined by a physiatrist supervisor who was unaware of which patients were included in the study.

The patients were evaluated by an ophthalmologist. Interesting toys were used during the examination. Agitated patients were given anxiolytic syrup. The examination used evaluation methods such as visual acuity, eye movements, VEP (visual evoked potential), and ERG (electroretinography).

Children in the 4–12 age group were evaluated using the SD Porteus and Kent EGY tests by a psychologist specializing in related tests.

The time of discharge was decided by a clinical trainer specialist who was unaware of which children were included in the study.

Approval for this study was obtained from the ethics committee of our hospital. Since the patients were of pediatric age, written consent for participation was obtained from their parents or legal guardians.

The Wilcoxon paired test and paired t-test were used after repeated measures ANOVA, to compare patient data recorded at different times. Spearman's correlation test was used to assess the correlation between CP type and mental condition.

## RESULTS

A total of 43 CP patients were initially included in this study. However, 15 patients were excluded from the study and the results of only the remaining 28 patients were eval-

**Table 1.** Classification of our CP patients (according to European CP follow-up group)<sup>1)</sup>

SP type (new classification)	N	%
Spastic bilateral	20	71.43
Spastic unilateral	4	14.29
Dyskinetic	2	7.14
Mixed	2	7.14
	28	100

**Table 2.** Classification of our CP patients

CP type	N	%
Spastic diplegic	13	46.4
hemiplegic	4	14.29
quadriplegic	7	25.00
Ataxic	1	3.57
Hypotonic	1	3.57
Mixed	2	7.14
	28	100

uated. The reasons for exclusion from the study included patients' desire for discharge before the completion of rehabilitation aims, 2 patients, and irregular or non-attendance at follows up for the remainder.

The 28 children with CP who were evaluated were within the 2–12 age group (mean 6.96±2.82 years), 12 (42.9%) were male, and 16 (57.1%) were female. Twenty-four of the patients were spastic in terms of clinical type (Tables 1 and 2).

Family histories showed that the parents of 10 (35.7%) of the participants were first-degree relatives.

Average age of diagnosis was 11.9±14.19 months; average age until rehabilitation was 35.6±30.56 months.

The average interval from time of diagnosis to start of rehabilitation was 23.7±29.88 months. Although 71.4% of the children were identified with a problem within their first two years, only 9 (32.1%) started rehabilitation (Table 3).

Of the 28 patients, 20 were evaluated by a specialist ophthalmologist. One patient was found to have a normal eye examination. Hypermetropia, myopia and astigmatism were not considered as refraction defects. These were the most frequent findings, followed by strabismus and optic disc paleness which is a retinal examination finding (Table 4).

Analysis of speech problems showed that 6 (21.43%) patients had normal speech, while 7 (25%) had dysarthria, 9 (32.4%) were able to speak 1–2 words and 6 (21.43%) could not speak.

Twenty patients were tested by a psychologist to determine their mental condition. Three (15%) were found to have normal intelligence; 7 (35%) had mild mental retardation; 8 (40%) had moderate mental retardation, and 2 (10%) had severe mental retardation. We found no correlation between the degree of mental retardation and CP type ( $r=0.11$   $p=0.932$ ).

**Table 3.** Identification of the problem and rehabilitation starting time in CP patients

	n	%
Identification of the problem before 12 months of age	20	71.4
Identification of the problem after 12 months of age	8	28.6
Starting rehabilitation before 12 months of age	9	32.14
Starting rehabilitation after 12 months of age	19	67.86

**Table 4.** Diagnosis of CP patients after eye examination

Diagnosis	Sub-group diagnosis	n
Refraction defect	Hypermetropia	14
	Myopia	4
	Astigmatism	12
Strabismus	Esotropia	4
	Exotropia	3
Pale optic disc		6
Other	Optic nerve coloboma	1
	Traumatic optical atrophy	1

**Table 5.** Comparison of GMFM Scores

GMFM total score	Mean±SD	p value
Admission	34.02±28.95	0.002*
Discharge	41.08±28.55	
Admission	34.02±28.95	0.001*
1 month follow-up	39.62±26.50	
Admission	34.02±28.95	0.001*
3 month follow-up	40.35±27.02	
Discharge	41.08±28.55	0.006*
1 month follow-up	39.62±26.50	
Discharge	41.08±28.55	0.007*
3 month follow-up	40.35±27.02	
1 month follow-up	39.62±26.50	0.096
3 month follow-up	40.35±27.02	

\*p&lt;0.01

The mean hospitalization time for rehabilitation was 50.9±18.45 days.

The patients were grouped according to GMFCS. Level 5 included 9 patients at the time of admission and 6 at the 3-month follow-up. Similarly, the number of patients in Level 4 decreased from 11 at the time of admission to 9 at the 3-month follow-up. Conversely, the number of patients in Level 3 increased from 2 to 7.

There was no significant difference in the GMFM total score between 1 and 3-month follow-up. However, in a comparison of pre-hospitalization score with post-discharge scores at 1 and 3 month follow-up, both the post-discharge scores showed significant increases when comparing with admission. However there was a significant decrease in GMFM score between discharge and 1st month (Table 5).

Sub-group scores were calculated separately. Comparison among the four evaluation times showed a significant increase in sitting and standing parameters at 1-month and 3-month follow-up ( $p<0.05$ ). Crawling and kneeling sub-groups only showed a significant decrease between discharge and 1-month follow-up scores. Similarly, walking–running–jumping scores showed a significant increase at the time of discharge, a decrease at 1-month follow-up and an increase at 3 month follow-up ( $p<0.05$ ).

Of the permanent caregivers, 24 (85.71%) were the patient's mother, while the caregivers in 4 cases (14.29%) were other relatives (aunt, grandmother, stepmother).

## DISCUSSION

CP has a mean incidence of 2–3/1000, although it shows variations on a country basis<sup>7</sup>. In a multi-centric cross-sectional study carried out in 27 cities in 1996 including 146 doctors 50,000 children aged 0–16, the prevalence of CP was 0.2% in Turkey<sup>8</sup>.

Since the presence and severity of accompanying prob-

lems shows wide variation, CP is regarded as a group of symptoms rather than a disease. Therefore, rehabilitation of individuals with CP requires a multidisciplinary approach that addresses the patients' needs more than the disease. Evaluation of CP rehabilitation results are rather difficult, since patients have differing developmental and motor levels. It is therefore difficult to determine whether observed improvements are the result of rehabilitation or a natural outcome of growth and development.

This study evaluated the rehabilitation results of 28 pediatric CP inpatients. The literature in Turkey contains a limited number of such studies. The use of 1-month and 3-month follow-ups permitted ongoing monitoring of rehabilitation and developmental outcomes at home following discharge from the hospital. Thus, the information provided to caregivers about their children's condition was repeated, and they were encouraged to perform certain exercises at home. However, a large proportion of patients failed to attend the follow-ups, and were lost to follow-up.

In the present study, 57.1% of patients were female and 42.9% were male. This differs from a study carried out in 14 centers in Europe, which reported that the proportion of male patients was higher ( $M/F=1.33$ )<sup>9</sup>.

The spastic type of CP is most prevalent<sup>1</sup>, comprising approximately 75% of all cases<sup>7</sup>. Recent prevalence studies validate this finding<sup>9, 10</sup>. Similarly, in this study, the spastic type had the highest prevalence.

Early diagnosis of CP is important for the start of early rehabilitation. The caregivers were asked to report the first identification of the child's problem. Although 71.4% of the patients were identified with problems in the first year of

life, only 31.4% started rehabilitation in the first year. In a CP population analyzed by Boyle et al., the level of diagnosis before the age of 2 was 35%, while 87% of patients were diagnosed before the age of 5<sup>11)</sup>.

Among our patients, 14 had hypermetropia, 12 had astigmatism and 4 had myopia. Similarly, 7 patients had strabismus, and 6 patients had pale optic disc, which is a retinal examination finding. In a study by Yüksel et al. of 41 CP patients, 24 (58.6%) had various visual impairments. They found that 43.9% of patients had strabismus, while 24.3% had refraction defects<sup>12)</sup>. Similarly, in a meta-analysis, Ashwal et al. reported that 28% of CP patients had visual impairment and ocular motility<sup>13)</sup>. In a multicentric study carried out in Europe, 11.1% of the patients with CP were reported to have severe visual defects<sup>9)</sup>. The differing prevalence of visual impairment conditions is associated with variations in the time and severity of brain damage, involvement location, and thus the occurrence of different visual problems according to CP type. The literature contains studies to define visual findings in a CP type<sup>14, 15)</sup>. However, the important thing is that children with CP commonly experience visual problems; therefore, eye examination should certainly be made, even if there is no visible finding. The importance of a multidisciplinary approach is emphasized once more.

Mental retardation is another problem of CP patients. The incidence of mental retardation was reported as 30–50%<sup>16, 17)</sup>. In our study, 3 (15%) patients had normal intelligence, 7 (35%) had mild mental retardation, 8 (40%) had moderate mental retardation and 2 (10%) had severe mental retardation. Approximately one-third of those with mental retardation had a mild degree of retardation. Athetotic types have better mental conditions than others. On the other hand, severe mental retardation is observed in spastic quadriplegic children with rigid, atonic and severe involvement<sup>16–19)</sup>. In this study, there was no correlation between the degree of mental retardation and cerebral palsy type. Another significance of mental condition in children with CP is that, as the degree of mental retardation increases, life expectancy decreases<sup>18)</sup>.

We used GMFM to evaluate rehabilitation results. GMFM is a motor function criteria designed by Russel et al.<sup>20)</sup> to measure the effectiveness of physical therapy in CP patients. In a study of 111 children with CP, evaluation scores of physiotherapists, families and blind evaluators were found to be significantly correlated. Thus, GMFM is sensitive to positive and negative changes in patients' condition<sup>20)</sup>. Nordmark et al. reported that GMFM provided reliable scoring between different evaluators and scoring at different times by the same evaluators<sup>21)</sup>. GMFM is a valid and reliable method that has been commonly used in recent years to evaluate the effects of physical therapy, medical therapy and orthopedic therapies on motor functions among children with CP. There is a large body of research on botulinum toxin, pallus stimulation, therapeutic electrical stimulation, muscle tendon surgery, walking aids and orthosis, hippotherapy, strengthening walking exercises<sup>6)</sup>.

In this study, mean GMFM score was 34.02 ± 28.95 at the time of admission and it increased significantly to 41.08 ±

28.55 at the time of discharge. This result indicates that rehabilitation during hospitalization was effective at improving motor function. Furthermore, there was a statistically significant difference between the 1-month and 3-month follows-up compared with the admission total score. There was a significant difference between discharge total score and 1-month and 3-month follow up. This suggests that the information and home-based exercise training provided for caregivers in order to enhance daily living activities might have maintained the significant increase in GMFM total score comparing with admission. Decrease in GMFM at 1st month comparing with discharge could be the adaptation of home again. However, the increase in total scores between the 1-month and 3-month follows-up was not significant. It can be inferred from the finding that the mothers were motivated and eager in the first month after discharge from hospital, but subsequently lost motivation. In a previous Turkish study, Doğan et al. analyzed GMFM scores at the time of admission and discharge among children hospitalized with CP. Their study reported mean age, female/male ratio and mean hospitalization stay similar to those of the present study<sup>22)</sup>. Similarly, there was a significant increase in GMFM and discharge total and sub-group scores. These findings suggest that rehabilitation programs have a positive impact on the gross motor functions of children.

There is a large body of research on the effects of various treatment methods for CP, many of which have investigated methods to reduce spasticity. Knox et al. (2001) analyzed the effect of therapy methods using GMFM. Total scores increased significantly among children who received 6-weeks of Bobath therapy<sup>23)</sup>.

In another study that used GMFM, patients who received a combination of physiotherapy, hypnotherapy, hydrotherapy and occupational therapy were followed for 18 months after the therapy<sup>24)</sup>. Analysis of two different groups that received either intensive therapy or routine physiotherapy showed no long-term difference in GMFM.

Although that study had a different aim, it resembles the present study in terms of evaluation of rehabilitation results and the use of GMFM; patients received physical therapy as outpatients; and the use of 18-month follow-up enabled the researchers to observe long-term outcomes.

Doğan et al. evaluated rehabilitation outcomes of children with CP. Patients were allocated to sub-groups according to calendar age and the Denver Development test age. Patients were evaluated according to the GMFCS with respect to CP type<sup>22)</sup>. Due to the small number of patients in the present study, and since GMFCS provides better indication of motor development, we preferred not to make comparisons according to CP type; instead, our patients were allocated to monitoring sub-groups according to the GMFCS. The present study aimed to analyze the distribution in groups rather than measuring changes in motor function.

The limitations of our study include:

- 1) The children in this study had different types of CP and GMFCS levels, so we were comparing the rehabilitation results of a heterogeneous group. However, all of the participants were children diagnosed with CP who were treated via physiotherapy as inpatients. Furthermore, the

literature contains other studies that included participants with different GMFCS levels and different types of CP<sup>24</sup>).

2) Duration of inpatient stay differed. However, an upper limit was set according to Bobath, and the duration of hospitalization was determined by a physiatrist supervisor who was unaware of which patients were included in the study.

3) The study included no control group; however, potential delays associated with such a methodology mean that it is ethically inappropriate to exclude a child with CP from rehabilitation for a period longer than 3 months.

In light of the research findings, and considering the limitations of similar studies, there is a need for further randomized controlled studies with more activity and participation parameters and a larger sample of CP patients.

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