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Original Article

Rehabilitation outcomes in children with cerebral palsy during a 2 year period

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Abstract. [Purpose] To observe motor and functional progress of children with cerebral palsy during 2 years. [Subjects and Methods] Pediatric cerebral palsy patients aged 3–15 years (n = 35/69) with 24-month follow-up at our outpatient cerebral palsy clinic were evaluated retrospectively. The distribution of cerebral palsy types was as follows: diplegia (n = 19), hemiplegia (n = 4), and quadriplegia (n = 12). Participants were divided into 3 groups according to their Gross Motor Functional Classification System scores (i.e., mild, moderate, and severe). All participants were evaluated initially and at the final assessment 2 years later. During this time, patients were treated 3 times/week. Changes in motor and functional abilities were assessed based on Gross Motor Function Measure-88 and Wee Functional Independence Measure. [Results] Significant improvements were observed in Gross Motor Function Measure-88 and Wee Functional Independence Measure results in all 35 patients at the end of 2 years. The Gross Motor Function Measure-88 scores correlated with Wee Functional Independence Measure Scores. Marked increases in motor and functional capabilities in mild and moderate cerebral palsy patients were observed in the subgroup assessments, but not in those with severe cerebral palsy. [Conclusion] Rehabilitation may greatly help mild and moderate cerebral palsy patients achieve their full potential.
Key words: Cerebral palsy, Outcome, Physical therapy

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INTRODUCTION

Cerebral palsy (CP) covers the broadest spectrum of childhood posture and movement disorders. CP patients have static brain lesions and clinical manifestations that change over time during growth and development of the affected individual. The wide range of problems associated with CP poses difficulties in patient assessment and achieving rehabilitation targets[1, 2)]. Rehabilitation of CP requires a multidisciplinary approach. The family and team of specialists should establish the most appropriate approach after determining the treatment goal. Although there are several treatment modalities, scientific evidence regarding the basis for treatment decisions is limited. The heterogeneity of CP and the absence of controls and results of disease specific measures are responsible for the lack of evidence[1)].

The goal of rehabilitation of CP is to reduce secondary musculoskeletal deformity rather than treating the primary central neurological deficit. Medical management may also be required in addition to physical, occupational, and speech therapy. Different management approaches are utilized in different institutions[2)]. Most physical therapies are based on the principles of neuroplasticity, patterning, postural balance, and muscle strengthening or stretching. In addition, there are conductive education therapies, which include integrated education programs[3, 4)]. However, there is no scientific evidence for the superiority of one treatment over another. Healthcare providers often use these therapeutic approaches in combination with functionally based therapies. The ideal duration and frequency of these therapies have not been established[1)]. The superiority of intermittent high-frequency treatments has not yet been successfully demonstrated in controlled studies[5, 6)].

CP has a reported global prevalence of 2–3.5 per 1,000 live births[7, 8)] and 4.4 per 1,000 live births in Turkey[9)].

Special education and rehabilitation centers exist in Turkey for children with CP covered by social security. These centers usually utilize a combination of therapeutic methods that are tailored to the needs of each child. In this study, we aimed to review long-term outcomes of rehabilitation in children undergoing such therapies.

SUBJECTS AND METHODS

We conducted a retrospective review of medical records in 65 pediatric patients with CP who were followed-up for 2 years from 2011 to 2013 at the CP outpatient clinic of Istanbul Medeniyet University, Goztepe Training and Re-

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search Hospital, Istanbul, Turkey. The approval to conduct this study was obtained from the The Institutional Board and local ethics committee at Istanbul Medeniyet University, Goztepe Trainig and Research Hospital, Istanbul, Turkey. Written informed consent provided from the parents/guardian of the children prior to enrolling in the study. Eleven children with CP were excluded due to a change in address leading to discontinuation of therapy; 19 children met the study exclusion criteria (i.e., priorly received botulinum toxin injection or had major surgery performed within the last 6 months). The study was completed by 35 CP patients who received continuous physical therapy for 24 months and were followed-up by our team. All patients were diagnosed with CP by a pediatric neurologist.

At the time of treatment initiation, children were enrolled in treatment programs at special rehabilitation centers after being examined by a physiatrist with expertise in CP and a physiotherapist working at our clinic. Patients received physiotherapy 3 times/week, which included traditional physiotherapy approaches and neurodevelopmental therapy. Depending on individual needs, patients were administered botulinum toxin injections, and assistance and orthosis were provided. Those patients who required surgical operation were referred for orthopedic intervention. Their caregivers were instructed to perform home-based exercises. All children were reexamined at the end of the 2 year treatment program by the same medical team.

Children with CP were classified according to the number of limbs affected as follows: quadriplegic, an impairment of the trunk and 4 limbs; diplegic, involvement of the lower extremities; and hemiplegic, only one side of the body was affected. Patients were evaluated using a locomotor system examination, Gross Motor Function Classification System (GMFCS), Gross Motor Function Measure-88 (GMFM-88), and Wee Functional Independence Measure (WeeFIM).

The GMFCS, commonly used in cerebral palsy studies, is a reliable and valid scale, which is based on self-initiated movement with a particular emphasis on sitting (truncal control) and walking[10]. The GMFCS consists of 5 levels; level 1 indicates independent mobility and level 5 indicates full dependency[11]. The reliability of the Turkish version of this scale was previously demonstrated[12].

Harries et al. have investigated changes in gross motor function during 6 months in children with CP aged 3–8 years who were classified using the GMFCS as mild, moderate, or severe[13]. In the present study, we also used the same classification for patient assessment. GMFCS level 1 and 2 patients walk without and with limitations, respectively. GMFCS levels 1 and 2 were classified together as mild. GMFCS level 3 patients walk with adaptive equipment assistance and were classified as moderate; level 4 and 5 patients who had no self-mobility were classified as severe. Based on this classification, the mild and moderate groups both contained 12 patients and the severe group had 11 patients.

The GMFM-88 is a valuable standardized test designed to examine the achievements and limitations of gross motor function in children with CP, monitor progress of the individual child, and evaluate the treatment outcomes of programs for this population[14]. The GMFM-88 is very reliable for assessing the mobility and functional ability of children with CP[15]. GMFM-88 consists of 88 items, which are scored as 0–3 points based on how well each of the following 5 activities are performed: lying and rolling (A), sitting (B), crawling and kneeling (C), standing (D), and walking, running, and jumping (E).

Table 1. Characteristics of the study participants

Characteristic	Value
Age (years)	3–15 (median 6)
Treatment course (sessions)	312
Duration of treatment (months)	24
Gender	
Male	23 (65.7%)
Female	12 (34.3%)
Type of involvement	
Diplegic	19 (54.3%)
Hemiplegic	4 (11.4%)
Quadriplegic	12 (34.3%)

The WeeFIM was used to evaluate the health of the patients, their developmental condition, educational level, and degree of local sociality. Items of the WeeFIM are scored as 1–7, where 1 indicates total assistance and 7 indicates complete independence. The lowest and highest possible score is 18 and 126, respectively[16]. The reliability and validity of the Turkish version of the WeeFIM for assessing the functional status in Turkish children with CP have been demonstrated[17, 18].

Statistical Package for Social Sciences (SPSS) for Windows 19.0 software package (IBM, New York, USA) was used for statistical analyses of study findings. Study data were analyzed using statistical methods (i.e., median and minimum-maximum) and Wilcoxon signed rank test was used for intragroup comparisons of quantitative parameters that did not follow a normal distribution. The associations between GMFM-88 and WeeFIM scores were analyzed using Spearman correlation analysis. Results were reported with 95% confidence intervals and a p-value <0.05 was considered significant.

RESULTS

The age range of the 35 children with CP was 3–15 years (median, 6 years). All CP patients had spastic type CP and most of them were boys with a diplegic predominance. Two children with athetoid form of CP and 4-limb involvement were included in the quadriplegic group. The characteristics of the study participants are illustrated in Table 1. A highly significant increase in GMFM-88 scores was observed after 24 months of treatment compared to baseline when all children were evaluated together ($n = 35$; $p = 0.000$). In addition, A highly statistically significant increase in WeeFIM values of the whole group was observed at the end of 24 months ($p = 0.000$; Table 2).

Significant increases were observed in gross motor function (Table 3) and functional measure scores (Table 4) following treatment among patients with mild and moderate disease. However, the reduction in GMFM-88 scores

Table 2. Gross Motor Function Measure-88 and Wee Functional Independence Measure results of patients with cerebral palsy (n = 35)

	Initial (median)	Final (median)
GMFM-88	125	176*
WeeFIM	46	71*

*p < 0.001, Wilcoxon signed rank test; GMFM-88: Gross Motor Function Measure-88; WeeFIM: Wee Functional Independence Measure

Table 3. Changes in the Gross Motor Function Measure-88 scores (pre-treatment–post-treatment)

	n	Initial (median)	Final (median)
Mild	12	218.5	247.5**
Moderate	12	123	175**
Severe	11	25	15

**p < 0.01, Wilcoxon signed rank test

Table 4. Changes in the Wee Functional Independence Measure scores (pre-treatment − post-treatment)

	n	Initial (median)	Final (median)
Mild	12	79	112***
Moderate	12	47.5	68**
Severe	11	18	19*

*p > 0.05, **p < 0.05, ***p < 0.01, Wilcoxon signed rank test

Table 5. Changes observed in Gross Motor Function Measure-88 and Wee Functional Independence Measure scores at the end of 2 years

	Increased	Decreased	No change
GMFM-88	26	8	1
WeeFIM	26	5	4

GMFM-88: Gross Motor Function Measure-88, WeeFIM: Wee Functional Independence Measure

observed among the severe group was not statistically significance. In addition, post-treatment changes in WeeFIM scores were not statistically significant in patients in the severe groups.

An increase, decrease, and no change in GMFM scores was observed in 26, 8, and 1 patient(s), respectively, according to the GMFM-88 evaluation after 24 months of treatment (Table 5). However, WeeFIM scores were increased, decreased, and unchanged in 26, 5, and 4 patients, respectively (Table 5). There was a significant correlation between baseline GMFM-88 and WeeFIM scores and post-treatment GMFM-88 and WeeFIM scores (p = 0.000).

DISCUSSION

Significant improvements in gross motor function were found when all (n = 35) pediatric CP patients were assessed together after 2 years. Individual evaluation of groups showed significant increases in both GMFM-88 and WeeFIM scores for mild and moderate groups. Yi et al. observed a marked improvement in gross motor function in 45 children with CP after 6 months of rehabilitation and attributed this improvement to a longer treatment duration, baseline GMFM-88 scores, and absence of a concomitant disorder. GMFM-88 scores were increased in both groups in this previous study, including diplegic and quadriplegic patients. A greater improvement was observed in diplegic patients compared to severely affected patients, albeit not statistically significant[19]. In contrast, a statistically significant change was not observed in GMFM-88 scores among our severely affected patients. Treatment was provided twice daily for 5 days/week in the study by Tae et al., which was different compared to our study.

Improvements in GMFM-88 scores were observed in all 3 groups (i.e., hemiplegic, diplegic, and quadriplegic) in a study with different types of CP patients after 8 months of treatment. According to that study, although a substantial improvement in motor performance was detected during the first 4 months in hemiplegic and quadriplegic children, the trend was not maintained in the succeeding 4 months. However, diplegic children displayed an improving trend during the succeeding 4 months. Average GMFC scores of quadriplegic children were found to be lower compared to those of other groups[20].

In a retrospective study by Harries et al., 106 children with CP were evaluated after 7 years of follow-up using GMFM-88, and an increase in GMFM-88 scores was observed among mild, moderate and severe CP groups. While the speed of improvement varied according to the severity of motor disability, both mild and severe groups reached their maximum gross motor function within the 7 year follow-up[13].

The developmental patterns of children with spastic diplegic (SD) and spastic quadriplegic (SQ) CP were compared in the study by Chen et al. In that study, it was observed that children with SQ had lower development quotients in all developmental functions compared to SD children[21]. In a similar study, gross motor functions and developmental patterns improved with age and were correlated with the degree of ambulatory function in diplegic children; however, these results were not observed among SQ children[22]. These findings corroborate our results of quadriplegic patients (i.e., severe group).

We found that the gross motor function and WeeFIM scores of children were correlated prior to treatment and following 24 months of rehabilitation. In our study, children with mild and moderate CP had higher post-treatment WeeFIM scores compared to baseline, which were consistent with their improved gross motor function, but there was no significant change in children with severe CP. In a study by Damiano and Abel, children with CP who achieved highest functional ambulation scores had higher GMFM-88 scores[23]. Beckung and Hagberg have stated that gross motor functions of children with CP are crucial for their physical independence and mobility[24]. The pre-treatment and post-treatment GMFM-88 and WeeFIM scores were determined

to be correlated in a study involving children with CP after 1 year rehabilitation[25]. However, no correlation was found between GMFM-88 and WeeFIM scores of children with CP in a contrasting study[26].

Major limitations of our study included the fact that patients were treated at different centers and a small sample size. While a non-intensive (i.e., 3 times/week) rehabilitation program provided marked motor improvement and increased functional capacity at the end of 2 years in children with mild and moderate CP, which helped them reach their full potential, there was no such improvement in patients with severe CP. Our findings are comparable to several previous studies in this area. Identification and anticipation of problems experienced by children with severe disability would help patients and their families prepare better for the future.

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