Effects of a Functional Therapy Program on Motor Abilities of Children With Cerebral Palsy

Background and Purpose. The purpose of this study was to determine whether the motor abilities of children with spastic cerebral palsy who were receiving functional physical therapy (physical therapy with an emphasis on practicing functional activities) improved more than the motor abilities of children in a reference group whose physical therapy was based on the principle of normalization of the quality of movement. **Subjects.** The subjects were 55 children with mild or moderate cerebral palsy aged 2 to 7 years (median=55 months). **Methods.** A randomized block design was used to assign the children to the 2 groups. After a pretest, the physical therapists for the functional physical therapy group received training in the systematic application of functional physical therapy. There were 3 follow-up assessments: 6, 12, and 18 months after the pretest. Both basic gross motor abilities and motor abilities in daily situations were studied, using the Gross Motor Function Measure (GMFM) and the self-care and mobility domains of the Pediatric Evaluation of Disability Inventory (PEDI), respectively. **Results.** Both groups had improved GMFM and PEDI scores after treatment. No time × group interactions were found on the GMFM. For the PEDI, time × group interactions were found for the functional skills and caregiver assistance scales in both the self-care and mobility domains. **Discussion and Conclusion.** The groups' improvements in basic gross motor abilities, as measured by the GMFM in a standardized environment, did not differ. When examining functional skills in daily situations, as measured by the PEDI, children in the functional physical therapy group improved more than children in the reference group. [Ketelaar M, Vermeer A, 't Hart H, et al. Effects of a functional therapy program on motor abilities of children with cerebral palsy. *Phys Ther*. 2001:81:1534–1545.]

Key Words: *Cerebral palsy, Children, Function, Motor abilities, Physical therapy.*

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erebral palsy is a description, not a specific diagnosis, that covers a number of neurological conditions resulting in abnormal development of movement and postural control. A recent consensus definition of cerebral palsy is: "an umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development."[1(p549)] No evidence exists that the brain damage can be reversed[2,3]; however, matura-tional and adaptive processes may change the clinical picture of the child over time.[4] Treatment for cerebral palsy, therefore, focuses on how best to help the individual maximize his or her potential.[5] Children with cerebral palsy typically receive physical therapy to facilitate motor development and to enhance their independence in motor skills, self-care, play, and leisure activities.[5] Over the years, many systems of treatment have been developed (eg, neurodevelopmental treatment [NDT], the Vojta method, conductive education, sensory inte-

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grative therapy) that differ in their specific treatment strategies, but aim at leading children with cerebral palsy toward the greatest degree of independence possible.[5] When distinguishing therapeutic approaches on their main emphasis, 2 basic principles can be recognized[6]: (1) emphasis on normalization of the quality of movement or (2) emphasis on functional activities.

The most common current therapeutic approaches, such as NDT and the Vojta method, focus on the first principle and can be classified as neurophysiological approaches.[2] In general, therapeutic approaches are based on both implicit and explicit assumptions associated with an underlying theory of motor development or motor control. Although other authors do not use the same terms to classify these approaches (other authors refer to them as "neurofacilitation approaches"[7] and "neuromaturational approaches"[8]), these approaches are based largely on assumptions drawn from the neuromaturational theories of motor development.[7–10] The main assumption of neuromaturational theories is that the development of movements and motor skills results solely from the neurological maturation of the central nervous system: higher centers inhibit and control lower centers, thereby allowing voluntary movements. In this view, cerebral palsy is seen as a disorder in which the abnormal patterns of posture and movement result from lack of inhibition of lower levels of the central nervous system. Neurophysiological approaches focus on eliciting and establishing normal patterns of movement through controlled sensorimotor experiences. These sensorimotor experiences are intended to inhibit abnormal movements and to facilitate postural adjustments to promote functional movement.[3]

In recent years, numerous publications have questioned both the assumptions and the effectiveness of neurophysiological approaches.[2,9,11–15] Criticism has been focused primarily on the problem of functional carryover, with authors questioning whether facilitated automatic movement improves voluntary, active movement. Some neurophysiological approaches, however, have evolved over the years. Bly,[16] for example, described changes in the practice of NDT and its theoretical construct that have occurred as knowledge of motor control has evolved. Postural control, functional activities, and active participation of the child are now emphasized; however, a strong emphasis continues to be placed on handling techniques to influence muscle function and patterns of posture and to organize movements.[10]

More recent theories on motor development and motor control, such as the ecological approach introduced by Gibson[17] and the dynamical systems approach described by Thelen and Smith[18] and Kelso,[19] emphasize that motor behavior or developing behaviors should not be viewed as the unfolding of predetermined or prescribed patterns represented in the central nervous system. These theories, often referred to by the umbrella term "action approach,"[20,21] reject the hierarchical view in favor of a so-called "heterarchical" view in which motor development and coordination are assumed to emerge from the dynamical interaction of many subsystems in a task-specific context.

Several articles and textbooks have elaborated on the implications of the action approach for assessment and intervention for people with movement deficits.[8–10,22–25] The focus of assessment and intervention strategies is on functionality. Although neurophysiological approaches emphasize facilitation of normal movement patterns, the functional approach emphasizes the role of the environment and the task in the performance of functional activities. Movement exploration and selection to find solutions to new task demands and the adaptation to changes in the environmental context are assumed to be critical parts of motor learning. In this view, the environment elicits action, and the individual actively explores the environment to detect information that supports the actions necessary to achieve the goal.[18] The functional approach, therefore, is based on an active rather than a passive view of motor learning; people learn by actively attempting to solve the problems inherent to a functional task, rather than repetitively practicing normal patterns of movement.

Because each environmental and task situation demands a unique solution, the task of the therapist is not to elicit specific responses by handling the child, but to provide an environment that enables the child to learn to perform self-initiated actions within naturally occurring restraints.[23,26] This can be viewed as a conceptual shift from focusing on normality to focusing on functionality. In this view, it is more important for the child to perform a task as functionally as possible than to perform it as normally as possible.

This study focused on the effects of a functional approach to physical therapy for children with cerebral palsy. *Functional physical therapy*, as defined in this report, emphasizes the learning of motor abilities that are meaningful in the child's environment and perceived as problematic by either the child or the parents. Children practice these motor abilities in functional situations, with the child having an active role in finding solutions for motor problems rather than having the physical therapist's handling result in a solution. Functional goals, in terms of skills, are established with parents and children based on their priorities. Functional activities are assumed to be learned by repetitive practice of goal-related tasks in functional situations.

Evaluation of treatment for cerebral palsy is complicated by the fact that therapists often do not use therapeutic approaches uniformly. Therefore, we first performed a pilot study in which we examined the intervention of all children who were referred to us to participate in the study. We asked their therapists to describe the methods of therapy they used with the children and their treatment goals. We concluded that all participating therapists based their therapy mainly on the principle of normalization of the quality of movement.[27] After this baseline study, half of the therapists were trained to systematically apply the principles of functional physical therapy. The purpose of the study was to examine whether the motor abilities of children with cerebral palsy who were receiving functional physical therapy improved more than the motor abilities of children in a reference group whose therapy was based on the principle of normalization of the quality of movement. We hypothesized that the children in the functional physical therapy group would improve more over time than the children in the reference group.

Method

Participants

Pediatric physical therapists working in primary health care in the Netherlands were invited to participate in the project. Each therapist could participate with a maximum of 4 children. Children were referred for participation in the study if they met the following inclusion criteria: having cerebral palsy (diagnosed by pediatrician or rehabilitation specialist), being between 2 and 7 years of age, not attending a school for special education, and not being treated at a rehabilitation center. At schools for special education and at rehabilitation centers, children often receive a combination of treatments, such as occupational therapy, play therapy, and speech therapy, which could be confounding variables. The parents must have understood the Dutch language and signed a parental informed consent statement for participation in the study.

Sixty-one children (median age=55 months, average=56 months, range=24–87 months; n=35 with hemiplegia, n=14 with diplegia, n=12 with quadriplegia) who met the inclusion criteria were referred to us by 37 therapists. All children were diagnosed with mild spastic cerebral palsy (use of both hands and/or gait is clumsy) (n=46) or moderate spastic cerebral palsy (able to use affected hand in bimanual activities and/or impaired gait) (n=15).[28]

The children were assigned to 1 of 2 groups: a group that received functional physical therapy and a reference group whose physical therapy was based on the principle of normalization of the quality of movement. Because we expected that age and type of cerebral palsy could be important variables that should be considered equally in both groups, a prestratified randomization procedure was applied to ensure an equal distribution of subjects. The children were separated into 6 blocks based on age (≤48 months and >48 months) and based on type of cerebral palsy (hemiplegic, diplegic, or quadriplegic). Within each of the 6 blocks, most children were then randomly assigned to the treatment conditions. Because we believed it to be undesirable for therapists to perform the "old" treatment for one child and the "new" functional treatment for another child, we decided to assign all children of the same therapist to the same group; therefore, pure random assignment for each child was not possible. Randomly assigned children "took their physical therapist with them"; for example, when a child of a therapist participating with more than one child was assigned to the reference group, the other children treated by the same therapist were also assigned to the reference group. Due to this procedure, 24 children were assigned based on the assignment of another child and thus were not entirely randomly assigned.

During the study, 2 children (1 from each group) were referred to a child rehabilitation center and 1 child in the reference group was later diagnosed as being autistic. Three children (2 in the functional physical therapy group and 1 in the reference group) changed therapists during the course of the study due to illness of the therapist or because the child's family moved to another town, and the new therapist declined to participate in the study. The data of these 6 children were not included in the data analysis; the data of the remaining 55 children (median age=57 months, average=55 months, range=24–87 months; n=32 with hemiplegia, n=11 with diplegia, n=12 with quadriplegia) were analyzed.

Twenty-eight children were in the functional physical therapy group, and 27 children were in the reference group. Characteristics of the children, therapists, and frequency of therapy at the baseline measurement are shown in Table 1. Using t tests for the continuous variables and chi-square tests for the categorical variables, we found no differences between the groups ($P>.05$). Using the Dutch registration file for pediatric physical therapists, we concluded that the ages of therapists who participated in the study were representative of the Dutch professional population.

Procedures

After random assignment to groups, all children were pretested, parents were interviewed, and therapists completed a questionnaire (see "Instruments" section). After the pretest measurements, the physical therapists for the functional physical therapy group received a special training program that focused on the systematic application of functional physical therapy. Six months after

Table 1.
Description of the Participants and Frequency of Therapy at Baseline

	Reference Group	Functional Physical Therapy Group
Children	n=27	n=28
Sex		
Female	10	12
Male	17	16
Age (mo)		
$\bar{X}$	56	54
SD	20	20
Cerebral palsy distribution		
Hemiplegia	16	16
Diplegia	5	6
Quadriplegia	6	6
Severity of cerebral palsy		
Mild	21	22
Moderate	6	6
No. of months of physical therapy		
$\bar{X}$	45	41
SD	19	23
Physical therapists	n=20	n=17
Age (y)		
$\bar{X}$	46	42
SD	6	7
No. of years of pediatric experience		
$\bar{X}$	19	18
SD	5	7
Frequency of therapy (times per month)		
$\bar{X}$	3.8	3.4
SD	1.9	1.8

the pretest measurements, the first follow-up assessment took place. Two follow-up assessments occurred at 12 and 18 months after the pretest measurements. In all assessments, the outcome measures were administered to the children and parents by independent evaluators who were trained in the use of the measurement instruments and who did not know the treatment allocation. To get insight into therapeutic practice and the changes in it following the training, therapists completed a questionnaire, which was sent and returned by mail.

The training was developed in close cooperation with a number of pediatric physical therapists who were highly experienced in managing children with cerebral palsy. The first part of the training (2 sessions, 3 hours each) consisted of recent theories of motor development and motor control (action approach) and the practical implications of the theories. The practical implications were incorporated into a model that consisted of a number of stages that the therapists had to follow step-by-step (see "Interventions" section).[27] The therapists received a manual in which all theoretical parts of the training, the

practical implications, and the stage model were described. The manual contained standard forms to guide the therapists through the stages.

After the first 2 training sessions, the therapists started the functional physical therapy program for the children participating in the study. Therapists wrote individual intervention plans and sent them to the trainers, using the forms in the manual. During the next 2 sessions, the individual intervention plans were discussed and experiences of the therapists were considered. After the training, the therapists regularly updated the individual intervention plans and sent them to the trainers, who discussed the plans with the therapists. We also held meetings with the subgroups (5 or 6 therapists per subgroup, based on region), during which questions about the application of the program and the individual programs of several children were discussed. Subgroups were formed to make a more individualized discussion possible. We held 2 meetings with each subgroup. Overall, the training consisted of 4 sessions (3 hours each) in 3 months.

Interventions
The therapists of the children in the reference group continued with their previous physical therapy regimen with no change. Nineteen of the 27 children in that group were treated according a neurophysiological treatment method (NDT or the Vojta method). The other children, according to their therapists, were not treated according to a specific method. After the pilot study, however, in which the therapy methods and intervention goals of all children were examined, we concluded that the focus of intervention for the children was based on the principle of normalization of motor performance and quality of movement.[27]

After the training, the physical therapists of the children in the functional physical therapy group administered the functional physical therapy program. Functional physical therapy, as defined for this study, is directed at promoting functional skills instead of normalization of movement. Because each child has different problems in performing functional skills and the physical and social environments of children are never the same, intervention is not standardized.

The therapy model consists of a number of stages that lead to a task-specific individual therapy plan to master functional skills that are important to the child and the parents. After collection of general information about the physical and social environments of the child and collection of specific information about the child's problems in the performance of functional motor activities, priorities are established with parents and child. A maximum of 3 problematic activities are selected.

In the next stage, the selected problems are analyzed separately. The constraints and possible support from the environment (both physical and social) in which the skill is problematic are determined, as well as individual factors such as specific impairments, functional limitations, and motivational aspects that are related to the functional skill. Not only must therapists analyze which subsystems constrain the performance of the task, but it is even more important that they analyze which constraining subsystems can be changed through intervention. When the constraints are analyzed, long-term goals (directly related to the selected problematic activities) are divided into short-term goals, which are related to the long-term goals, but are less complex. For example, a child falls very often when walking on uneven surfaces. His parents run a farm, and he likes to walk in the stables. His poor ability to stand on one leg and the uneven surfaces in and around the stables are the main factors related to his falling. The long-term goal is formulated as follows: the child walks in and around the stables without falling. Short-term goals are related to this goal; for example: (1) the child steps over a doorstep without holding on to the doorpost, and (2) when standing on a mat, the child kicks a ball without falling. An evaluation date is established for each goal.

In the implementation stage, the short-term goals are practiced in various natural settings. Repetitive practicing takes place in situations that resemble as much as possible the situation in which the activities are problematic. This means that practice takes place in natural situations (mostly at home or outdoors, and maybe in the therapy room when the desired situation can be simulated). The therapist and parents discuss how, when, and where to practice. They also discuss the amount of assistance, the reduction of assistance, the time of day that is most practical for practicing the specific skill (fit into the daily routines), and the setting in which the child practices the skill. The parents, child, and therapist together evaluate the goals at the established dates.

In summary, the main features of the functional approach are the establishment of functional goals, repetitive practice of the problematic motor abilities in functional situations (in a meaningful environment), an active role for the child (the child must find solutions for motor problems), and active involvement of parents in all stages of the program (eg, goal setting, decision making, implementation in daily life, evaluation of goals).

Instruments

Both basic gross motor abilities in a standardized environment and motor abilities in daily situations were studied using the Gross Motor Function Measure (GMFM)[29] and 2 domains of the Pediatric Evaluation of Disability Inventory (PEDI),[30] respectively.

The GMFM[29] is a standardized observational instrument for children with cerebral palsy, developed to measure change in gross motor function over time. The test consists of 88 items that have been grouped into 5 dimensions of gross motor function: (1) lying and rolling, (2) sitting, (3) crawling and kneeling, (4) standing, and (5) walking, running, and jumping. Each item is scored on a 4-point Likert scale. A percentage score is calculated for each dimension.

The GMFM is a validated evaluative instrument designed to detect change in gross motor function of children with cerebral palsy.[31] Intraclass correlation coefficients (ICCs), calculated to study interobserver and intraobserver reliability, were high.[31] In our study, we used a Dutch translation of the GMFM.[32] Interobserver reliability and test-retest reliabilty of the Dutch version of the GMFM were assessed in a sample of children with mild, moderate, or severe cerebral palsy. The ICC for interobserver reliability for the first dimension (lying and rolling) was .75; ICCs for the other dimensions ranged from .96 to 1.00. The ICCs for test-retest reliability ranged from .96 to .99 for the 5 dimensions.[33] The evaluative quality of the GMFM has been confirmed in a study in which the Dutch version was used.[34]

Five pediatric physical therapists who were not involved in the study and 1 of the research assistants were trained to administer the GMFM. For each assessment, the GMFM was administered to the child by the same tester in the same standardized therapy room. Because only children with mild or moderate cerebral palsy whose gross motor problems were mostly related to standing and walking participated in the study, we were mainly interested in the achievements in the fourth dimension (standing) and the fifth dimension (walking, running, and jumping) of the GMFM.

The PEDI[30] is a judgment-based, standardized instrument using parent report through a structured interview. It was administered by independent evaluators (the same evaluator each time) who were trained in its use and who did not know the treatment allocation. The PEDI measures both capability and performance of functional activities in daily life situations in 3 domains: (1) self-care, (2) mobility, and (3) social function. Because the focus of our study was on the children's motor abilities, the social function domain is not discussed in this article. Capability is measured by the identification of functional skills the child has mastered. For this functional skills scale, the parent indicates whether the child is capable of performing each of 197 specific tasks in the 3 domains. Performance of daily functional activities is measured by the level of caregiver assistance the child needs to accomplish major functional activities and by the number of modifications or

amount of adaptive equipment the child uses within each domain. The caregiver assistance scale measures the extent of help the caregiver provides in typical daily situations. The amount of assistance in 20 daily activities is assessed on a 6-point scale ranging from "total assistance" to "independence."

Raw scores of the functional skills scale and the caregiver assistance scale can be transformed into scaled scores, which provide an indication of the performance of the child along the continuum from relatively easy to relatively difficult items in a particular domain. Scaled scores are distributed along a scale from 0 to 100, with increasing numbers representing increasing degrees of functional performance.

Internal consistency of the scales and inter-interviewer reliability for the PEDI are good (alpha values ranging from .95 to .99 and ICCs ranging from .84 to 1.00, respectively). Satisfactory reliability has been found with respect to agreement on the functional status of individual children between parents and rehabilitation team members (ICC=.76–.96).[30,35] Content validity,[36] construct validity,[37] concurrent validity (with the Peabody Developmental Motor Scales)[35] and responsiveness to change[38] have been confirmed. In this study, a Dutch translation of the PEDI was used. Internal consistency and inter-interviewer reliability of the Dutch version were studied. Alpha values ranged from .82 to .92, and ICCs ranged from .80 to 1.00.[27] The reliability of scores obtained with the Dutch version of the GMTM and the PEDI was confirmed in earlier studies.[27,33] For the present study, the evaluators received the same standardized training. Therefore, the reliability of the measurements in this study was not again determined.

We developed a questionnaire for therapists to get a picture of their therapeutic practices and to examine changes in therapeutic practice following the training of the therapists of the children in the functional physical therapy group. Therapists completed a number of open-ended questions that addressed aspects of the therapy of each child, such as frequency, duration of treatment sessions, preparation time, problem definition, goals of therapy, involvement of parents, and evaluation of therapy goals. The answers to the questions about problem definition and therapy goals were analyzed and scored according to the percentage of the answer that referred to functional skills.[39] A problem definition that consisted of 3 parts, for example, in which 1 problem was a functional skill (eg, problems with dressing) and 2 problems were impairments (eg, increased muscle tone and contractures) was scored as 33%. Intraclass correlation coefficients, used to determine interrater reliability and intrarater reliability of the percentage of the problem definition that referred to functional skills, were found to be .80 and .81, respectively.[39] Fifty percent of all problem definitions were scored by 2 evaluators, and these problem definitions were also scored twice by 1 evaluator, with a 1-month period between scorings.

Data Analysis
The hypotheses with respect to the outcome variables were analyzed using a one-tailed repeated-measures analysis of variance (group [2] × time [4]). The probability of Type I error (alpha) was determined as .05. Because some of the therapists participated in the study with more than one child, the data of the children were not completely independent. For this reason, we initially assessed all variables for the effects of the therapist using a repeated-measures analysis of variance.

Results
During the pretest measurements, the groups' scores on the GMFM and the PEDI did not differ (P=.24–.92). The GMFM mean scores and standard deviations of both groups on the fourth dimensions (standing) and the fifth dimension (walking, running, and jumping) of the GMFM are shown in Table 2. A higher score indicates better gross motor function.

For the PEDI functional skills scale, the mean scores and standard deviations of the groups' scores on the self-care and mobility domains are shown in Table 3. Table 4 shows the groups' scores on the caregiver assistance scale of the PEDI. Higher scores for functional skill level and caregiver assistance indicate better performance and more independence, respectively. In Tables 2, 3, and 4, the degrees of freedom and the F values of the main effect of time, the main effect of group, and the effect of group × time interaction using the univariate approach also are shown. Because the sphericity assumption was not met for some of the variables, degrees of freedom for the F ratio were adjusted according to the Greenhouse-Geisser epsilon.[40] For all variables of the GMFM and the PEDI, the effect of the therapist was not significant.

For all domains of the GMFM and the PEDI, an effect of time was found. During the study, both groups improved on all domains. For the GMFM, no differences due to group or due to time × group interaction were found. The groups did not differ with respect to the degree of improvement; both groups improved equally on the fourth domain (standing) and the fifth domain (walking, running, and jumping) of the GMFM.

For the PEDI, a main effect of group was found for mobility in the functional skills scale. The mean scores of the children in the functional physical therapy group were higher than the mean scores of the children in the reference group. Group × time interactions were found for self-care and mobility in the PEDI functional skills

Table 2.
Mean Scores and Standard Deviations for the Group of Children Who Received Functional Physical Therapy (n=28) and the Referral Group (n=27) and Results of the Repeated-Measures Analysis of Variance for Dimensions 4 (Standing) and 5 (Walking, Running, and Jumping) of the Gross Motor Function Measure (GMFM)

| | GMFM (%) | | | | | | | | Effect | | | | | |
| | Pretest | | Follow-up 1 | | Follow-up 2 | | Follow-up 3 | | Time | | Group | | Group × Time | |
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	df^a	F	df	F	df^a	F
Standing														
Referral group	81.2	20.3	87.1	12.5	87.6	11.2	90.8	6.6	1.5	15.93^b	1	0.01	1.5	0.45
Functional physical therapy group	82.8	15.7	85.9	12.9	88.5	12.3	90.6	10.5						
Walking, running, and jumping														
Referral group	70.8	24.4	76.3	20.9	82.1	17.1	84.8	15.5	1.7	79.94^b	1	0.04	1.7	0.59
Functional physical therapy group	70.2	18.2	76.7	16.4	84.1	13.4	86.5	12.8						

[a] Adjusted degrees of freedom using Greenhouse-Geisser epsilon statistic.
[b] $P<.01$.

Table 3.
Mean Scores and Standard Deviations for the Group of Children Who Received Functional Physical Therapy (n=28) and the Referral Group (n=27) and Results of the Repeated-Measures Analysis of Variance for the Domains of the Functional Skills Scale of the Pediatric Evaluation of Disability Inventory (PEDI)

| | PEDI Functional Skills Scale Scores | | | | | | | | Effect | | | | | |
| | Pretest | | Follow-up 1 | | Follow-up 2 | | Follow-up 3 | | Time | | Group | | Group × Time | |
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	df	F	df	F	df	F
Self-care														
Referral group	67.3	10.1	70.3	12.7	71.7	9.9	76.5	12.1	3	61.60^b	1	0.64	3	2.72^c
Functional physical therapy group	68.3	14.9	71.9	14.9	76.7	15.0	79.7	14.4						
Mobility														
Referral group	75.8	11.6	76.7	10.6	79.9	9.1	81.2	7.5	2.1^a	36.74^b	1	3.29^c	2.1^a	3.13^c
Functional physical therapy group	78.2	11.3	80.4	10.9	86.1	11.9	88.1	10.2						

[a] Adjusted degrees of freedom using Greenhouse-Geisser epsilon statistic.
[b] $P<.01$.
[c] $P<.05$.

scale and caregiver assistance scale. This finding indicates that one group improved more than the other group in both capability and performance of self-care and mobility activities. The means of the groups indicate that the children in the functional physical therapy group improved more than the children in the reference group.

Effect size is another useful measure for interpretation of differences between groups.[41] To compare the groups' improvements, we calculated effect sizes using the difference scores (the score on last follow-up assessment minus the score on the pretest measurements) of both groups. The effect sizes of the functional skills scale were 0.34 for self-care and 0.61 for mobility. The effect sizes of these 2 domains in the caregiver assistance scale were 0.90 and 0.59, respectively. Following Cohen's

guidelines,[41] an effect size of 0.34 should be interpreted as small, the effect sizes of 0.59 and 0.61 should be interpreted as medium, and the effect size of 0.90 (self-care domain in the caregiver assistance scale) should be interpreted as large.

Because the age range of the children was large, we decided to examine the effect of age on the progress the children made. An age × time interaction was found for both domains of the GMFM and for the mobility domain of the PEDI ($P<.05$). Further analysis of the data revealed that younger children improved more than older children. No age × group × time interactions were found.

During the pretest measurements, the groups of therapists did not differ with respect to problem definition

Table 4.
Mean Scores and Standard Deviations for the Group of Children Who Received Functional Physical Therapy (n=28) and the Referral Group (n=27) and Results of the Repeated-Measures Analysis of Variance for the Domains of the Caregiver Assistance Scale of the Pediatric Evaluation of Disability Inventory (PEDI)

| | PEDI Caregiver Assistance Scale Scores | | | | | | | | Effect | | | | | |
| | Pretest | | Follow-up 1 | | Follow-up 2 | | Follow-up 3 | | Time | | Group | | Group × Time | |
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	df	F	df	F	df	F
Self-care														
Referral group	59.2	11.6	60.6	12.3	66.5	10.2	68.3	11.4	3	71.86[b]	1	0.79	3	4.14[b]
Functional physical therapy group	58.7	13.7	63.0	15.3	71.4	17.4	73.9	15.1						
Mobility														
Referral group	74.0	15.7	77.7	13.2	81.9	12.7	84.4	12.6	2.2[a]	54.11[b]	1	0.42	2.2[a]	2.96[c]
Functional physical therapy group	72.7	13.7	78.8	13.3	86.4	12.2	88.7	11.6						

[a] Adjusted degrees of freedom using Greenhouse-Geisser epsilon statistic.
[b] $P<.01$.
[c] $P<.05$.

Table 5.
Mean Scores and Standard Deviations for the Group of Children Who Received Functional Physical Therapy (n=28) and the Referral Group (n=27) on Pretest and First Follow-up for Problem Definition and Therapy Goals

| | Pretest | | Follow-up 1 | |
	$\overline{X}$	SD	$\overline{X}$	SD
Problem definition (% functional skills)				
Referral group	6	15	1	5
Functional physical therapy group	1	6	40	40
	NS[a]		$P<.001$	
Therapy goals (% functional skills)				
Referral group	17	23	14	16
Functional physical therapy group	18	19	57	44
	NS		$P<.001$	

[a] NS=not significant.

and formulated therapy goals (Tab. 5). In the reference group, the percentage of problem definitions formulated in terms of functional abilities did not change during the study. It slightly decreased to a mean of 1% (SD=5%) on the follow-up assessments. The problem definitions for the functional physical therapy group did change. On the first follow-up assessment after training, the mean percentage of problem definitions in terms of functional skills was 40% (SD=40%). The difference between these percentages of the groups, after the training of the therapists of the children in the functional physical therapy group, was significant ($t[28.0]=4.82$, $P<.001$). The percentages did not change on the other follow-up assessments. The same development was found for the description of therapy goals. The percentage of goals defined in terms of functional skills in the reference group did not change from a mean of 17% on the pretest measurements to an

average of 14% (SD=16%) on the follow-up assessments. In the functional physical therapy group, the mean percentage increased from 18% on the pretest measurements to 57% (SD=44%) on the first follow-up assessment. The mean was 52% on the second follow-up assessment and 48% on the third follow-up assessment. The difference between the groups in the description of functional goals after the training of the therapists of the children in functional physical therapy group was significant ($t[34.0]=5.31$, $P<.001$).

During the study, frequent therapy was stopped for 7 children in the reference group and for 9 children in the functional physical therapy group. These children no longer had problems that required regular therapy. Therapists kept in touch with the child and the parents to determine whether any problems occurred that required therapy to be resumed. For the children whose therapy was uninterrupted during the study, the frequency of therapy in the reference group gradually increased from a mean of 3.8 times per month on the pretest measurements to a mean of 4.3 times per month (SD=1.3, n=20) on the last follow-up assessment. In the functional physical therapy group, frequency of therapy gradually decreased from a mean of 3.4 times per month on the pretest measurements to a mean of 2.4 times per month (SD=1.3, n=19) on the last follow-up assessment. The difference between the groups' frequency of therapy on the last follow-up assessment was significant ($t[37]=4.44$, $P<.001$).

The therapists of the children in the reference group reported no differences during the study in duration of treatment (mean duration of 45 minutes per session) or in time spent on preparation and consultation (mean

time of 15 minutes per session). For the pretest measurements, the therapists for the functional physical therapy group reported the same duration of intervention and time spent on preparation and consultation as the therapists for the reference group. On the first follow-up assessment, however, they reported that consultation with the parents and child and the time needed to prepare therapy had increased to a mean of 60 minutes per session. Direct intervention time did not change (on the average, 45 minutes per session). On the later follow-up assessments, the time needed for preparation and consultation gradually decreased to an average of 40 minutes on the second follow-up assessment and to an average of 20 minutes on the last follow-up assessment.

Discussion and Conclusions

The purpose of this study was to examine whether children with cerebral palsy receiving functional physical therapy had greater improvements in motor abilities compared with a reference group of children who received therapy based on the principle of normalization of the quality of movement. Both basic gross motor abilities in a standardized environment (measured with the GMFM) and motor abilities in daily situations (measured with the PEDI) were studied. We found no differences between the groups for the improvements in basic gross motor abilities. However, when examining functional skills in daily situations, children in the functional physical therapy group improved more than children in the reference group.

Although both the GMFM and the PEDI measure motor abilities, these measures have some important differences. First, the GMFM measures basic gross motor abilities such as sitting, standing, walking, and jumping. These abilities were measured in a standardized environment (a therapy room) by an independent pediatric physical therapist who had no previous knowledge about the child. The PEDI, however, measures gross and fine functional motor abilities that are related to self-care and mobility, such as holding a toothbrush, putting on a T-shirt, and getting on and off the toilet. These abilities are measured by a standardized interview with one of the parents and reflect the capability and performance of the child in the daily environment. Thus, the PEDI better reflects the physical and social environments in which the child has to function than does the GMFM.

Scores on the PEDI are based on an interview with the parents. The opinion of parents regarding the achievements of their children might be influenced by various factors. One such factor is that the parents of the children in the functional physical therapy group knew that their children were managed according to an alternative approach. Specific expectations of a "new" approach might have led to relatively positive answers,

especially during the first follow-up interview. One of the features of the functional physical therapy program, however, is the participation of parents in all stages of the program. They indicate the main problems in the child's daily functioning. They know the goals of therapy, and they know how they can participate in helping their child to become as independent as possible in skills related to a specific goal, with the focus on active problem solving by the child in natural situations. That is, the parents of the children in the functional physical therapy program may have had better awareness of their child's specific problems and their own role in improving the child's independent functioning than the parents of the children in the reference group. If this is true, the differences between the groups' functional skills and the amount of caregiver assistance is an important finding. The parents of the children in the functional physical therapy group may have become more aware of the fact that they gradually had to reduce the amount of help they provide to let their children become more independent in daily functioning.

When interpreting the results of the GMFM and the PEDI, it is important to realize that for both measures the mean scores of both groups were relatively high. In particular, the scores were high for both domains of the GMFM and for the mobility domain in the caregiver assistance scale of the PEDI. At the last follow-up session, the mean scores for some children were near 90 (for both the GMFM and the PEDI, the maximum score is 100). Such high scores could have masked development of skills that were not included in the instruments. A therapy goal for a number of children in the functional physical therapy group, for example, was to learn cycling. Improvements in such an activity are reflected in neither the GMFM scores nor the PEDI scores.

In general, we conclude that the application of a functional physical therapy program has positive effects on both the child's capability as well as the performance (independence) of daily functional motor skills. Nevertheless, the study had some limitations.

The main point is the presumed difference between the therapeutic practice of the 2 groups. Using a questionnaire, we aimed at getting an overall picture of the therapeutic practice. We found considerable changes after the therapists of the children in the functional physical therapy group had been trained. The children's problems and therapy goals were more frequently defined in terms of functional skills. A questionnaire, however, gives a rather global picture of the therapeutic practices. Although the therapists for the functional physical therapy group reported that the therapy they applied after the training differed from what they had previously given, videotape recordings or other observa-

tional methods could have confirmed the therapists' reports. According to the therapists, the methods differed mainly in the systematic way of working on the child's daily functional problems: the focus on functional activities versus the focus on quality of movement; the practice of functional skills versus the facilitation and normalization of movements; concrete versus abstract goals; and the collaboration with parents, who were more involved in decision making about problem definition and goal setting and in the evaluation of goals. Although the therapists for the functional physical therapy group reported changes in their way of working, we do not know, for example, how much practice actually took place for children in both groups or to what extent the groups differed with respect to carryover to home activities and time spent in home activities.

We cannot rule out the possibility of socially desirable answers. The parents reported that they were more involved, that their child had a more active role, and that they more often practiced functional skills in daily situations. Another finding was the decrease in frequency of therapy in the functional physical therapy group. These changes cannot be explained solely by social desirability.

Although the differences in therapeutic practice between the groups cannot be defined as being solely related to the neurophysiological approach versus the functional approach, it is evident that the groups differed in the focus of the therapy, the systematic way of working on the functional problems of the child, and the collaboration with parents to accomplish the goals. The opinions of the therapists about the functional approach were positive. All of the therapists stated that the approach was useful for the children who participated in the study. They appreciated the systematic way of working, the way they were "forced" to analyze the child's problems in daily functioning, and the way they had to formulate and evaluate functional goals. The following advantages of the functional approach were mentioned by the therapists: it was more purposeful and more functional; it had more structure; it was clearer for parents, children, and therapists; it promoted better participation of parents and higher motivation of parents and children; it was more enjoyable for the children; it led to better collaboration with parents and children because they were expected to indicate which skills they wanted to improve; it provided better insight into problematic skills of the children; improvements were more apparent; frequency of therapy could be reduced; and reporting to other professionals was easier because therapy goals were clearer.

The main difficulties of the functional approach, as reported by the therapists, were difficulties with setting functional goals; difficulties dividing long-term goals into small steps of short-term goals; less attention to quality of movements; the risk of too high demands leading to frustration of both parents and children if the goals could not be achieved; and the time needed for home and school visits, for consultation with parents and others, and for a thorough analysis of the child's problems. This finding was confirmed by the time needed for preparation and consultation, which increased from an average of 15 minutes at baseline to an average of 60 minutes immediately after the training when the program had to be applied in practice. At the subsequent follow-up assessments, therapists apparently became familiar with the approach, and preparation time decreased gradually to the baseline level.

The results of this study cannot be generalized to all children with cerebral palsy. The children participating in this study had relatively mild forms of cerebral palsy. In addition, therapists and parents agreed to participate on a voluntary basis. Therapists had to be open to another approach, and parents were informed that the therapy program of their child could change and that their own role could change. Thus, the parents who agreed to participate were relatively well motivated and perhaps even relatively involved in their child's program. We can conclude, therefore, that the children and the families are not representative of the whole population of children with cerebral palsy. Future studies are necessary to determine whether this functional approach is feasible for children with more severe cerebral palsy and for parents who are less involved or have more problems with an active role. The parent's role in the therapy could be too demanding for some parents.

The described model for a functional therapy program is not restricted to the treatment of children with cerebral palsy. It is a systematic way of trying to solve a child's functional problems. Most of the participating therapists who received the training reported that they had started to apply the program to other children (children with more severe cerebral palsy or with other diagnoses such as spina bifida, developmental delay, or attention-deficit/hyperactivity disorder). Future studies should be performed to determine for which children and for which parents this approach is useful. In addition, the children in our study generally received only physical therapy. Children who attend schools for special education or who attend rehabilitation centers often receive a combination of therapies that involve many professionals. In such situations, collaborative problem definition and collaborative goal setting become more difficult, but are even more important. It would be interesting to study the application of the functional physical therapy model for children involved with many professionals.

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