

The Effectiveness of Physiotherapy Program for the Children with Visual Impairment and Additional Disabilities: A Case Series

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ABSTRACT

Objective: Children with visual impairment and additional disabilities (CVIAD) often encounter significant motor issues and health problems stemming from factors such as brain damage, early vision loss experiences, hearing loss, and a lack of tactile and cutaneous senses. Therefore, physiotherapists should provide appropriate verbal teaching and manual support to those children during treatment, but there is no evidence-based physiotherapy program for CVIAD as an early intervention. This study aimed to understand the effects of a physiotherapy program for CVIAD on the neurodevelopment of child as a part of early intervention.

Methods: Two children were included in the study. The Gross Motor Function Classification System (GMFCS), Pediatric Evaluation of Disability Inventory (PEDI), Functional Independence Measure (WeeFIM), and The Goal Attainment Scale (GAS) were used to determine the neurodevelopmental changes in the cases. The children were included in the 12-week physiotherapy program, which specialized in verbal and tactile stimulations.

Results: The PEDI self-care and social function subtest scores and the WeeFIM score of the case 2 increased after the intervention.

Conclusion: The physiotherapy program enriched with child-specific tactile and verbal stimuli and toys suitable for these children will contribute to motor and sensory development.

Keywords: Visual impairment, additional disabilities, multiple disabilities, physiotherapy, rehabilitation.

Introduction

Children with Visual Impairment and Additional Disabilities: Definitions

Visual impairment (VI) is a rare condition that affects many areas of development and causes delays in motor skills,¹ and it is known that half of the individuals with VI also have also additional disabilities.^{2,3} Children with visual impairment and additional disabilities (CVIAD) experience some serious motor issues and health problems⁴ due to brain damage, lack of early experience, and vision loss.⁵ Children with visual impairment and additional disabilities also includes hearing loss, physical disabilities, congenital syndromes, intellectual disabilities, and significant communication delays.⁶⁻⁸

The Motor Development and Problems of Children with Visual Impairment and Additional Disabilities

Children with visual impairment and additional disabilities have motor disabilities that affect voluntary movements such as paresis or plegia, abnormal muscle tone, involuntary movements, and ataxia.⁴ With intellectual and motor difficulties, sensory impairments are extremely common.⁹ Many children with multiple disabilities have visual impairments, besides hearing loss. Tactile and cutaneous senses are also thought to be affected in some children with profound intellectual and multiple disabilities.⁹ Most children with multiple disabilities have problems such as epilepsy, gastrointestinal disorders, and concerns linked to overall fitness and feeding/drinking as well.¹⁰

Visual impairments have an impact on a child's ability to learn and do daily tasks^{11,12} and affect all aspects of a child's development. Children who have both cerebral palsy (CP) and visual impairment develop more slowly in the areas of self-care, mobility, and social functioning than

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children who just have CP.¹³ Physical activities of CVIAD are limited due to all these motor and sensory issues. The course of sensory, motor, and cognitive involvement also triggers limited voluntary movement and lack of physical activity, making it difficult to maintain neurodevelopmental progress.

It is critical that therapists provide appropriate verbal teaching and manual support to those children during treatment.¹³ So far, functional physiotherapy programs for children with CP and other diagnoses have been developed mostly, but as we noticed, there is no evidence-based physiotherapy program for CVIAD as an early intervention for children at the age of 0-3 years.¹⁴ There have been studies on the usefulness of physiotherapy applications such as Bobath concept therapy or an exercise discipline, which are commonly used in CP early intervention programs.^{4,15,16} The occurrence of vision impairments in children with multiple disabilities is not considered in current therapy programs.^{17,18} As a result, it is essential to incorporate visual impairments into the motor and functional activities of children with multiple disabilities to build an adapted functional rehabilitation program for these children.¹⁹

Therefore, the purpose of this study is to understand the effects of a physiotherapy program for children with visual impairment and additional disabilities on the neurodevelopment of children as a part of early intervention.

Methods

Study Design

This case series study is a part of a broader study which was aimed to explore planned as a case series. CVIAD, whose parents participated in the online training provided within the scope of the Erasmus+ project were included in the study. The participants' process was overseen by the physiotherapist. Families and children who had received pre-study counseling from the project researchers and expressed voluntary interest in participating were included in the study. All parents were informed about the study, and a written informed consent form was obtained from the parents of the patients. The study was approved by the İstanbul Medeniyet University Educational Sciences Ethics Committee (Approval no: 02-16, Date: February 1, 2021) and was conducted in accordance with the Declaration of Helsinki.

This study was conducted between September 2021 and January 2022. The cases were evaluated at the baseline and immediately after the physiotherapy program in their daily environment. The physiotherapist and psychologist conducted the examinations. Following the initial examination, the cases were assigned to a physiotherapy program, and re-evaluations were conducted.

Participants Description

E. was a 17-month-old (corrected age) preterm infant (32 weeks, 1900 g) with visual impairment, intellectual disability, CP, feeding, and gastroesophageal issues caused by cleft palate (case 1). She was diagnosed with cleft palate congenitally. For the first 2 weeks after she was delivered, she had typical developmental behaviors. During her time in the incubator, she had an attack that led to permanent brain damage. A few weeks ago, before the first evaluation, genetic tests were conducted, and she was diagnosed with DiGeorge Syndrome. Her head control was weak, but her sitting balance was appropriate with assistance. Her upper extremity movements were not selective, and postural reactions were seen rarely. Primitive reflexes were still active. She had weak eye-following movements. Her vision was completely impaired. Whole-body extension spasticity was seen. She had no control over saliva and chewing-swallowing.

Y. was a 33-month-old (corrected age) extremely preterm infant (23 weeks, 690 g birth weight) with visual impairment, intellectual disability, and physical disability (case 2). After birth, he stayed in the intensive care unit for 9.5 months. He had cerebral visual impairment, and his right vision area was completely lost. His head control was weak; it could be seen only in the supine position. He could sit with assistance for 5-10 seconds. Postural reactions were rarely seen. He had moderate to weak eye-following movements. He had no control over saliva, and he could not chew and swallow consciously.

Inclusion and Exclusion Criteria

The existence of any diagnosis of visual impairment with additional disabilities by the pediatrician of the child, and being at the age of the Pediatric Evaluation of Disability Inventory (PEDI), Functional Independence Measure (WeeFIM), and Gross Motor Function Classification System (GMFCS), were criteria for inclusion. From the medical records of the children, the level of visual impairment, additional disabilities, and clinical diagnosis were documented.

Evaluations

Gross Motor Function Classification System, WeeFIM, and PEDI were used to determine the neurodevelopmental changes of the cases. The Goal Attainment Scale (GAS) was used to evaluate whether the goals of the children and their parents in terms of gross motor function and functional skills were achieved.

Gross motor function levels of children were determined by using the GMFCS.^{20,21} Gross Motor Function Classification System is a classification system based on child-initiated movements with an emphasis on sitting, displacement, and mobility. It can be used to divide the gross motor skills (such as sitting and walking) of children and young people into 5 levels. Since the motor functions of children change depending on age, functions are defined according to children in each age group: under 2 years old, 2-4 years old, 4-6 years old, and 6-12 years old for each level.

The WeeFIM is an easy-to-use scale for evaluating independence in children aged 6 months-7 years. It is appropriate for children aged 6 months-21 years who have developmental disabilities.²² Self-care, sphincter control, mobility, locomotion, communication, and social cognition are among the 18 measurement items in the WeeFIM instrument. Performance is graded using a seven-level ordinal grading system ranging from 7 (full independence) to 1 (total help). The lowest total score possible is 18 (total dependence in all skills), and the highest score possible is 126 (complete independence in all skills). The questionnaire is valid and reliable for the Turkish population.²³

The PEDI-NL is a questionnaire that assesses children's capability and performance in self-care, mobility, and social function domains of daily childhood activities between the ages of 6 months and 7.5 years.²⁴ The PEDI-NL consists of 3 main sections under the subheadings of functional skills, caregiver assistance, and modifications. Each of these sections assesses the areas of self-care, mobility, and social function. In the functional skills section, the child is given points as unable (0 point) and able (1 point) for each item. The caregiver assistance and modifications sections, measure the child's disability according to the amount of help needed to perform the functional activity. At the end of each subsection, the scores of that section are summed up.

The GAS is a generalized personalized evaluative criterion-referenced tool that can be used to track a child's progress.²⁵ Depending on the goal achieved, a score of -3 to +2 was assigned. A score of 3 indicates a drop in performance compared to the baseline target. A score of 1 indicates that the child's outcome was less than predicted, while a score of 0 indicates that the child's outcome was as expected after the

Table 1. The Demographic Data of the Cases

	Age / Corrected Age (months)	Gender	Diagnose	Additional Disabilities	GMFCS Level
Case 1	18/17	Female	DiGeorge syndrome, cleft palate	Visual impairment, intellectual disability	5
Case 2	37/33	Male	Extremely preterm	Visual impairment, intellectual disability, and physical disability	5

intervention. A score of +1 or +2 indicates that the child has made more or much more progress than the baseline. In this study, the goals were determined with the parents due to the intellectual disability of the children, after the evaluation.

The cases were evaluated at the baseline and immediately after the physiotherapy program. Due to the multilayered nature of the evaluation tools, which included aspects such as communication, social cognition, and function, the examination of the cases was conducted collaboratively by the physiotherapist and psychologist. Following the initial examination, the cases were assigned to a four-month physiotherapy program, and re-evaluations were conducted.

Physiotherapy Program

The cases underwent the individualized physiotherapy program for 12 weeks, with 2 sessions per week, each lasting 45 minutes. The sessions took place at the children's homes, providing a familiar daily environment. Initially, the physical therapists conducted the first evaluations, including the PEDI, GMFCS, and WeeFIM, for these children. Subsequently, the individually tailored physiotherapy program commenced. The program consists of gross motor function activities in different positions and functional activities based on the PEDI and WeeFIM evaluations (e.g., mobility parts, rolls, or crawls on the ground).²⁶

Based on the degree of freedom of the child, the physiotherapist used the most advanced body position (e.g., supported sitting) and applied the activities in this position. To practice combining movement patterns, middle-line activities such as clapping hands, playing with toy cars, simple stretching, and tracing animals were done. Position transitions such as supine to prone, body rotations, and side-lying to sitting were practiced. To improve head control, toys were placed in front

of the kid in the prone position, and the child was engaged in small games. Before each activity, the evaluation team observed the kid for a while to understand that if the kid was attracted to play/toys and engaged in the activity itself. Every activity began with the kid being introduced to the materials by placing the toy in his or her hand, making a noise with the item, and giving him or her time with the toy. The evaluation team carefully selected toys that had a motivating effect, aroused curiosity, were age/visually impaired-appropriate, and, above all, were fun for the child. The evaluation team gave clear verbal prompts for visual targets to trigger the child with visual impairment. The team gave the child enough time and verbal direction to process knowledge without rushing them.

In addition, the team provided guidance on positioning, holding, carrying, and transferring positions to the families/caregivers, and asked to give attention to these principles and stimulations during daily care.

Statistical Analysis

The results of the PEDI and WeeFIM evaluations before and after the physiotherapy intervention were used to generate descriptive statistics. A Wilcoxon signed-rank test was used to determine differences in pre- and post-intervention PEDI overall and subtest scores, as well as WeeFIM scores. The Statistical Package for Social Sciences version 22.0 software (IBM Corp.; Armonk, NY, USA) was used to conduct statistical analyses, with a significance level of 0.05.

Results

The demographic data of the cases are given in Table 1.

After 12 weeks of the intervention program, the cases were evaluated, and the results are given in Table 2.

The GMFCS scores of the children did not differ after the intervention. The PEDI self-care (e.g., “eats crushed/stirred/strained food,” “eats hard/lump-shaped foods,” “keeps the head straight while combing the hair,” and “allows his nose to be wiped”) and social function subtest scores of case 2 were increased after the intervention (Table 3). Only for case 2, the WeeFIM score was increased after the intervention (Table 3). This increase in the cognitive subtest of WeeFIM (e.g., communication, expression, and social interaction) is similar to the increase of PEDI social function (e.g., “he/she is directed toward the sound,” “responds to the word “No”; recognizes his own name and those of people he is familiar with”) score after the intervention. There was no statistically

Table 2. Outcomes Before and After the Physiotherapy Program

	Pretest Median (Minimum–Maximum)	Posttest Median (Minimum–Maximum)	Z Score	P
PEDI-I Mobility	2 (1-3)	2 (1-3)	0.00	1.00
PEDI-I Selfcare	1 (1-1)	2.5 (1-4)	1.00	.31
PEDI-I Social Function	2 (1-3)	2.5 (1-4)	1.00	.31
PEDI-II & III	0 (0-0)	0 (0-0)	0.00	1.00
WeeFIM	18 (18-18)	19.50 (18-21)	1.00	.31

Table 3. PEDI Sub-scores Before and After the Physiotherapy Program

	PEDI					
	Functional Skills			Caregiver Assistance		
	Self-care (Pre–Post-Test) Difference	Mobility (Pre–Post-Test) Difference	Social Function (Pre–Post-Test) Difference	Self-care (Pre–Post-Test) Difference	Mobility (Pre–Post-Test) Difference	Social Function (Pre–Post-Test) Difference
Before the intervention						
Case 1	1	1	1	0	0	0
Case 2	1	3	3	0	0	0
After the intervention						
Case 1	1	1	1	0	0	0
Case 2	4	3	4	0	0	0

significant improvement after the intervention except increased scores of case 2.

Both parents had 2 goals expected. The goals were (1) getting head control for at least 5 seconds in a sitting position and (2) increasing the time at independent sitting for at least 10 seconds. Case 1 reported "Greater than expected outcome" (+1) after the intervention for both goals. Case 2 reported "Expected outcome after therapy" (0) after the intervention for both goals.

Discussion

This study, which aimed to understand the effects of a physiotherapy program for CVIAD on the neurodevelopment of children as a part of an early intervention, shows that the physiotherapy program may increase a child's self-care and social functionality. In addition, based on the GAS scores, the parents agreed that their kid had improved at least one point in motor functioning.

In the current literature, there was an insufficient number of studies that researched the effectiveness of physiotherapy programs for CVIAD. The studies were generally conducted with CP or reported results for individuals older than 3 years and adults with VIAD.²⁷⁻²⁹ Early intervention programs covering the first years of life are of great importance, particularly for at-risk and high-risk infants. Therefore, interventions for children aged 3 and above are insufficient to fill this gap in the literature. This study reported the effectiveness of the physiotherapy program for children 0-3 years as a part of an early intervention program. The strengths of our study are that it provides a program for how to apply physiotherapy techniques in these CVIAD cases, such as studying physiotherapy techniques with the help of materials in sound and contrast colors and keeping movements slow enough to attract the child's visual perception and attention, even at a minimal level.²² The greater benefit observed in case 2 from early intervention, despite case 1 having a younger corrected age, underscores the significance of early intervention and physiotherapy.

Another strength of our study is that the physiotherapy program applied to infants and children aged 0-3 years with VIAD was revealed because of a multidisciplinary teamwork (physiotherapist, psychologist, and early intervention specialist) in accordance with the scope of the early intervention program.

In the cases included in the study, although there were motor improvements such as increased head control and increased independent sitting time, in accordance with the statements given by the families in goal attainment scale, the fact that they could not be shown in the evaluation results made us think of the need for evaluation tests with sensitivity and specificity suitable for the evaluation of CVIAD. Although there are assessment tests specific to these children used in the evaluation of CVIAD in the literature,³⁰⁻³² these tests require special training and are paid, which poses a problem in terms of their use and dissemination.

In the study of Salavati et al., it was revealed that the physiotherapy program provided improvement in gross motor function and functional abilities in children with cerebral visual impairment and CP.²⁹ Unlike our study, mild and moderately affected children were included in this study, and the effect of physiotherapy on motor development may have been more clearly demonstrated because the Gross Motor Function Measure 88 (GMFM-88) battery specific for those with CP was used.

It can be said that due to the neurodevelopmental supportive features such as contrast-colored materials during the physiotherapy program,

the slow movement of stimuli, and the use of verbal cues, the program contributed to the improvement of social interaction and cognition parameters.

There is no doubt that qualified and holistic early intervention services (EIS) for children with disabilities are crucial and effective for both the children and their parents, and the CVIAD is no exception.^{33,34} Thus, EIS should start as early as possible to support children with VIAD's overall development, especially their physical and motor development. The activities that should be provided to improve the CVIAD's motor development can be performed not only by physiotherapists, special educators, and other health providers but also by parents. So, including the parents in the process and keeping them informed about their child's progress will also help to support the family's well-being.^{35,36} The findings of this study also suggest that supporting parents through home-based intervention is essential. Since there is no such occupation called early interventionist and there are quite limited services available for children with VIAD in Türkiye, the current studies outcomes should be considered important and serve as guidance for future studies and implementations. Given the physiotherapy program determined in this study, future randomized controlled studies with larger sample sizes are warranted.

Conclusion

As conclusion, the physiotherapy program which is enriched with child-specific tactile and verbal stimuli, and toys suitable for these children, may enhance a child's self-care and social functionality and contribute to motor and sensory development. The neurodevelopmental supportive features such as contrast-colored materials used during the physiotherapy program, slow movement of stimuli, and the use of verbal cues contributed to the improvement of social interaction and cognition of the children with visual impairment and additional disabilities.

Limitations

The study had to be completed with a smaller sample size than expected due to pandemic conditions, transportation difficulties, and families having difficulties in continuing the program. Future studies need to be conducted with a larger sample size because of the small sample size and heterogeneity of the CVIAD has numerous effects that may have been statistically insignificant. It may be more valuable to reveal the efficiency of physiotherapy if evaluation batteries unique to CVIAD, who require special education and budget, were utilized. In the future, evaluation batteries like top down motor milestone test should be used.

Ethics Committee Approval: Ethics committee approval was received for this study from the Istanbul Medeniyet University Educational Sciences Ethics Committee (Approval no: 02-16, Date: February 1, 2021).

Informed Consent: Written informed consent was obtained from parents of the patients who participated in this study.

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