

UDC 615.825 DOI:

10.53068/25792997-2022.2.6-242

EFFECTIVENESS OF AN INDIVIDUAL SENSORY INTEGRATION THERAPEUTIC PROGRAM IN DELAYED REHABILITATION OF CHILDREN WITH SPASTIC DIPLEGIA

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Keywords: cerebral palsy, physical rehabilitation, sensory integration.

The actuality of the research topic.

Cerebral palsy (CP) is defined as a condition resulting from injury to brain tissue caused by various exposing factors affecting brain in prenatal, perinatal or early postnatal periods. CP is commonly presented with various manifestations, including mental retardation, epilepsy, visual, auditory, speech, cognitive, and sensory-perceptual deficit [1]. Children with CP have various sensory integration issues. The concept of sensory integration, as a theory, was originally proposed by Ayres. It can be perceived as a neurophysiological phenomenon that enables the perception, interpretation, integration processes in brain, using the spatiotemporal aspects of sensory input to decode information from the body or environment and responding with organized motor behavior

[2, 3]. Sensory integration is conceptualized as a relationship between the brain and motor behavior.

Disruption of this relationship can lead to perceptual and motor disturbances. The main hypothesis is that motor skill learning depends on the ability to perceive and process sensory information received in the central nervous system from the environment and reproduce it with own body movements, structuring an organized behavior.

Combined cognitive sensorimotor dysfunction can be defined as the inability to adapt and integrate with the environment. The central nervous system cannot assimilate sensory stimuli, so the body is unable to elaborate or maintain appropriate and efficient motor skills. Instead, an isolated system of motor behavior control and defective sensorimotor integration mechanism

develops. The described functional failure results in disrupted adaptation and barriers the transmission of sensory information, needed for the development of cognitive structures in brain [3-5].

Children with CP may have impaired sensory integration, resulting from neurological dysfunction in the brain or lack of normal motor control due to a deficit and limited input of sensory afferent impulses. These children have sensorimotor issues such as impaired body image, impaired right-left discrimination, spatial positioning, visual perception, finger agnosia, astereognosis and apraxia. Sensory disintegration is one of the main pathophysiological phenomena encountered in children with CP. Disturbances from sensory integration limit the functional abilities in activities of daily living [6,8,9].

In the process of physical rehabilitation, sensory integration is restored via the individualized therapy approach. However, group therapy strategies have shown to produce similar results. [2, 7, 10].

The purpose of the study was to demonstrate the effectiveness of the individual therapy program used to restore the sensory integration in delayed rehabilitation of spastic diplegia in children with CP.

The main tasks of the study were:

1. Analysis of accumulated research evidence in different databases and selection of the most adequate method of sensory

integration management, which can be used in the rehabilitation program of children with spastic diplegia.

2. Selection of the most effective method for the assessment of sensory integration based on the published research evidence.

3. Efficacy analysis for the used sensory integration management in the delayed rehabilitation program for children with spastic diplegia.

Research methods. The presented research is a series of clinical cases, in which eight children (6-8 years old, 3 girls and 5 boys) with CP were involved. The patients have not received any somatosensory stimulation training, or other equivalent interventions before the study. The sensorimotor training program was applied for one and a half hour, three times a week, for three months. The Ayres South Carolina Sensory Integration Test was used to assess sensory integration skills. A physical ability test was used to assess the daily activities of living [2, 3].

The Ayres test was applied in all children to assess sensory integration skills. Spatial position (SP), image replication (IR), kinesthesia (KE), dual tactile stimuli perception (DTSP), finger identification (FI), graphesthesia (GE), identification of tactile stimuli by location (ITSL), postural imitation (PI), motor accuracy (MA) and right-to-left discrimination tests (RLDT) were used. Two

points (2) were given for the full performance of the tests, one point (1) - for the partial performance, and zero (0) points for non-performance.

The Physical Capacity Test (PCT) was used to assess activities of daily living typical for the age group. The evaluation was performed based on the following criteria: (1) the task is not performed; (2) inability to perform few of the task related movements; (3) the ability to perform main specific movements of the task; (4) is able to complete the task with support; (5) slow, weak and intermittent movements when performing the task; (6) performing the task with slow to moderate speed of movements; (7) good performance (movements performed with sufficient speed and duration). Accordingly, the highest score (7 points) were given for performing movements with good or sufficient speed and duration.

The sensorimotor training was carried out in a graded manner, from simple to complex tasks, until a required level of skills was developed. There was no transition to the next level, unless the task was performed completely. For children included in the study and receiving individual therapy, the exercises were conducted according to the following protocol:

- Exercises affecting the sensory system (the therapist lifts the child's legs, and the child "walks" on the hands;

combination of swimming in the pool with drying).

- Exercises designed to recognize the body (touching/squeezing the body parts).

- Exercises for the vestibular system (swinging of the limbs, jumping on the springboard, climbing the bars on the wall)

- Tactile system improving exercises (stereognosis training, walking along a bumpy path).

- Movement planning exercises (exercises with rotating objects, writing an unfamiliar text or holding the hand of the child when drawing).

- Balance and posture improving exercises (different extremities used in these exercises: two knees and two hands, two hands and one leg, two elbows and one leg, two knees, and rising from kneeling position with support).

- Posture correction and eye exercises (catching the ball, catching the ball with a partner, kicking the ball, throwing the ball into the basket or towards the target).

- Two-way motor coordination and movement planning (exercises on a fitness ball or an inflatable toy, hitting a ball with a club, etc.).

- Development of visual-spatial awareness (matching images, assembling puzzles)

- Fine motor skills and movement programming exercises (stringing beads, hand exercises on the table, writing

exercises in different positions, drawing while kneeling, knotting, buttoning, tying knots, and duplicating images in drawing)

- Right-left discrimination exercises
- Development of standing and walking.

The program with the described exercises consisted of 70-minute sessions with two-day intervals (10 sessions per month). Duration of the study program was three months. Before the program and after the completion all participants were assessed with the Ayres testing method. The difference between the average values of the results obtained in initial and final assessments was evaluated by the Student's t- test.

Analysis of research results. Differences between the assessment scores

recorded before and after the intervention were analyzed. The results of this study showed that individual therapy was effective for the delayed intervention in children (6≤ years of age) with spastic diplegia. In addition to the identified neuromuscular manifestations, children with CP had also other dysfunctions: disruption in body image perception, disturbance in right-left discrimination, lack in description of body parts, altered perception of body position, and sensory perception problems such as limb agnosia and apraxia. All participants scored low in sensory perception test. The results showed that all children with spastic diplegia have visual and somatic sensory receptivity dysfunction.

Table 1.

Comparison of data from initial and final assessment using the Ayres system. Data are presented as means with standard deviations.

Ayres Testing System	Initial assessment results ($m \pm sd$)	Final assessment results ($m \pm sd$)	Statistical significance of the difference between the two assessment results
SP	0,38±0,27	1,38±0,52	$P < 0,05$
IR	0,63±0,52	1,63±0,53	$P < 0,05$
KE	0,75±0,21	1,88±0,35	$P < 0,05$
DTSP	0,50±0,53	1,63±0,53	$P < 0,05$
FI	0,38±0,52	1,50±0,53	$P < 0,05$
GE	0,25±0,46	1,25±0,46	$P < 0,05$
ITSL	0,25±0,46	1,38±0,52	$P < 0,05$

PI	0,63±0,52	1,38±0,52	$P<0,05$
MA	0,50±0,53	1,50±0,53	$P<0,05$
RLDT	0.88±0,35	1,75±0,46	$P<0,05$
PCT	2,88±0,83	5,50±1,31	$P<0,05$

Gordon has demonstrated the importance of visual perception training in the treatment of patients with hemiplegia. Seventy-seven patients with hemiplegia were divided into study and control groups [4]. Trainings with a complex visual perception program were conducted with the study groups, using trainings based on somatosensory stimulation. At the end of seven-week training period, no improvement in visual perception was observed compared to the control group. The design of this study was similar to a trial conducted by Platzer and coauthors, where the study group scored higher than the control group [6].

Vargas and co-authors had conducted a meta-analysis to evaluate the efficacy of sensory integration therapy [9]. Twenty-six studies were used to compare the effects of sensory integration management approaches with alternative therapies. A meta-analysis showed that sensory integration therapies are as effective as a variety of alternative therapies. Christopher and co-authors have presented a meta-analysis comparing the effects of individual and group methods of sensory integration in

patients with mental disorders. The results showed that individual and group treatment methods have almost the same efficacy.

In our study, we have used the individual approach. The results showed that application of the individual approach for the sensorimotor training is an effective strategy for children with sensory integration dysfunction who were diagnosed with spastic diplegia and were involved in the delayed rehabilitation program. The used training strategy was effective for the improvement of daily activities and elaboration of functional skills of upper extremities in study participants.

The results of our study are similar to those of Christopher and Gordon. In all studies, the results of the individual methods are more positive than the results of the treatment with the control method. These research data had motivated us to use the individual approach for the delayed rehabilitation program.

Conclusion. This study was the first attempt to evaluate the effectiveness of sensory integration method in children with spastic diplegia involved in delayed rehabilitation program. Sensory integration

is one of the most important issues in the rehabilitation process of children with CP, who have sensory integration deficit caused by a neurological dysfunction in the brain or limited sensory experience due to the deficit of motor control. The results of this research showed that the program implemented using the individual approach to manage the sensory integration is highly effective in the delayed rehabilitation program of children with spastic diplegia. When designing rehabilitation programs for sensory

integration, it is necessary to take into account the individual needs of the child and plan individual sessions, which have the potential to increase the effectiveness of rehabilitative intervention. The results of our research are similar to the results of the studies conducted by Christopher and Gordon, confirming the effectiveness of individual sensory integration methods. The individual approach of sensory integration management showed high efficacy in delayed cases of physical rehabilitation.

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**ԱՆՀԱՏԱԿԱՆ ԶԳԱՅԱԿԱՆ ԻՆՏԵԳՐԱԿԱՆ ՎԵՐԱԿԱԳՆՄԱՆ ԾՐԱԳՐԻ
ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅՈՒՆԸ ՍՊԱՍՏԻԿ ԴԻՊԼԵԳԻԱ ՈՒՆԵՑՈՂ ԵՐԵՒԱՆԵՐԻ
ՀԵՏԱԶԳՎԱԾ ՌԵԱԲԻԼԻՏԱՑԻԱՅՈՒՄ**

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Հայաստանի ֆիզիկական կուլտուրայի և սպորտի
պետական ինստիտուտ, Երևան, Հայաստան

ԱՄՓՈՓԱԳԻՐ

Առանցքային բառեր: Մանկական ուղեղային կաթված, ֆիզիկական ռեաբիլիտացիա, զգայական ինտեգրացիա:

Հետազոտության նպատակն է՝ ցույց տալ զգայական ինտեգրման կիրառման արդյունավետությունը սպաստիկ դիպլեգիկ մանկական ուղեղային կաթված ունեցող երեխաների հետաձգված ռեաբիլիտացիայում:

Մեթոդներ և հետազոտության կազմակերպում: Զգայական ինտեգրացիան մանկական ուղեղային կաթվածով հիվանդ երեխաների վերականգնման գործընթացի ամենակարևոր խնդիրներից մեկն է: Այրեսի թեստավորման համակարգի միջոցով իրականացված գնահատումը՝ զգայական ինտեգրման ծրագրից առաջ և հետո, հնարավորություն տվեց համեմատելու նախնական և միջամտությունից հետո ստացված արդյունքները:

Հետազոտության արդյունքների վերլուծություն: Արդյունքները ցույց տվեցին, որ զգայական ինտեգրման անհատական սկզբունքով իրականացվող մոտեցումներն ունեն բարձր արդյունավետություն՝ մանկական ուղեղային կաթվածով երեխաների

ռեաբիլիտացիայի գործընթացում: Այրեսի համակարգում ներառված բոլոր թեստերի համար ստացվել է վիճակագրորեն հավաստի տարբերություն նախնական և հետմիջամտական տվյալների միջև:

Եզրակացություն: Զգայական ինտեգրման ծրագրեր կազմելիս անհրաժեշտ է հաշվի առնել երեխայի անհատական կարիքները և ծրագրում ներառել ոչ միայն խմբային, այլև անհատական պարապմունքներ, որոնք մեծացնում են վերականգնողական բուժման արդյունավետությունը: Զգայական ինտեգրացիայի վերականգնման անհատական մոտեցումը բարձր արդյունավետություն ունեցավ նաև հետաձգված ֆիզիկական ռեաբիլիտացիայի դեպքերում:

ЭФФЕКТИВНОСТЬ ИНДИВИДУАЛЬНОЙ СЕНСОРНО-ИНТЕГРАЦИОННОЙ ЛЕЧЕБНОЙ ПРОГРАММЫ В ОТСРОЧЕННОЙ РЕАБИЛИТАЦИИ ДЕТЕЙ СО СПАСТИЧЕСКОЙ ДИПЛЕГИЕЙ

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Ключевые слова: детский церебральный паралич, физическая реабилитация, сенсорная интеграция.

Цель исследования. Целью исследования было продемонстрировать эффективность применения сенсорной интеграции в отсроченной программе реабилитации детей со спастическим диплегическим параличом.

Методы и организация исследования. Сенсорная интеграция является одной из важнейших аспектов в реабилитации детей с детским церебральным параличом. Оценка пациентов, проведенная с помощью системы тестирования Эйреса до программы сенсорной интеграции, позволила сравнить эти результаты с данными, полученными после терапевтического вмешательства.

Анализ результатов исследования. Результаты показали высокую эффективность индивидуальной программы сенсорной интеграции в отсроченной реабилитации детей с церебральным параличом. Для всех тестов, включенных в систему Эйреса, была

получена статистически значимая разница между исходными результатами и данными, полученными после вмешательства.

Краткие выводы. При разработке программ сенсорной интеграции необходимо учитывать индивидуальные особенности ребенка и тип нарушений, включая в программу не только групповые, но и индивидуальные упражнения, повышающие эффективность восстановительного лечения. Индивидуальный подход для восстановления сенсорной интеграции показал высокую эффективность также в случаях отсроченной физической реабилитации.

Հոդվածն ընդունվել է 11.02.2022-ին:

Ուղարկվել է գրախոսման՝ 12.02.2022-ին: