

## PHYSICAL REHABILITATION IN SCOLIOTIC SPINE INJURIES IN CHILDREN SUFFERING FROM CEREBRAL PALSY

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**Annotation.** The results of the effectiveness of physical rehabilitation programs for children with cerebral palsy with scoliosis spinal lesion. The study involved 20 children aged 5-6 years. Diagnosis of motor function of children assessed to determine the strength endurance of back muscles and abdominals. The angle of curvature of the spine was measured on a scale Chaklin. The reaction of the cardiovascular system load was determined using a sample Shalkova and oxygen supply of the body - the breakdown of the Stange and Genchi. For improvement of lung function and cardio-respiratory systems of children are used with breath exercises and training of diving in the pool. It is established that the introduction of a game program "In the world of animals" and holding corrective exercises in the pool has a positive effect on the functional state of the spine, the cardiorespiratory system and the physical development of children.

**Keywords:** cerebral palsy, scoliosis, physical rehabilitation.

### Introduction

The problem of physical rehabilitation (PR) of children with infantile cerebral paralysis (ICP) and scoliosis [9,10] is studied in researches of many scientists [1,2,3,4,5]. There many developed PR programs with application of therapeutic gymnastics, massage, physio-therapeutic procedures, which solve the problems of improvement of motion activity, physical and psychic development, social adapting of children with ICP. Method of dynamic proprioceptive correction with application of special suit, oriented on reducing of muscles spasticity and hyper kinetic demonstrations, on improvement of vertical stability and orientation in space, correction of patient's posture deserves special attention [6].

Analysis of scientific works did not help to find complex PR programs for children of junior school age, in medical and special literature, the programs, which would be directed on correction and prevention from scoliosis, improvement of bio-geometrical human profile, power endurance of back and abdomen muscles as well as dysfunctions of cardio-respiratory system and functions of external breathing. All these factors determined the direction of our research.

### Purpose, tasks of the work, material and methods

*The purpose of the work* is to theoretically develop and practically test efficiency of complex PR program for scoliotic lesions of backbone of 5-6 years children with ICP.

*Organization and methods of the research.* The research was carried out on the base of Donetsk educational training center "Korn" in preparatory group with 20 children, who suffered from ICP, complicated by scoliosis, during seven months at trainings on therapeutic physical culture (TPC) and swimming. After stomatoscope examination and determination of spine curvature angle with X-raying we selected children with spastic diplegia, left side C-like scoliosis of 1-2 level of thoracocervical and thoracic sections of spine; these children were divided into two groups (10 persons each): control and experimental. After physical exercises and static loads children of both groups felt tiredness, pain in backbone and spine muscles from right side, heaviness in right arm.

During research, at every of its stage we used the following methods: somatoscope examinations, which reveal peculiarities of constitution, posture and state of supporting motor system [7]; measuring of mass and length of body. Examination was carried out in three positions: front of body, side and back of body. When examining from front position we paid attention to possible asymmetry of neck, shape of chest, triangles of waist, position of pelvis. Examination from side position permitted to check posture in sagittal plane. But the most detail was examination from back of body: position of head; symmetry of shoulders, crest of huckle bone, level of blades and their distance from backbone; equality of waist triangles; determination of backbone position by spinous process of vertebra. With the help of these indicators we determined form of scoliosis, direction of curvature, affected section of backbone and the level of scoliosis. The obtained data were proved by X-raying and record in child's health card.

Diagnostics of children's motion functions [4,7] we carried out by the following indicators: power endurance of spine muscles – was measured with rising of torso from position lying on belly, arms pointed back, legs were fixed. With the help of stop-watch we measured time of this position's holding in seconds (mean indicators for healthy children of 5-7 years old – is approximately 2 minutes); power endurance of abdomen muscles was measured with torso raising from lying position in sitting one up to first signs of tiredness: unqualified fulfillment, flushing of face, trembling, pushing off the floor with hands (standard value of this indicator is 10-15 times) [7,8].

Angle of spine curvature (by Chaklin's scale) was measured with the help of X-ray pattern [7]. Response of cardio-vascular system to load was determined by Shalkov's test [4]. Pulse and BP were measured with child's lying position. Just after 20 squatting with support on wall bars pulse and BP were measured again (registration of acute

influence of physical load), the, after 3, 5 and 10 minutes accordingly the same indicators were registered (registration of rehabilitation period). With positive response these indicators increase by 20-25%; with negative – by 30-50% and more in comparison with the state of rest (with health child these indicators become normal after 3-5 minutes, with sick children – after 5-10 minutes and more).

Vital capacity of lungs was measured with the help of spirometry. Its standard for 5-6 years old healthy children is approximately 2.0 liters. Oxygen supply of organism was determined with the help of Shtange's and Genchy's tests [4,7]. Besides, we used the method of electric neuro-stimulation by influencing on different zones and sections of back. The procedures of bio-controlled electric neuro-stimulation improve coordination of muscles movements, activate their micro-circulation, optimized muscles' balance with formation of adequate dynamic muscles' stereotype of body position both in rest and in motion. Owing to the fact that children with ICP can not independently master necessary movements, we encouraged them for this action, using game method by program "Animals' world". This fairy game enriches children with information about surrounding world, develops their motion activity, fantasy and mental abilities.

The obtained data were processed with the help of mathematical statistic method by Student's t-criterion.

In control group correction measures envisaged usual therapeutic physical culture (TPC) with classic complex of therapeutic exercises, massage and swimming; also physical culture pauses were in the middle of every subject of common knowledge. Therapeutic gymnastics was carried out trice a week, 30 minutes every training; swimming – twice a week, 30 minutes every training; massager – 15 minutes (1.5 massage units).

Experimental group trained as per offered by us PR program. Quantity and duration of TPC trainings, swimming and massage were the same as in control group. Determinate feature of the program is complex application of TPS, therapeutic swimming, massage and up-to-date physio-therapeutic method – dynamic electric-neuro-stimulation directed on backbone column; fulfillment of correcting physical exercises in the form of cheerful games from program "Animals' world" which were accompanied by music.

At first stage we carried additionally breathing exercises and TPC with elements of game, massage for scoliosis, trainings in swimming pool, with low level of physical loads. In TPC complexes we used mobile games, which positively influence not only on development of physical qualities, but also on children's psycho-emotional sphere, facilitate development of attention, thinking and communication abilities, reduce aggressiveness [3]. The main purpose of first stage is strengthening of muscular system, of sinew-joint system, improvement of children's motion activity and preparation for game program "Animals' world".

Second stage included TPC, which was complicated with exercises for balance and massage was supplemented by stretching. Most time of TPC was devoted to fulfillment of game program "Animals' world". For improvement of lungs' functional state and cardio-respiratory system we used exercises with pauses in breathing and training of diving in swimming pool. Trainings in swimming pool included special correcting exercises. At this stage TPC was combined with electric-neuro-stimulation sessions of 15 minutes duration.

At final stage TPC program was again complicated, in this case owing to increasing of physical exercises and fulfillment of "Animals world" games as competition with encouraging of winner with some prizes (density of trainings was increased from 50% to 70% from maximum).

### Results of the researches

Method of mathematical statistics for data processing permitted to establish that by the values of the studied indicators there was no confident difference between control and experimental groups before experiment ( $P > 0.05$ ).

The research of physical conditions' indicators witnesses that children with ICP confidently lag behind their healthy peers by such indicators as mass and length of body. Lagging behind in length of body was within 8% in control group and 5% in experimental group, and in mass of body – 15% and 17% accordingly comparing with this age standard. Analysis of results of anthropometric measurements confirmed deformation of backbones, which was established by X-raying: most of control group children had spine curvature angle of 20.5% and spine curvature angle of experimental group children was 21.0%, that witnessed about presence of C-like left side 2<sup>nd</sup> level scoliosis of throacocervical and thoracic sections of spine. Testing showed that tested children had significantly reduced static power endurance of spine and abdomen muscles, which participate in formation of orthograde posture. For example indicators of static power endurance of spine muscles in control group was (in seconds) 10.3, of abdomen muscles (quantity of times) - 4.3; in experimental group – accordingly – 10.5 and 4.4 that was approximately 50% from analogous indicators of healthy children.

When researching functional state of respiratory organs of children with spastic diplegia, we found that lagging behind of vital capacity of lungs (VCL) from standard of healthy children is in control group by 35% and in experimental group – by 32%. Children with ICP in both studied groups had reduced organism's adapting to hypoxia both owing to main disease and resulted from scoliotic deformation of chest. Indicators of Shtange's test were lower than standard values by 59% in control group and by 58% in experimental one. Indicators of Genchy's test were also lower than normal by 62% in control group and by 63% in experimental one. The children organism's response to change of respiratory system's functional state was increasing of HBF in rest, in control group up to 103 b.p.m. that is 14% higher than indicators of healthy children. Mean indicators of experimental group's children – 98 b.p.m. and it exceeds norm by 9%. Differentiated functional test by Shalkov showed the percentage of pulse acceleration after load (HBF of load) equal to 47% in control group and 57% in experimental one. BP increased within normal limits.

Rehabilitation of pulse after 5 minutes rest was not registered in both groups; in control and experimental groups it exceeded initial by 48%. The data, obtained at the end of experiment are presented in table 1.

Table 1

*Indicators of children with ICP, complicated by scoliosis of backbone after physical rehabilitation*

Indicators	Control group	Experimental group
Height, cm	104.0	106,3
Body mass, kg	18.7	20.1
Spine curvature angle, degrees	19.0	12.6
Spine muscles' endurance, sec.	12,0	19.0
Abdomen muscles' endurance, q-ty of times	9	13
VCL, liters	1.6	2,0
Shtange's test, sec.	15.5	27
Genchy's test, sec.	10.0	13.0
HRF in rest, b.p.m.	101	90
HRF of load, b.p.m.	184	117
BP in rest, mm. merc.col.	111/60	104/60
BP of load, mm. merc.col.	108/69	125/71

Application of the offered PR program resulted in confident increase of mass of children's bodies by 21% in comparison with initial values, while in control group this indicator increased only by 10% (confident difference between groups' indicators -  $P < 0.01$ ). Changes in height were insignificant and connected mainly with time factor. Spine curvature angle of experimental group's children reduced up to 12.6°, that is less than initial values by 40%, in control group this reduction was only by 12%, ( $P < 0.01$ ). In experimental group indicators of muscular endurance increased, which exceeded initial values of spine muscles by 81% and abdomen muscles by 195% with confident difference between indicators ( $P < 0.01$ ).

Vital capacity of lungs in experimental group increased by 67% and reached this age standard, while at control group it increased only by 23%, ( $P < 0.01$ ). Positive influence of the offered PR program was obvious also with adapting of organism to hypoxia. It was proved by increasing of indicators of Shtange's test by 86% and Genchy's test – by 40%, while at control group these indicators increased only by 9% and 4% correspondingly, with confident difference ( $P < 0.01$ ) and ( $P < 0.05$ ).

Heart beat frequency in rest in experimental group improved by 8% and reached age standard (90 b.p.m.); in control group this indicator improved by 2% with confident difference ( $P < 0.01$ ).

Indicators of differentiated functional test by Shalkov also normalized: period of HRF rehabilitation reduced up to normal value – 5 minutes. Pulse after load increased by 30%, comparing with initial value, while in control group it increased by 83%. BP changed within normal limits both in experimental and control groups.

**Summary**

1. Studying of indicators of junior school age children with ICP, complicated by scoliosis of backbone, witnesses that children with cerebral paralysis lag behind their healthy peers by physical conditions, static power endurance and by most important indicators of cardio-respiratory system.

2. The developed PR program supplemented with modern electric neuro-stimulation, introducing of game program "Animals world" and correcting exercises in swimming pool positively influenced on functional state of backbone, cardio-respiratory system and physical conditions of children. It has been proved by reaching of indicators of age standard for healthy peers, such as body mass, HRF in rest, vital capacity of lungs and by increasing of indicators of spine and abdomen muscles' endurance. Spine curvature angle of experimental group's children also reduced and adapting abilities to hypoxia – increased.

3. The offered PR program can be recommended for application in health related educational centers for children of such nosology.

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**Cite this article as:** Kalogerova V.G., Gryshun Yu.A., Korchak O.M., Bulkina E.A. Physical rehabilitation in scoliotic spine injuries in children suffering from cerebral palsy. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2013, vol.7, pp. 19-22. doi:10.6084/m9.figshare.735951

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Received: 25.05.2013  
Published: 30.07.2013