CORRECTION OF MOVEMENT STEREOTYPE IN PATIENTS WITH SPASTIC FORMS OF CEREBRAL PALSY

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Summary. In this article, the authors proposed a rehabilitation program, which involves the impact of bio muscle kinematic chain on the body of patients with cerebral palsy, taking into account the construction of the spiral body muscles during rehabilitation procedures.
Key words: cerebral palsy, muscular spiral, rehabilitation, motor stereotype.

It is well known that the main clinical pattern of cerebral palsy is characterized by the inability of the patient to maintain normal vertical posture of the body and perform voluntary movements [4]. Very promising approach to reducing treatment in this sense is the consideration of human movement stereotype in the context of balanced work of the functional association of the skeletal muscles which are represented by the longitudinal muscle groups, muscle pairs and muscle spirals (MS). Interacting with each other, paired longitudinal associations of muscles retain symmetry of the body and are involved in the movements of the spine and the axial skeleton as a whole. Ventrally located spinal muscles act as flexors; muscles located dorsally act as extensors. Simultaneous reduction of homolateral, ventral and dorsal groups complement the action of the lateral metameric muscles that provide lateral tilt of the spine. Muscle pairs are associations of muscles that provide stabilization and motion kinematic parts of the body around particular axis of rotation. Muscle helix is a functional association of muscles which provide rotational-translational movement. Basis MS is a chain of the skeletal muscles, essential to the functioning of transmission from link to link. Wherein each spiral belongs to a certain set of muscles, from which some of them may be involved in other spirals. In case of violation the spiral muscle interactions develop changes that cut through bilateral symmetry of the body and reduce muscle performance. MS normally run from the head, neck, extend to the muscles of the upper limbs, the muscles of the back, chest to the opposite leg. They support the axial skeleton, dynamically fix the position of the head, keep the physiological curves of the spine, are involved in the respiratory movements of the chest, as well as ensure the stability of body position and movement of the limbs (Figures 1 and 2). P.P. Shaparenko was the first who provided a detailed description of the location and bilaterally dynamic symmetry of the spiral muscles in the human body [5]. The affected muscle chain in patients with cerebral palsy was first implemented in the method of dynamic proprioceptive correction using the therapeutic costume "Adele" by Semenova K.A. [6]. Further development of this trend is reflected in the scientific and practical activities of Professor Kozijavkin [7] who proposed the author's technique, which is based on the biomechanical correction of the spine and large joints and muscle spiral effect on the trunk and extremities using costume biodynamic movement correction "Spiral", followed by the construction of approximate physiological movement stereotype.

In order to further improve the approach and effectiveness of this method especially in patients who are not able to stand and walk, we have developed and tested a private rehabilitation program, the principal feature of which was the impact on the body with cerebral palsy with the inclusion of the whole bio-kinematic muscle chain, possibly simultaneously, taking into account construction of the spiral body muscles during rehabilitation procedures [8].

The cervical portion of the spine bio kinematically connected to all parts of the spine, joints, pelvis and lower limbs and neck muscles (flexors and extensors) is an integral part of the major muscle helices that span the human body from the lower extremities to the head. Therefore, limitation of movement of the cervical spine occurs as independent patho-important functional blocks, as well as compensatory sanogenetic to retain the balance of the body, and as a result, it is one of the links in the formation of abnormal movement stereotype.

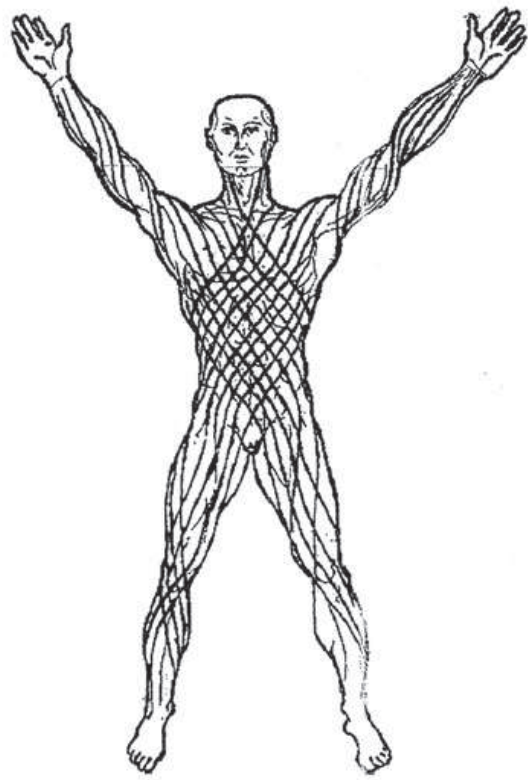


Fig. 1. General location scheme of helices muscle in the human body (by Shaparenko P. P., 2003)

We examined 168 children, aged 3 to 7 years, with spastic forms of cerebral palsy (spastic diplegia - 68 children, hemiplegia - 63, double hemiplegia - 37 patients). All the children were divided into two groups of observations: the main group was represented by 98 children who underwent a rehabilitation course at the Rehabilitation Centre for children with organic damage to the nervous system at the Poltava Regional Children's Hospital during the period 2007-2013. The control group consisted of 70 children, similar in age and gender who were treated at the Department of Nurology of the Poltava Regional Children's Hospital.

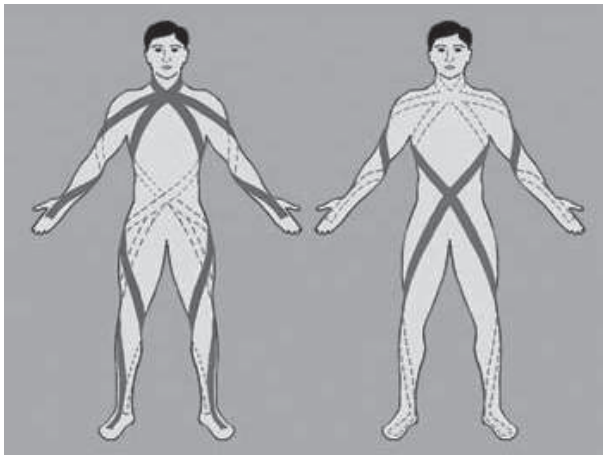


Fig. 2. Arrangement of muscle spirals external and internal rotation in the human body (by Shaparenko P. P., 2003)

In the control group the examination was carried out at the same time as the examination in the study group, before the course of treatment for handling child in the hospital and after the course of rehabilitation. Children in the control group received a standard set of regenerative therapy, according to the clinical protocol of rehabilitation for children with cerebral palsy № 889 on 09.12.2009.

Children from the main group were offered our own rehabilitation program, which provided a comprehensive physiotherapeutical effect on MS neck, trunk and extremities. The proposed rehabilitation program for patients spastic forms of cerebral palsy, by acting on the muscle spirals, included:

- Hardware physiotherapy at the crossroads of MS (biomechanical stimulation, sinusoidal modulated currents, electrical). Biomechanical muscle stimulation was performed by aparata "Grizzly" and "Youth" in the mode recommended by the manufacturer 22 Hz 2-3 min, 26 Hz for 2-3 minutes. The course of treatment included 8-12 procedures. Physiotherapy apparatus "Amplipuls", "Stimulus" with a concrete

impact affected muscle spiral: their crosshairs on the neck, thigh, back pain, muscle chains on the projection of the external or internal rotation of the extremities (individually). The number of procedures applied were 5-6 per day. The starting position during the procedure and BMS was selected individually so to stretch muscle spiral part which is significant patho-muscle;

- Mud therapy and ozocerite therapy in place of MS intersections;
- Massage during the MC, which by the nature of the impact and objectives differed significantly from the massage, which is usually used in case of spastic forms of cerebral palsy. All the procedures were aimed at normalizing reflex activity of the central nervous system and muscle tone chains. To achieve relaxation of the muscles in spastic conditions in spirals we used passive soft tissue techniques for multivector in author's modification with simultaneous effect on the joints in the massaged area. That stimulated the hypotonically and functionally weakened muscles and improved their tone, reduced the possibility of applied techniques of deep stroking, kneading, shading along the muscle chain, which also lowered the tone in the muscle spirals antagonists. The procedure used for the elements of segmental massage reflex affected segmental apparatus of the spinal cord through certain areas of the skin receptors, tendons, ligaments, muscles, and places intersections MS. Techniques were repeated 3-5 times.
- Mobilization abbreviations of abnormally tight muscles of the limbs and trunk muscles were carried out simultaneously with the whole spiral. Affecting muscle contraction was performed in the initial supine position on a convex soft support while sitting on the deck with a soft stuffed like "riding on an animal" with the location of the trunk and limbs so that the kinematic effect of stretching at the same time covered the entire spiral, which included the contraction of muscles at the same time stimulating effect was performed on muscle chain antagonists.
- Correct movement stereotype physiotherapy by "Spiral" was held in order to fix the achieved correction effects, optimization postures and movements, balance training, relaxation and activation of reduced flabby muscles on unstable support, trampoline, inflatable cushion, gymnastic balls in and out. n. standing, sitting alone or with the help of a doctor, lying on his stomach, back, while integrating the work of kinematic chains oppositely oriented muscle spirals. Thus, the mobilization of the dynamic potential of all parts of the kinematic chain helix makes it possible to show the maximum power reserve balance in the gravitational field.
- Treatment position using facilitated corrective pilings and pilings in the middle position, taking into account the impact on the contraction of the muscle with simultaneous correction of the entire spiral and spiral activation – antagonist
- "School of parents" and hippotherapy (as an additional method of influence on MS) were used to maintain and strengthen the effect between the stationary rehabilitation.

Thus, the application of our methodology aimed at obtaining therapeutic effect on spastic muscles directly and by exposing the whole muscle portions of the spiral.

The most informative and reliable, simple to perform as a criterion of rehabilitation effects on muscle spiral patients spastic forms of cerebral palsy is the study of the passive side of the slopes in the cervical region with simultaneous rotation in geterolateralnuyu side, thus testing the upper portion of the trapezius and the sternoclavicular-mastoid muscle. This testing technique allows examination, even in patients with disabilities in the supine position. For a healthy baby lateral tilt of the cervical spine reaches 50º from the vertical axis. Measurement of the angle of inclination to the side is held to a more limited traffic.

In order to quantify the initial state of the patient and changes after the treatment we proposed the following score for changes in the volume limitation of movement of the cervical spine:

1) an excellent result - an increased range of motion ≥ 15º;
2) a good result – increased range of motion 10º - 14.99º;
3) a satisfactory result - increased range of motion 5º - 9.99º;
4) an unsatisfactory result - increased range of motion ≤ 5º.

Testing the range of motion in the cervical region is often accompanied by pain, the intensity of which varies in children. In our opinion, it is important to assess the intensity of pain during the test, which to some extent determines current position

of a patient, the scope and methods of rehabilitation, as well as a criterion of its effectiveness.

Children in the study group self-assessed pain intensity using a visual analogue scale icons of happy and unhappy people. This is a scale of grimacing faces by Wong-Baker [9] which has a corresponding digital coding. (See Table 1).

The scale is clear and easy to complete and provides information about the dynamics of pain. Comparing previous and subsequent indicators of pain, it is possible to judge the effectiveness of the treatment.

Assessment of pain	No pain	Minimal pain	Middle pain	Expressive pain	Very expressive pain	Most expressive pain
Scores	0	2	4	6	8	10

Table 1. Scale of face grimaces by Wong-Baker to assess pain intensity

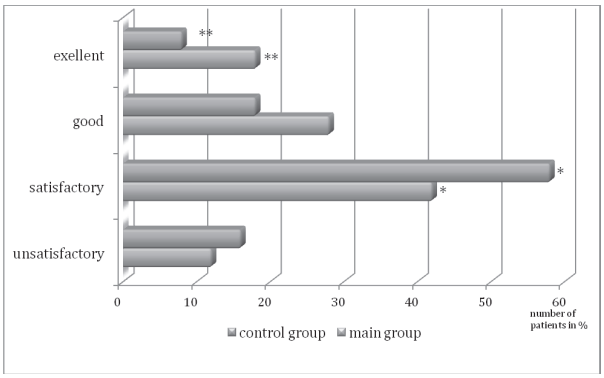
In most cases the treatment produced positive changes in the clinical status of a patient. The effectiveness of rehabilitation and stability of therapeutic effect differed between the treatment groups. Thus, in the group of patients and control group changes in the mobility of the cervical spine were found. They were recorded using the proposed integrated assessment, namely in patients who were engaged in the proposed method the range of motion in the cervical region of the spine (passive lateral tilt with the element of rotation) significantly increased when compared with estimates prior to rehabilitation. Moreover, a significant decrease in the intensity of pain was observed, which allowed for the manipulation to a greater extent (Table 2).

Table 2. The results of the rehabilitation effects on indicators of motion in the cervical region of the spine in patients from examined groups

Examined groups	The main group		The control group	
	Baselines	After treatment	Baselines	After treatment
The amount of motion in the cervical area of the spine (passive side slope element of rotation), º	22.4 ± 2.17º *	33.2 ± 3.05º *	23.6 ± 2.21º	28.1 ± 4.11º
The intensity of the pain, scores	4.4 ± 0.2*	1.7 ± 0.1*	4.2 ± 0.3	2.8 ± 0.3

* - differences likely to occur

Changes in muscle spirals in the cervical spine in the groups of examined patients as the integrated evaluation of the effectiveness of rehabilitation in view of the impact of spiraling build muscle including the work of the whole bio-kinematic chain muscle at the same time, are shown in Fig. 3. It illustrates the vast majority of non-rehabilitation outcomes among patients from the main group and the number of satisfactory results among the control group.



*, ** - differences likely to occur

Fig. 3 The results of the integrated assessment of the effectiveness of the rehabilitation effects on muscle spiral portion of the cervical spine in patients treatment groups (%).

Thus, therapeutic effect on spastic muscles, after the application of our technique had an immediate impact on the way and the whole muscle portions of the spiral (Fig. 4).

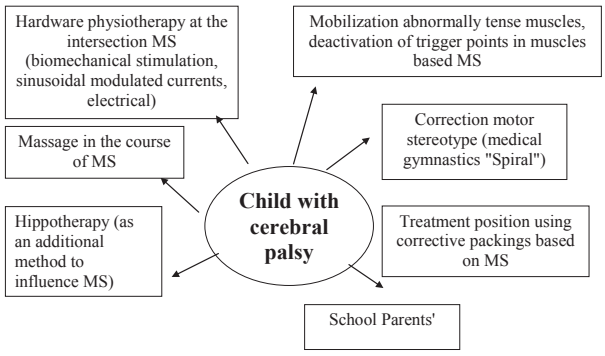


Fig. 4. Scheme of the rehabilitation program

CONCLUSIONS

1. The proposed method of rehabilitation of children with spastic forms of cerebral palsy has expressive sanogenetic influence, i.e. it stimulates body's own reserves of health

and triggers a cascade of reactions aimed at the formation of movement stereotype, approximate to the optimal by restoring the balance of the functional association of skeletal muscle (muscle spirals).

2. Shift in the cervical region of the spine sufficiently informative as before treatment in order to assess the initial state and the dynamics and at the end of the course is an integral indicator of muscle kinematic spiral.
3. Increasing the range of motion of the cervical spine area, taking into account the intensity of pain should be used as a criterion of the effectiveness of rehabilitation effects on muscle in patients with spastic spiral form of cerebral palsy.

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