

Treatment of Nervous and Mental Diseases**INDIVIDUAL PROFILE OF FUNCTIONAL ASYMMETRIES IN CHILDREN WITH CEREBRAL PARALYSIS IN APPLICATION OF TREATMENT-LOADING SUIT (ИНДИВИДУАЛЬНЫЙ ПРОФИЛЬ ФУНКЦИОНАЛЬНЫХ АСИММЕТРИЙ У БОЛЬНЫХ ДЕТСКИМ ЦЕРЕБРАЛЬНЫМ ПАРАЛИЧОМ ПРИ ИСПОЛЬЗОВАНИИ ЛЕЧЕБНО-НАГРУЗОЧНОГО КОСТЮМА)**

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The concept of individual profile of functional asymmetries, that is, of aggregate of motor (arms, legs) and sensory (vision, hearing etc.) asymmetries inherent in a certain individual is an expression of contemporary ideas of interhemispherical interaction [2, 3, 13]. In patients with infantile cerebral paralysis, formation of pathological interhemispherical asymmetry is possible because of early influence of damaging factors on immature encephalon, in particular in the case of hemiparetic form of the disease which form is characterized by one-sided morbid affection [2, 13]. Organic damage and hypoplasia of associative parts of the brain which determine the formation of pathologic asymmetries in patients with infantile cerebral paralysis can lead to reduction of both intellectual functions and vertical stability owing to impairment of the synthesis of "body image". So long as distorted sensory information incoming from pathologically changed musculoskeletal and visual apparatuses [7, 9] to central nervous system can be one of the possible causes of the hypoplasia of associative parts of the brain in the case of infantile cerebral paralysis, search and physiologic substantiation of the methods that allow to correct the impaired proprioceptive flow prove to be actual. One of them is the technique of dynamic proprioceptive correction with dosaged application of a treatment-loading Adeli Suit [10]. It was shown during research works pursued in the past that even a single application of this technique in patients with infantile cerebral paralysis contributes to some alteration of individual profile of functional asymmetries as well as correction of vertical position [13].

Influence of repeated (course) application of a treatment-loading suit on intellectual faculties and vertical stability is explored insufficiently in patients with infantile cerebral paralysis who have different individual profiles of functional asymmetries. The fulfillment of this task will allow to considerably extend the field of application of the technique above.

Three groups of teen-agers were examined: 19 healthy persons (aged 15.6 on average), 41 patient with right-side and 38 patients with left-side hemiparetic form of infantile cerebral paralysis (aged 15.9 on average). The diagnosis of right- or left-side hemiparesis was clinically made on the basis of one-sided reduction of extremity strength, its shortening and muscular hypotrophy as well as change of tonus and reflexes.

In order to form individual profile of interhemispherical asymmetries a questionnaire worked out by N.N.Bragina and T.A.Dobrokhotova [2] was used as well as computer techniques allowing to explore motor asymmetry of arms, sensory visual asymmetry and asymmetry of a position of body center of gravity [10, 13]. When exploring motor asymmetry of arms, certain computerized procedures were used that had been worked out by us on the basis of a standard paper form test of lineograms. Such procedures allow to estimate the precision of movements made with a left or right arm in four directions: from the left to the right, from the right to the left, from the front backwards, and from behind forwards [13]. Our method is based on coincidence of movement direction of both a handler (a computer mouse) and its cursor on the display screen; in proportion as a cursor moved the precision amount was ascertained for each hand. To explore sensory visual asymmetry a standard tachystoscopic technique was applied in computer adaptation [12], with alternate presentation of a number of alphabetical letters now in the right now in the left half of a visual field.

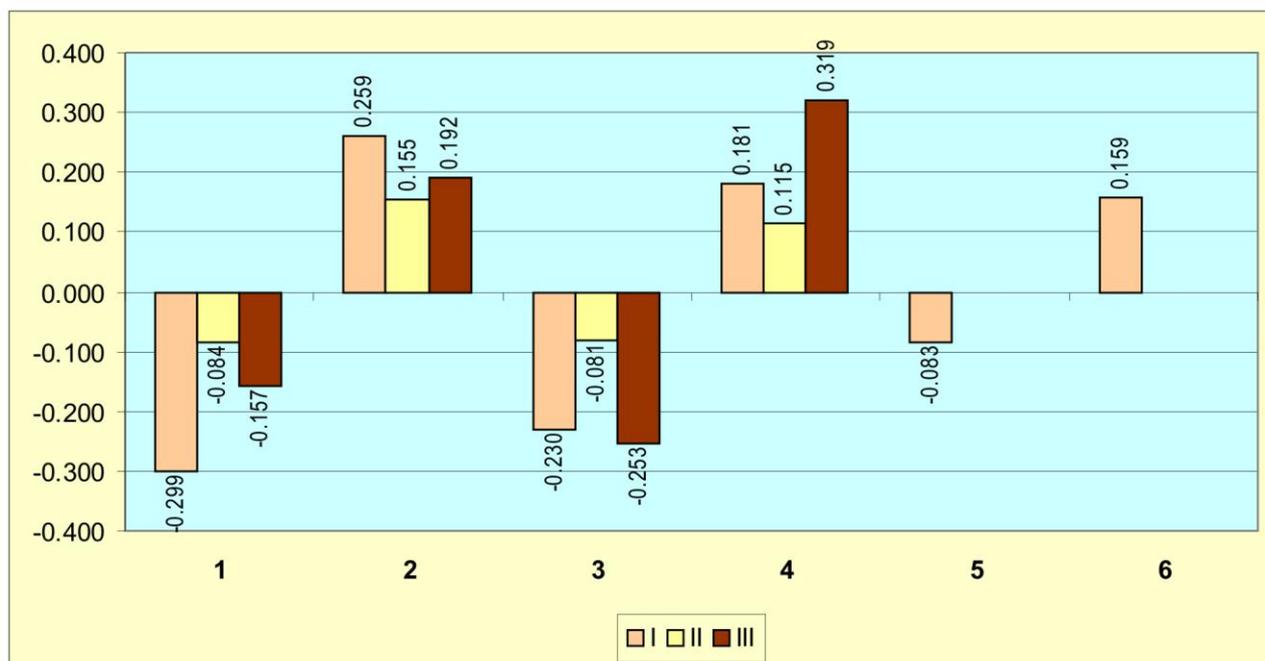
In order to estimate sensory visual asymmetry and motor asymmetry of arms a standard formula of calculation of an asymmetry coefficient was applied (AC) [2]. A positive value of a coefficient points to right-side asymmetry and a negative value points to left-side asymmetry. A value near close to zero testifies to – ambidexterity. Exploration of asymmetry of a body center of gravity was carried

out by means of computer stabiligraphic techniques [10, 13]: a positive value pointed to a deflection of a body center of gravity to the right from the center of coordinates of a stabiligraph, a negative one – to the left. Vertical stability was judged from the area of statokinesigram: as the latter was increasing, vertical stability become lower [10]. Since in the case of infantile cerebral paralysis mental impairment is often accompanied with diminished countably additive functions and space-constructive thinking [4], a standard procedure of “Numerical series” (a component of the School test of intellectual growth and development [11]) was used with the object of examination of verbal intellect; if it was a nonverbal one, a short version of Raven’s test [5] followed.

The above-mentioned techniques and procedures applied, the healthy teenagers were examined only once (control), and the patients with infantile paralysis – before treatment, after a course of treatment with application of a loading suit, as well as after a course of traditional treatment (including exercise therapy, massage, physio- and drug therapy without nootropes). The method of dynamic proprioceptive correction consisted in course (20-fold) application of the Adeli Suit [1, 10, 13] under the conditions of Earth gravity with vertical pulling load 98 H.

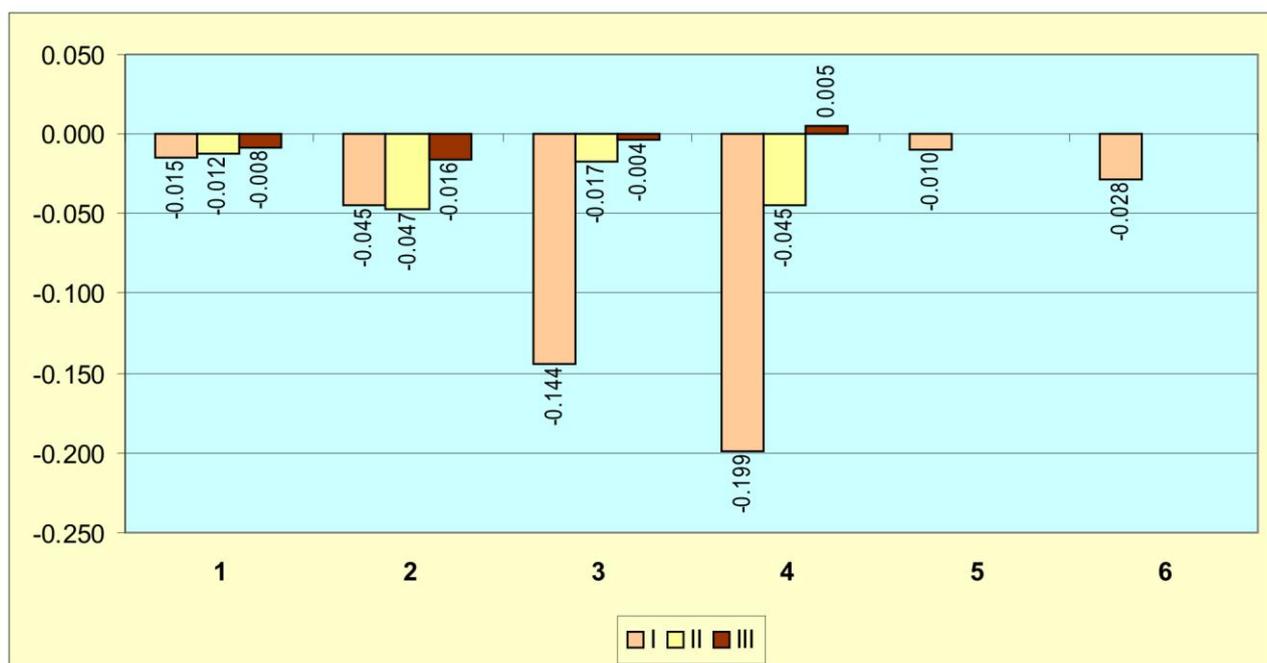
During statistic elaboration of the observational results the EXCEL-5 computer program was used. The reliability of differences was estimated by the Mann – Whitney method of distribution-free statistics.

Healthy teenagers. During examination by the paper form method worked out by N. N. Bragina and T. A. Dobrokhotova, the healthy teenagers were divided into left-handers and right-handers on the basis of the data concerning their manual preference. When examining individual profile of functional asymmetry by means of appropriate appliances it turned out that in left-handers AC of arms (Fig. 1), visual hemiareas (Fig. 2), and shift of a body center of gravity (Fig. 3) had lower values than in right-handers. This fact reaffirms the data coming from the literature on the subject stating that laterality of sensory functions manifests itself more in right-handers 2, 3]. Vertical stability was lower in healthy left-handed teenagers than in right-handers ($p < 0.05$) (Fig. 4). Maybe, this phenomenon is connected with the fact that mechanisms of “body image” in left-handers are presented bilaterally [2]. When examining intellectual functions, significant differences of indexes of both verbal and nonverbal intellect between right-handers and left-handers were not revealed (Fig.



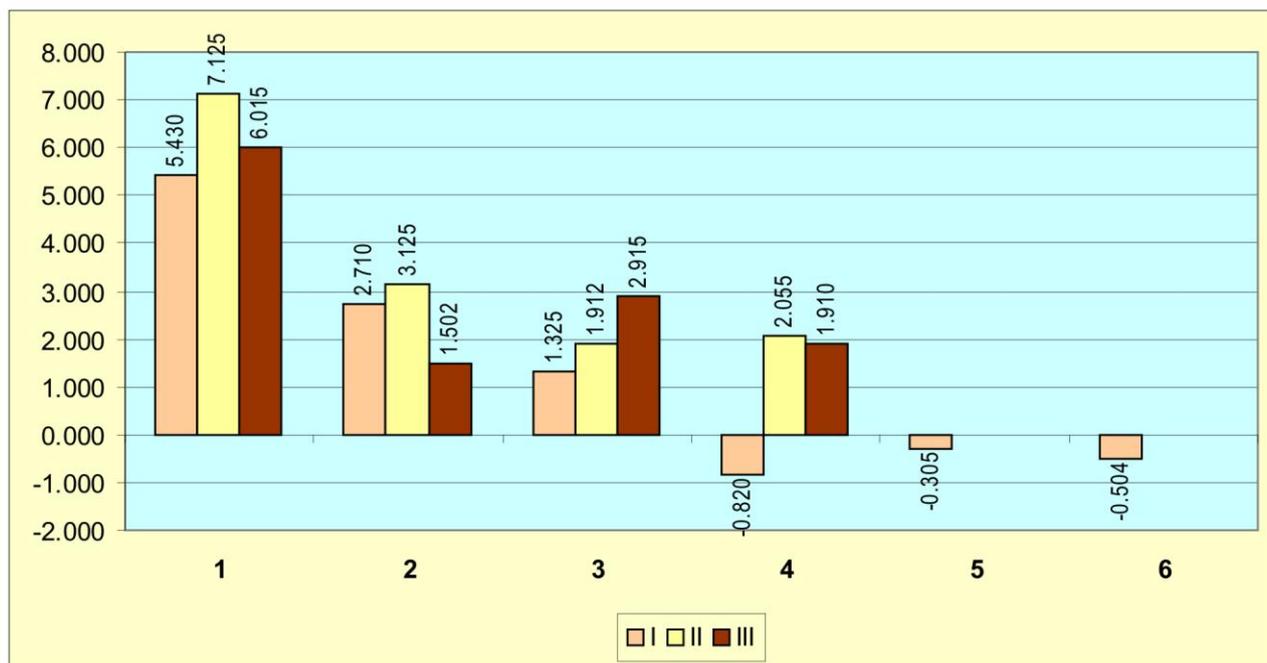
5 and 6). This testifies to even development of intellectual functions in healthy teenagers.

Fig. 1. Change of AC of arms in patients with hemiparetic form of infantile cerebral paralysis in consequence of treatment. 1 – Left-side hemiparesis / left-handers, 2 – Left-side hemiparesis / right-handers, 3 – Right-side hemiparesis / left-handers, 4 – Right-side hemiparesis / right-handers, 5 – Healthy / left-handers, 6 –



Healthy / right-handers. I – Before treatment, II – After a course of traditional treatment, III – After a course of treatment with application of a loading suit.

Fig. 2. Change of AC of vision in patients with hemiparetic form of infantile cerebral paralysis in consequence of treatment. 1 – Left-side hemiparesis / left-handers, 2 – Left-side hemiparesis / right-handers, 3 – Right-side hemiparesis / left-handers, 4 – Right-side hemiparesis / right-handers, 5 – Healthy / left-handers, 6 – Healthy / right-handers.

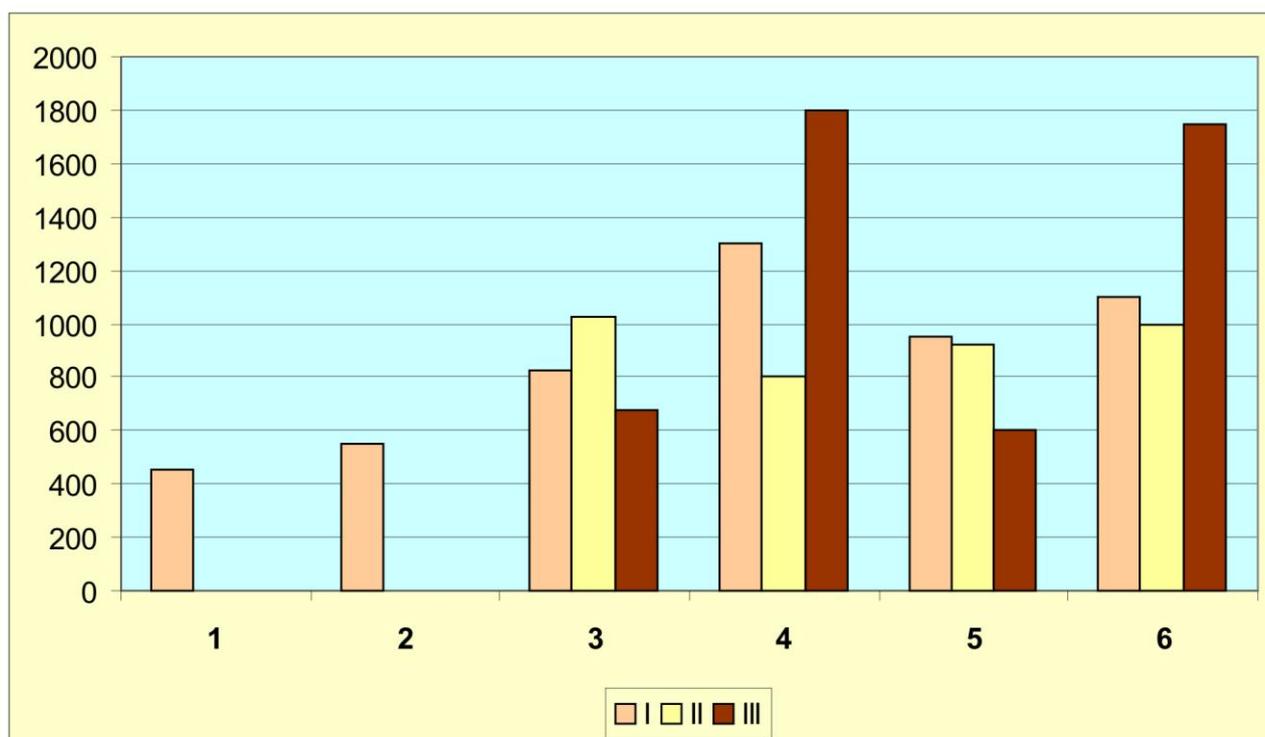


6 – Healthy / right-handers. I – Before treatment, II – After a course of traditional treatment, III – After a course of treatment with application of a loading suit.

Fig. 3. Change of the deflection of body center of gravity (in mm) in patients with hemiparetic form of infantile cerebral paralysis in consequence of treatment. 1 – Left-side hemiparesis / left-handers, 2 – Left-side hemiparesis / right-handers, 3 – Right-side hemiparesis / left-handers, 4 – Right-side hemiparesis / right-handers, 5 – Healthy / left-handers, 6 – Healthy / right-handers. I – Before treatment, II – After a course of traditional treatment, III – After a course of treatment with application of a loading suit.

Patients with hemiparetic form of infantile cerebral paralysis. When examining patients with infantile cerebral paralysis by the paper form method, each group was also divided into right-

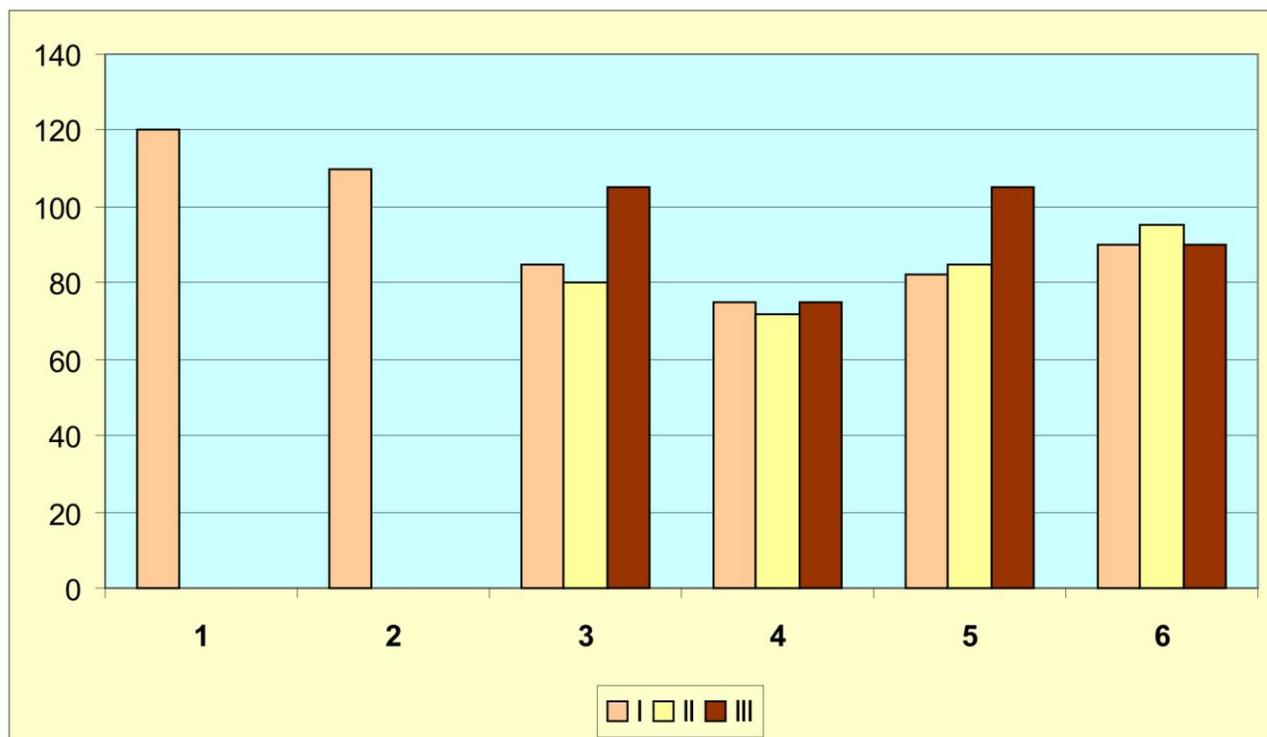
handers and left-handers. During exploring motor asymmetry of arms in patients who use their healthy extremity mainly (in left-handers with right-side hemiparesis and in right-handers with left-side hemiparesis), it was recorded that the healthy arm moved in them more precisely, i.e., there was conformity of morphological arms' asymmetry with dynamic one. In persons who use their affected extremity mainly (in right-handers with right-side hemiparesis and in left-handers with left-side hemiparesis) the sore arm – in spite of its shortening and muscular hypotrophy – surpassed the healthy in precision of movements, i.e., there was no conformity of morphological arms' asymmetry with dynamic one. Besides, coefficients of motor asymmetry of arms (see Fig. 1) and sensory visual asymmetry (see Fig. 2) had larger value in patients with infantile cerebral paralysis than in healthy teenagers. The most expressed left visual asymmetry was observed in patients with right-side hemiparesis, perhaps, for account of affection (which is usual in this form of infantile cerebral paralysis) of the left hemisphere specialized in perception of verbal stimuli [2]. Shift of body center of gravity was also marked more obvious in patients with infantile cerebral paralysis than in healthy teenagers (see Fig. 3), the fact pointing to more asymmetry of distribution of postural tonus in patients with infantile cerebral paralysis [4, 13]. Thus, the available data confirm the formation of pathologic functional asymmetries in the case of hemiparetic form of infantile cerebral paralysis, the fact that could be caused by both primary organic affection of one cerebral hemisphere and compensatory functional reorganization of another. When exploring vertical stability in patients with infantile cerebral paralysis, its decrease (to a greater degree in left-handers) was established in comparison with healthy teenagers (see Fig. 4). As to intellectual functions, in patients with infantile cerebral paralysis a decrease (in comparison with healthy teenagers) of indexes of nonverbal intellect (see Fig. 5), and larger values were observed in right-handers with right-side hemiparesis and in left-handers with right-side hemiparesis. It may be explained not only by the conservation of a subdominant hemisphere, but also by the fact that patients actively used their sore extremity, and, besides, it confirmed the importance of identification of the shape of a thing in the making of spatial (nonverbal) thinking [4]. In all patients with infantile cerebral paralysis a decrease of indexes of verbal intellect was ascertained, and essential differences between the subgroups were not brought to light (see Fig. 6). Since, as is well known, verbal functions are younger in phylogenetic aspect [2, 3], they suffer owing to action of damaging factors on an immature encephalon



mainly.

Fig. 4. Change of the area of statokinesigram (in mm²) in patients with hemiparetic form of infantile cerebral paralysis in consequence of treatment. **1** – Left-side hemiparesis / left-handers, **2** – Left-side hemiparesis /

right-handers, **3** – Right-side hemiparesis / left-handers, **4** – Right-side hemiparesis / right-handers, **5** – Healthy / left-handers, **6** – Healthy / right-handers. **I** – Before treatment, **II** – After a course of traditional



treatment, **III** – After a course of treatment with application of a loading suit.

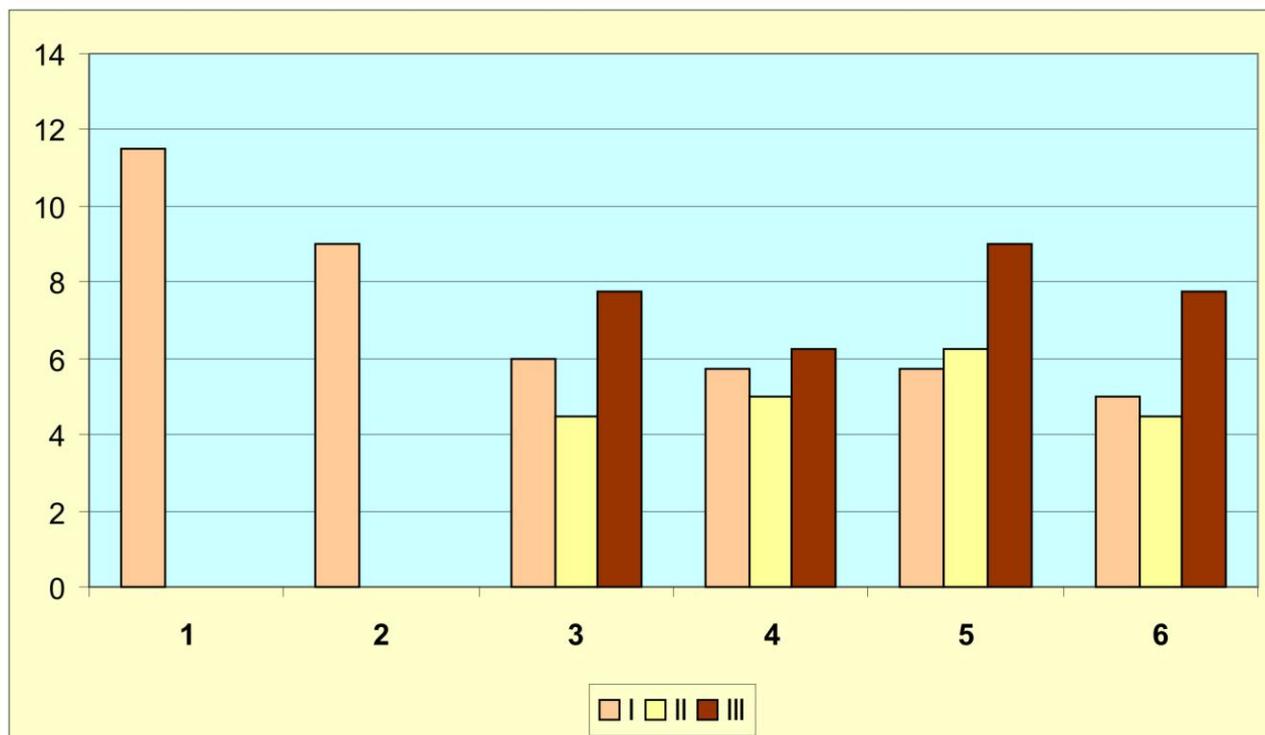
Fig. 5. Change of the nonverbal intellect in patients with hemiparetic form of infantile cerebral paralysis in consequence of treatment. **1** – Left-side hemiparesis / left-handers, **2** – Left-side hemiparesis / right-handers, **3** – Right-side hemiparesis / left-handers, **4** – Right-side hemiparesis / right-handers, **5** – Healthy / left-handers, **6** – Healthy / right-handers. **I** – Before treatment, **II** – After a course of traditional treatment, **III** – After a course of treatment with application of a loading suit.

After a course of application of a treatment-loading suit a change of individual profile of functional asymmetries was established, and in patients with infantile cerebral paralysis the adaptive function of a conserved right hemisphere (in the case of right-side hemiparesis) was realized for account of amplification of an initially dominant extremity (see Fig. 1), and not for its decrease, as is usual in healthy persons under adaptive conditions [3]. Proprioceptive stimulation led to more significant decrease of sensory visual asymmetry than the traditional treatment in each subgroup of patients (see Fig. 2) – the fact that may be conditioned by the reorganization of interaction of sensory systems under the action of a changing proprioceptive load [9]. After proprioceptive stimulation a decrease of the initial laterality of body center of gravity was recorded in right-handed patients and its increase – in left-handers (see Fig. 3). And an increase of vertical stability in right-handers (see Fig. 4) was accompanied by a growth of indexes of nonverbal intellect (see Fig. 5) – the fact that may point to the improvement of visual-spatial analysis in them. After application of the technique of dynamic proprioceptive correction a decrease of vertical stability (see Fig. 4) was marked in left-handers, but the indexes of nonverbal intellect did not change essentially (see Fig. 5).

As is well known, a “body image” disorder and a disorder in constructive and spatial thinking cease to go with affection of associative parietal and occipital parts of the brain in left-handers with focal brain damages, as used to be in right-handers [8]. The lower effectiveness of proprioceptive stimulation when correcting postural and intellectual impairments in left-handers may be connected with the strengthening of initially available intra- and interhemispheric dissociation of mechanisms responsible for the realization of body image and intellectual functions. At the same time the repeated proprioceptive stimulation contributes to an improvement of indexes of verbal intellect (see Fig. 6) in both left-handed and right-handed patients.

It is typical that after application of the technique of dynamic proprioceptive correction the indexes of intellectual development in patients with infantile cerebral paralysis does not reach the level of healthy teenagers. It is possible that proprioceptive stimulation improves the intellect for account of functional reorganizations at the time of maturation of associative parts of the cerebral cortex [6, 12] (owing to amplification and correction of the sensory flow), however, the availability of a focal damage impedes its complete restoration.

Fig. 6. Change of the verbal intellect in patients with hemiparetic form of infantile cerebral paralysis in con-



sequence of treatment. **1** – Left-side hemiparesis / left-handers, **2** – Left-side hemiparesis / right-handers, **3** – Right-side hemiparesis / left-handers, **4** – Right-side hemiparesis / right-handers, **5** – Healthy / left-handers, **6** – Healthy / right-handers. **I** – Before treatment, **II** – After a course of traditional treatment, **III** – After a course of treatment with application of a loading suit.

The findings allow to work out a differentiated approach to the application of the technique of dynamic proprioceptive correction and extend its field of use in patients with various diseases of central nervous system.

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