

Treatment of Nervous and Mental Diseases**ELECTRONEUROMYOGRAPHIE CHARACTERISTICS OF THE EFFECTS OF ADELI-92 TREATMENT-LOADING SUIT IN CHILDREN WITH INFANTILE CEREBRAL PARALYSIS (ВЛИЯНИЕ ЛЕЧЕБНО-НАГРУЗОЧНОГО КОСТЮМА (ЛК-92 «АДЕЛИ») НА ЭЛЕКТРОНЕЙРОМИОГРАФИЧЕСКИЕ ХАРАКТЕРИСТИКИ У БОЛЬНЫХ ДЕТСКИМ ЦЕРЕБРАЛЬНЫМ ПАРАЛИЧОМ)**

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By means of global electromyography and monosynaptic testing (H-reflex), treatment-loading suit (Adeli-92) was investigated in terms of its influence on functional state of neuromotor apparatus in 25 children with infantile paralysis in the form of spastic diplegia. Improvement of motor functions may be conditioned by a decrease of an amplitude of bioelectric activity in spastic muscles at physiologic rest and by an increase of an amplitude of agonists' biopotentials at arbitrary movements. Improvement of motor functions may be also caused by normalization of both the coefficients characterizing coordinated muscles' interactions and functional state of spinal motoneurons as well as of the mechanisms of their suprasegmental regulation. It is suggested that such effect may be realized because of the afferentation normalization as well as by means of the influence of Adeli-92 on both central and segmental structures of motor analyzer including neuromediator systems.

Disturbance of motor functions is a basic syndrome of infantile cerebral paralysis. It is determined by primary affection of some brain structures. Functional state of peripheral neuromotor apparatus changes as well.

Proceeding from the idea that a sensory flow is of great importance in respect of both the regulation of movements and the maintenance of muscular tonus, in the treatment of infantile cerebral paralysis close attention is turned to the methods that are based on the correction of afferent flow: vibratory massage, artificial local hypothermia, acupuncture, microwave resonance therapy [3-5, 8, 9].

The search of more effective techniques of rehabilitation of patients is actual nowadays too. In this connection the treatment mode put forward in 1991 is noteworthy with respect to patients with motor and speech disorders cerebral by origin. This treatment mode is based on the optimization of afferent flow by means of a treatment-loading suit (Adeli-92) and corresponds with the needs of the clinical picture of infantile cerebral paralysis to the utmost degree: it is "simple in performance, available, and effective enough" [2].

The modern methods of electrophysiology, in particular clinical electroneuromyography, not only help clinicians in differential diagnostics, but also allow to make the control of dynamics of a treatment process more objective as well as to estimate a state of neuromotor apparatus on each level of it – from the periphery to the center. As a result, it makes possible to explore the neurophysiological mechanisms of sanogenetical action of the method applied [6, 7, 11].

The influence of the Adeli-92 on functional state of neuromotor apparatus in patients was explored by means of methods of global and stimulatory electroneuromyography.

Under our surveillance there were 25 patients (of 10-18 years old) with infantile cerebral paralysis in the form of spastic diplegia. The clinical picture of some of them was complicated by a number of severe syndromes and, therefore, the traditional complex therapy proved to be ineffective.

The work was carried out with a electroneuromyograph of "Counterpoint" ("Dantec" Danish company) with the use of skin electrodes.

The bioelectric activity of muscles of lower extremities was registered at physiological rest, during performance of any physiological movements with maximum effort and in upright position. This allowed to discover some changes of muscular tonus under various loads and to calculate their coordinative interrelations: coefficients of adequacy, reciprocity, and synergy [4].

The stimulatory methods of electromyography consisted of monosynaptic testing of a state of motoneuron pool of spinal cord and of a character of supraspinal influences on segmental apparatus of spinal cord by means of *N*-reflex [7, 11-14]. *N*-reflex was registered with observance of the traditional technique in salens muscle when irritating tibial nerve in popliteal space. And the ratio of the amplitude of the maximum *N*-reflex to the amplitude of the maximum *M*-response (N_{max}/M_{max}) was to be estimated as a measure of excitability of spinal motoneurons and as a degree of involvement of both large (phasic) and small (tonic) motoneurons [11]. It is suggested that a degree of involvement of large and small motoneurons reflects a level of activity of monoaminergic and cholinergic neuromediator systems respectively [11].

Under low-frequency (3 Hz) rhythmical stimulation of tibial nerve a degree of depression of *N*-reflex was defined taking into account the ratio of the mean amplitude of *N*-reflex of 5 last responses out of 10 to the amplitude of *N*-reflex in response to the first stimulus. This index, as it is deemed [12], allows to judge of a state of central mechanisms regulating intrasegmental interneuronal interaction.

The effects observed after treatment were various and individual, and, nevertheless, we succeeded to discover a number of tendencies in dynamics of some indexes of functional state of neuromotor apparatus which were examined with respect to the whole group.

According to the findings of superficial electromyography, at the beginning (before treatment) almost all the patients had certain signs of disturbance of the suprasegmental regulation of muscular tonus. This phenomenon manifested itself as a considerable abnormal growth of coefficients of reciprocity, synergy, and adequacy, and, in other words, coordinative interrelations of muscles were disturbed. After 20 runs normalization of coefficients was marked in 75 % of patients: almost twofold decrease (Fig. 1). Changes of these indexes reflect decrease in co-contraction of antagonists and contralateral synergists (Fig. 2), and thanks to that functions of agonist can be realized in a more adequate way.

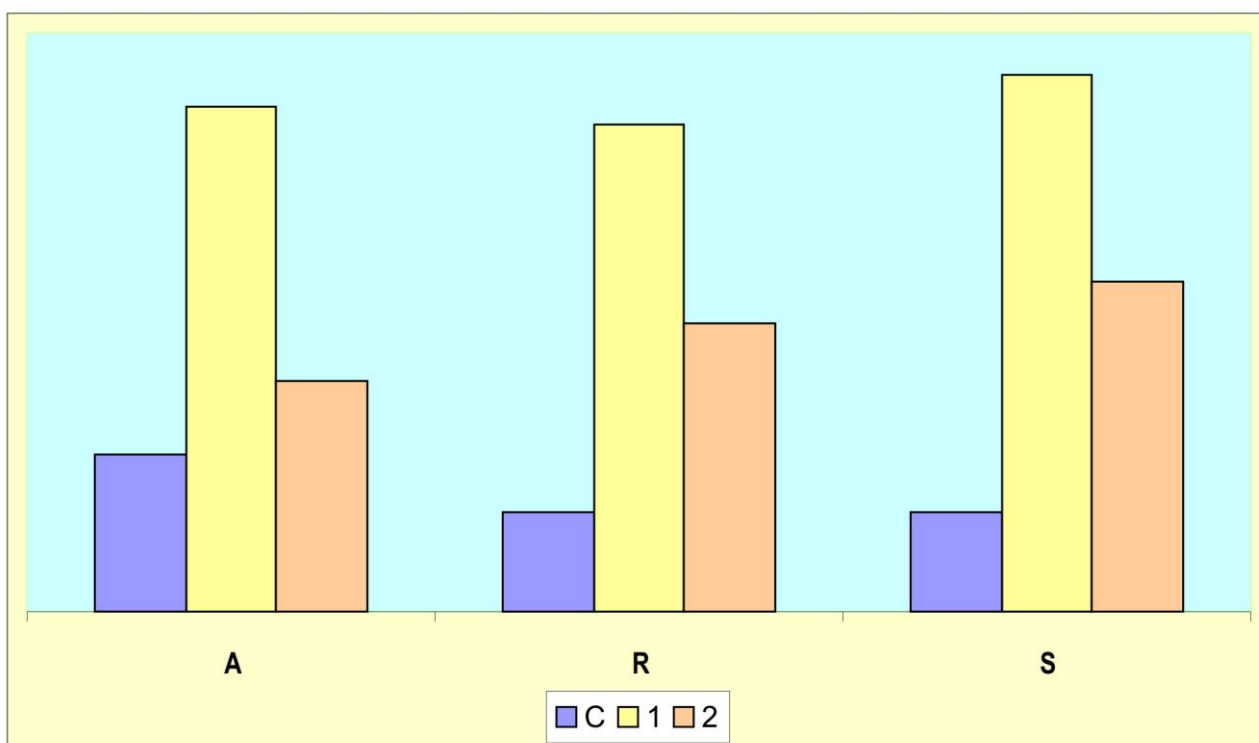


Fig. 1. Influence of the method of Adeli-92 on coefficients of adequacy (A), reciprocity (R), and synergy (S).

C – control [4]; 1 – before treatment; 2 – after treatment. Asterisk means authentic differences between values both before and after treatment ($p < 0.05$ in accordance with Mann–Whitney–Wilcoxon criterion).

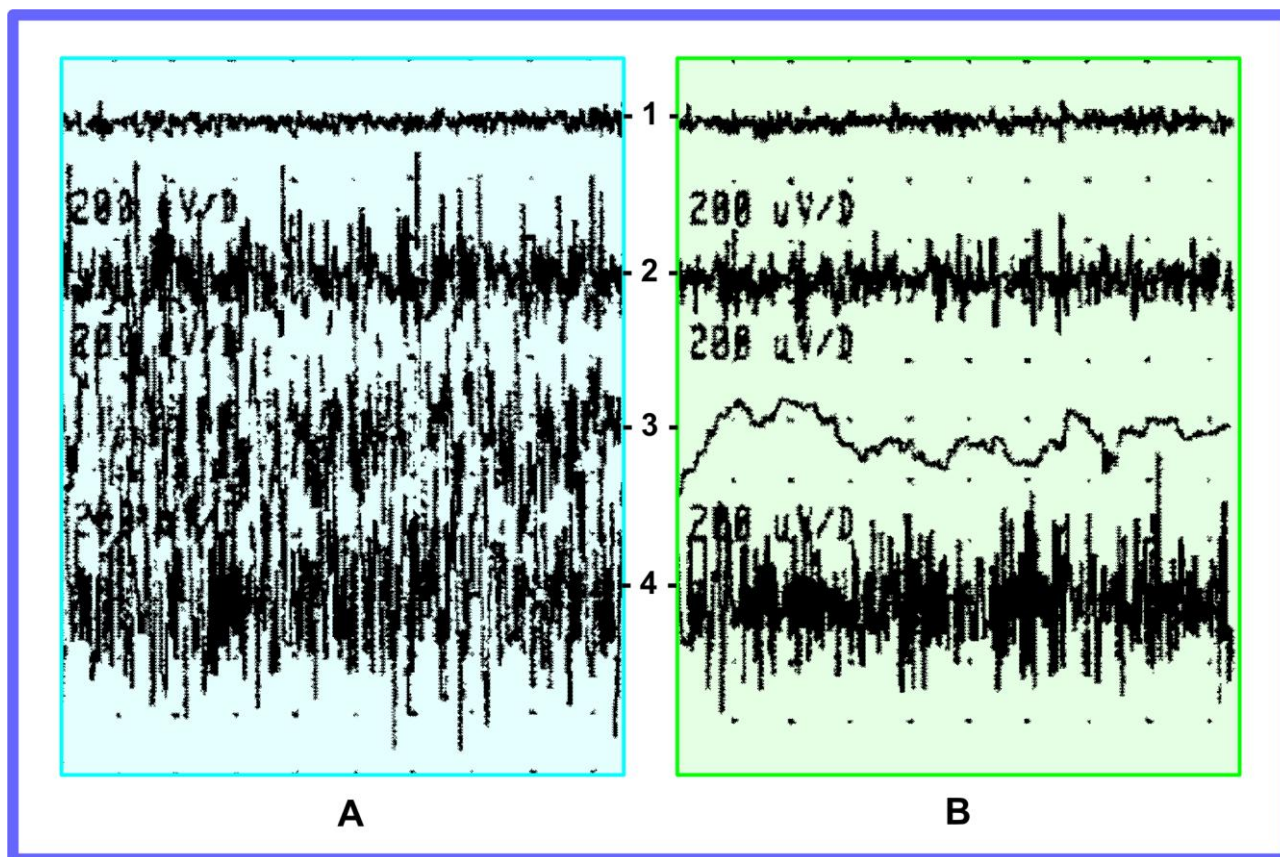


Fig. 2. Bioelectric activity of muscles of calf when making an arbitrary maximum effort (plantar extension of right foot).

A – before treatment; **B** – after treatment by means of the method of Adeli-92. **Muscles:** 1 – left anterior tibial; 2 – left gastrocnemius (medial); 3 – right anterior tibial; 4 – right gastrocnemius (medial).

Co-contraction of antagonists and involvement of muscles in pathologic synergies become less apparent in patients with whom such changes were observed. And, as a consequence, the function of agonist improved, that is, the amplitude of its bioelectric activity increased in the course of making arbitrary physiologic efforts, and as to the clinical picture – motor capability of patients improved.

After treatment pathologically high original bioelectric activity reduced in muscles with spastic increase of tonus in 50 % of cases, patients standing on both feet (in plantigrade position). Increase in steadiness of a patient in plantigrade position while keeping his balance may be conditioned by that. These data can indirectly testify to the normalization of antigavity mechanisms. After the course of treatment the ratio of activity of the flexors and the extensor muscles of lower extremities when placing a patient in plantigrade position is normalized, spasticity of adductor muscle of thigh weakens, and this allows to keep one's balance with more ease when standing because of better stabilization of joints. Any considerable changes were not observed in electromyograms of semimembranosus and semitendinosus muscles at rest. But after treatment, a patient being placed in plantigrade position, originally high abnormal bioelectric activity of those muscles decreased. Such a change of tonus in ischiocrural muscles with increased spastic tonus is connected with decrease in influence exercised by pathologic tonic reflexes on them. The alterations of bioelectric activity of muscles of lower extremities described above testify to their optimal functioning in a patient keeping his balance when being placed in plantigrade position and indirectly – to a decrease in influence exercised by pathologic tonic reflexes on muscular tonus.

After the course of application of a treatment-loading suit of Adeli-92 a tendency towards decrease

in hyperkinetic activity and tonic consensual reactions was recorded. It is typical that hyperkineses decreased not only in muscles of those segments that had been exposed to the effect of a treatment-loading suit, but also in muscles of hands, mimic and articulatory musculature.

Table 1. Alteration of indexes of monosynaptic testing under the influence of Adeli-92

Time of exploration	Nmax./Mmax., %		Degree of involvement of motoneurons in response, %				Degree of depression %
	< 50%	> 50%	large		small		
			< 50%	> 50%	< 50%	> 50%	
Control [11, 12]	About 55		63		46		80
Before treatment	28	82	25	71	19	89	29
After treatment	35	60	41 *	80	31	51 *	56 *
<i>n</i>	8	8	11	5	7	9	16

Note: Asterisk points to the values that differ authentically from the indexes before treatment ($p < 0.05$ according to Mann – Whitney - Wilcoxon criterion).

Monosynaptic testing showed that the value of correlation of Nmax./Mmax. which characterizes a level of excitability of spinal neurons in patients varied from 8 % to 87 % before treatment. After application of the Adeli-92 treatment-loading suit this index did not differ authentically from a initial value, that is, the aggregate amount of motor units of motoneuron pool involved in reflex phenomena did not change considerably. However, after treatment there was recorded a tendency towards decrease in this index in patients with originally high value (more than 50 %) and a tendency towards increase in it in patients with originally low value (less than 50 %), that is, such a tendency revealed itself that pointed to normalization of the correlation above (see Table 1.).

After treatment large (phasic) motoneurons were involved more actively in reflex phenomena in the majority of patients (66 %), that is, their activity increased, it was especially significant ($p < 0.05$) in patients with an initial value of this index less than 50 %. As mentioned above, this may reflect a growth of activity of monoaminergic neuromediator system. In patients with originally high index of involvement of small (tonic) motoneurons (more than 50 %) its considerable ($p < 0.005$) decrease was observed (see Table 1). On this basis it may be suggested that cholinergic neuromediation is normalized after treatment with application of the Adeli-92 treatment-loading suit.

The course of treatment with application of the Adeli-92 treatment-loading suit finished, depression of N-reflex which characterizes a state of mechanisms of central inhibition increased in 71 % of patients. The change of this index in the case of low-frequency stimulation may testify to involvement of suprasegmental structures in mechanism of sanogenetic effects, because an increase of this index is usually connected with increase of influence of pyramidal tract on segmental motoneurons and interneurons – it is suggested that such effect may be realized because of the strengthening of presynaptic inhibition. The observed stabilization of indexes of N-reflex points to certain normalization of mainly supraspinal influences on the segmental apparatus of spinal cord under the influence of the Adeli-92 treatment-loading suit, and this phenomenon may be connected with alteration of an afferent flow in structures of the central nervous system as well as with changes of neuromediator functions.

Positive changes of different kind were observed in the majority of patients after application of the Adeli-92 loading suit, but in 25 % of cases there were no considerable changes of myographic indexes after therapy.

The positive dynamics of electromyographical indexes which showed itself after a course of treatment with application of the “Adli-92” loading suit testifies to the alteration of functional state of neuromotor apparatus, and, perhaps, it is because of the optimization of regulatory influences emanating from suprasegmental structures of motor analyzer. The positive dynamics of motor capabilities of a patient which is observed clinically may be conditioned by that, because alterations of neuromyographic indexes are often accompanied by a change of the clinical picture. A decrease of an amplitude of bioelectric activity of muscles with spastic increase of tonus at physiological rest,

an increase of an amplitude of bioelectric activity of agonist at arbitrary efforts, a reduction of coefficients of reciprocity, synergy, and adequacy reflecting improvement of coordinative interrelations of muscles as well as an alteration of functional state of motoneurons of spinal cord on the basis of a monosynaptic testing create a favorable background to normalization of motor acts in the course of treatment. According to numerous authors [1, 2, 10], normalization of muscular tonus and coordination of movements are connected with normalization of a flow of afferent impulses towards the brain, and the Adeli-92 loading suit, as it was mentioned above, has a powerful proprioceptive effect. As a result of the course of treatment procedures a considerable reorganization of motor-kinesthetic analyzer takes place. One can pick out a number of factors that lead to alterations described. First of all, intermuscular relations change, that is, relations between different groups of synergists and antagonists, and, then, more correct interactions are established in respect of involvement of any muscular groups in a motor act. This results in alteration of an afferent inflow in central managing structures – one of the most important conditions indispensable for the motor system as a whole in order to function correctly. Central regulation of movements changes which manifested itself in more adequate reflex activity and normalization of bioelectric activity of muscles at rest and in plantigrade position; to all appearances, it is connected with a decrease of influence of pathological tonic reflexes on muscular tonus. The process of integration and regulation of motor functions on a segmental level becomes more active as a result of an improvement of functional state of central structures, a functional state of spinal motoneurons returns to normal, and the findings of monosynaptic testing are evidence to that. It is obvious that motor functions become normal not only because of afferentation, but also by means of changes in a state of neuromediator systems. The data concerning alteration of a degree of involvement of tonic and phasic motoneurons in monosynaptic reflex tell in favor of this [11]. The direct influence of the Adeli-92 loading suit exercised on the state of motoneurons may not be excluded. It is confirmed by the findings pointing to disappearance of anterofrontal activity after treatment in those children whose cerebral palsy was complicated with disturbance of peripheral segmentary structures.

Thus, according to the findings of electroneuromyography, the application of the Adeli-92 treatment-loading suit normalizes functional state of neuromotor apparatus both on segmentary and suprasegmental levels, improves suprasegmental regulation of motor function, its realization on a segmentary level – presumably it happens because of both the afferentation normalization and the influence on motoneurons and neuromediator systems.

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