

Efficacy of Application of the Adeli Suit in Treatment of Infantile Cerebral Palsy

On the basis of **Eugene G. Sologub**'s doctoral dissertation "System of Rehabilitation of Patients with Infantile Cerebral Palsy by the Method of Dynamic Functional Proprioceptive Correction" – Moscow, 1997

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Introduction

Early diagnosis and early rehabilitative treatment play a major role in rehabilitation of patients with cerebral palsies, since the traditional methods do not invariably yield tangible results at the residual stage of this disease. The existing methods of conservative and surgical treatment should be recognized unsatisfactory, because 60% of the patients need repeated correction of contractures and deformations as early as one year after the surgical therapy. Especially complicate cases are the patients with the hyperkinetic form of the disease, to whom surgical treatment is not indicated.

Nowadays, to treat children with cerebral palsy, mostly various devices are applied that limit the movement volume in joints (or theses, plaster casts, etc.); limiting the muscular function and, therefore, proprioception, this "static" approach precludes functional treatment. Presence of load elements (rods, rubber bands, etc.) solves this problem only in part, for they make impact only on some elements of the locomotor system, and even that impact is weak.

A new promising functional method of treatment has become repeated impact on a patient's neuromuscular system made by the Adeli special "space" suit, whose prototype was the load suit used by Russian astronauts when they stay in the zero gravity state for a long period.

The volume of studies

The author is a practitioner of the Moscow Children's Psychiatric Hospital, an orthopedist and surgeon with many years long experience in the field of treatment of children with ICP. He evaluated the efficacy of the Adeli suit in a group of 210 patients, aged 10 to 18, with ICP in the residual stage. The form of ICP was diagnosed in 120 patients (57%) as spastic diplegia, in 30 (14%) as hemiparetic diplegia, in 40 (19%) as hyperkinetic diplegia and in 20 (10%) as atonico-astatic diplegia.

Each patient of the observed group had been treated earlier several times (9 times at average) at hospitals; 14% of the patients had undergone surgical correction of deformations; in spite of it, pathology of the locomotor system of at average two levels persisted in all of them: of 210 children of the observed group, 35% had scoliotic and

kyphotic deformations of backbone, 29% pronational contracture of upper limbs, 34% flexion-adduction contracture of hip joint, 27% flexion contracture of knee joint, 60% equino-varoid or valgoid deformation of ankle joint and foot.

Depending on the degree of disease gravity, all patients were divided into 5 groups; in the first of them, the gravest one (17%), the children could not even stand unaided.

To treat the patients of the observed group, the Adeli-92 load suit was used. Training in suits continued for about one hour daily, the total length of the series of treatment being 20 days.

All patients underwent one or more series of treatment. To evaluate the therapeutic effect, the following methods were used: electroencephalography (500 examinations), clinical biomechanics (150 analyses), ergometry (120 examinations), shooting and photoing of locomotions (35 patients twice) and stabilography (2100 examinations).

Results

Electroencephalographic studies

Rehabilitation of the patients with ICP by application of the Adeli load suit caused positive shifts in the electroencephalograms (EEG): in 50% of the cases an increase was noted in the basic cortical rhythm, in 58% epiactivity reduced; as a whole, EEG approached the norm in 28% of the patients.

Even a single impact of the suit led to positive changes in the profile of cerebral interhemispheric asymmetry; besides motor asymmetry, sensory and visual asymmetry also changed. These data indicate to the possibility of “loosening” the initial pathological spatiopostural stereotype of a patient, which, combined with other results of our studies (stabilography, biomechanics), may testify to sufficient plasticity of the CNS in patients with ICP and therefore to the possibility of positive rearrangement of the connections in the CNS under the impact of somatosensory afferent flow, which emerges in the course of wearing the suit.

Biomechanics and locomotions

The study was conducted using a program-hardware complex that permitted registration of the volume of movements in the joints of lower limbs in three planes (presence of contractures and other deformations, parameters of flexion and extension, abduction and reduction, rotational parameters in joints, etc.).

An improvement was demonstrated of the angulometric parameters in the patients who had undergone a series of the suit treatment. The step characteristics also showed a positive change in all children, accompanied by asymmetry of the therapeutic effect (uneven degree of the improvement on the left and right sides). After wearing the suit,

the length of step increased in all patients; cyclicity changed due to a decrease in the leaning and double leaning periods.

Energometry

Figure 1: The Dynamics of Energy Consumption in Patients.

Average indices of energy consumption in patients with cerebral palsy in the course of treatment. Whereas energy consumption reduces by 11% during walking in the patients treated by the traditional methods, application of Adeli Suit ensures its reduction by 20%.

The Adeli treatment suit considerably increases the mechanical load on some segments of the locomotor system and on the skeleton as a whole. The levels of energy consumption were determined by the indirect calorimetry method when the suit was worn (load) and without it (rest).

It was demonstrated that, despite a considerable increase in the physical load, energy consumption substantially reduced in the patients when they wore the suit: at average by 15% in the children with all forms of ICP and by a half in those with the hyperkinetic form [Figure 1]. As this took place, our method did not influence the patients' energetic metabolism in the state of rest (in the sitting and lying positions).

Stabilographic studies

One of the most informative indices of efficacy and control of the rehabilitation process in patients with ICP, including those who are treated by Adeli, is stabilography, which reflects the patient's ability for correct fixation of the centre of the body mass in the standing position, both with visual control (eyes are open) and without it (eyes are close).

Our stabilographic studies in healthy patients (the control group) and patients with ICP who wore the load suit demonstrated a considerable (two times at average) improvement of the parameters of statokinesigrams, which objectively testifies to enhanced stability of

the body and therefore to substantial normalization of the patients' muscular tonus while maintaining the vertical posture.

In healthy children the visual analyzer has a great importance in maintaining a posture; in patients with ICP its role weakens. Improvement of spatial stability, noted as a result of the treatment, persists after its end, too (control studies were conducted 2-3 months later); the role of the visual in maintaining the vertical posture analyzer approaches the norm in the patients.

Manifest positive shifts were observed as a result of treatment of the children with the hyperkinetic form of ICP (40 patients in total). After treatment ended, 80% of the patients of this category were ascribed to the groups with the least manifest pathologies (the 4th and 5th groups). In the group of children with spastic diplegia all parameters improved after just one series of treatment by 54% compared to the background (before the treatment); in this category the results of treatment proved the best, judging from the final parameters.

Main conclusions

1. Many years long studies demonstrate that the traditional methods of conservative and surgical treatment of ICP in the residual stage are imperfect: even after multiple series of treatment (at average 9 series per a patient) high frequency persists of backbone pathology (36%), deformation of the upper limb and joints of the lower limbs (25-60%), which aggravates the orthopaedical and neurological status in most of the patients.

The traditional methods yield insufficient results in junior children, too, since the effects achieved in the course of treatment are lost subsequently in a part of patients as a result of the continuing pathological process, and in some patients the pathology strengthens.

2. Use of the Adeli load suit permitted development of a new efficient system of rehabilitation of patients with ICP, based on the principle of dynamic functional proprioceptive correction; high efficacy of this method has been confirmed by the totality of our experimental studies (electroencephalography, biomechanics and locomotions, energometry, stabilography).
3. The positive effect of proprioceptive correction is uneven in different forms of ICP: it is most manifest in the patients with spastic diplegia, as well as with the hyper-kinetic form, the least curable by the traditional methods. In the hemiparetic form of ICP improvement of the patients' parameters was relatively less manifest, and in the patients with the atonico-astatic form the condition improves considerably only after several series of treatment.
4. Counter indications for use of this method include manifest orthopaedical pathology, presence of the spasmodic and algescic syndromes and deep impairment of intellect.
5. Application of Adeli enhances economic efficiency of the rehabilitation process:

- the length of the repeated series of treatment may be reduced two times with higher efficacy of treatment than in the first series;
 - in the case of surgical correction of the deformations subsequent application of the therapeutic suit reduces the period of the post-surgical adaptation more than two times with more manifest results of the treatment;
 - the average length of a patient's stay in the hospital is 12 days shorter; the need of applying physiotherapeutic procedures and medicines is considerably less;
 - as a whole, the economic cost of using the method of proprioceptive correction is approximately 40% less than that of treatment by the traditional methods.
6. It is expedient to start application of the method of proprioceptive correction, using Adeli, for treatment of children with cerebral palsies in the age of 3 years; to consolidate and improve the treatment results, it is desirable to repeat series of treatment twice a year.

Note: all primary experimental data (plots, tables, diagrams, statistical calculations, etc.), whereon the presented results are based, may be found in the text of the dissertation.