The system of electrostimulation with biotechnical feedback.

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Abstract
In the given article “MIOS”, the multichannel device of electrostimulation with a biotechnical feedback, for the treatment of a number of movement disorders of central and peripheral origin, the correction of movements, the training of impellent skills etc. is discussed. The experimental approbation showed high efficiency of the developed device: there was a restoration not only of forces of contractions of disordered muscles, but also of lost impellent skills.

1. Introduction
The systems of electrostimulation with feedback are the systems of a new type, as they allow in a mode of real time to carry out the control of some physiological parameters, according to which the therapeutic treatment is developed. The contribution of components of the medical equipment and some elements of the diagnostic equipment takes place. One of the perspective approaches is the application of a biotechnical feedback [1,2]. On a contour of a biotechnical feedback the electrical parameters describing a biological condition of an object are transferred. On the basis of the given information a signal of influence on the patient is automatically corrected in real time. This, the coordination of parameters of a bioobject and the technical components of the system and the optimal medical treatment are carried out. Other approach consists in the use of a biological feedback, which basic task is the training of self-regulation.

The essence consists in granting to the patient on the screen of the computer monitor or in audio form of the current data of his physiological parameters. Thus, during the biological feedback procedure the strengthening or the easing of the given physiological parameter is possible and consequently also of the level of activation of that regulatory system, whose activity the given parameters reflects. The realization of the above-mentioned principles in one system results in qualitatively new opportunities of increasing the efficiency of the conducted rehabilitational measures.

1.1. Previous Work
The above-stated principles gave the basis of the developed device of multichannel of electrostimulation with a complex biotechnical feedback “MIOS” for the treatment of a number of movement disorders (paralyses and pareses) of central and peripheral origin, the correction of movements, the training of impellent skills etc. The device provides multichannel bioelectrical stimulation of muscular groups with the help of cutaneous electrodes.

The control of multichannel electrostimulator, influencing the muscular tissue and nervous system is carried out by the personal computer.

The contour of a biotechnical feedback is realized according to algorithm: submission of electrostimulating signals on the muscular groups – reading of the information about the condition of the muscular groups – processing of the diagnostic information – updation of the influence according to control function.

In the developed device as a stimulation signal it is offered to use standard integrated myogramms. The choice of the myogramms is carried out on the basis of the constitutional and age attributes, in view of the degree of the disordered muscular groups counting the results of electrodiagnostics. There is a library reference of standard myogramms of different muscular groups.
As the places of submission of stimulating signals it is offered to use impellent points of skeletal muscles of the patient. A sort of a stimulating current is rectangular and sine wave with 5 kHz frequency and pointed pulses of 3–100 Hz.

The data on the condition of muscular groups taken before and in the period of the stimulation are used for the formation of the managing signals specifying parameters and modes of stimulation. The change of the characteristics of the biological tissue during the procedure defines the necessity of automatic adjustment of the basis parameters of influence in real time to optimize medical influence. In this connection the dependence of the amplitude of a managing signal on diagnostic parameters is determined:

\[ I_d(t) = [I_k(0) + m*D_n(0)] * [1 + \ln\left(\frac{m*D_n(t)}{D_k(t)} - \frac{m*D_n(0)}{D_k(0)}\right)] \]

Where \( I_d(t) \) – the amplitude of a current of a stimulating signal of disordered muscular groups at the current moment of time, \( I_k(0) \) – the amplitude of a current of a stimulation signal of control muscular groups at the initial moment of time, \( D_n(0), D_n(t) \) – diagnostic parameters, describing the condition of disordered muscular groups accordingly at the initial and at the current moment of time, \( D_k(0), D_k(t) \) – diagnostic parameters, describing a condition of a control muscular groups accordingly at the initial and at the current moment of time, \( m \) – the function, which is taking into account the constitutional status of the patient, condition of muscles and sort of the current. The given dependence allows to correct the amplitude of a current and also the force of muscle contraction and the duration of the procedure according to the weariness of the muscular groups.

The functioning of the biological feedback under the classical circuit in this device is impossible whereas the movements are caused not by strong-willed effort but by the electrical signal. In this connection the modified biological feedback is realized in this device. The contraction of muscles is caused by the electrostimulation. The caused movement appropriate to the contraction of muscular groups is demonstrated on the screen of the monitor synchronously with a submitted signal. The changes of the diagnostic parameters are simultaneously displayed. The system allows with the help of the multimedia means to visualize the simple movements, to make up complexes consisting of alternating movements, to generate complex movements by integrating simple movements.

2. Summary and Conclusions

The principles of designing the systems of electrostimulation with a biotechnical feedback are discussed in the given article. On the basis of the given statements the multichannel device of electrostimulation with a biotechnical feedback “MIOS” for the treatment of a number of movement disorders of central and peripheral origin, the correction of movements, the training of impellent skills etc. is analyzed. The experimental approbation showed high efficiency of the developed device: there was a restoration not only of forces of contractions of disordered muscles, but also of lost impellent skills. The therapeutic effect besides a physiological component is also caused by the significant positive psychoemotional effects.

References