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Psychological Peculiarities of Physical Rehabilitation of Patients with Ischemic Stroke

Психологічні особливості фізичної реабілітації хворих на ішемічний інсульт

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ABSTRACT

The purpose of the research is: *to study the characteristics of disorders of psychomotor function and psycho-emotional state of patients with ischemic stroke according to the initial examination; to develop a method of physical rehabilitation of patients with ischemic stroke at the inpatient stage of rehabilitation, depending on the severity of psychomotor functions and features of the psycho-emotional state; to outline psychological essence of biomechanical laws which direct the disorders of the psychomotor function of a personality.*

Research methods*. There were used the following psychological and pedagogical research methods: the analysis of literature sources, the method of psychological and pedagogical observation, psychological and pedagogical experiment.*

The results of the research. *The methods of functional biomanagement with external feedback are proved to be fundamentally new and promising in physical rehabilitation, having been used with the aim of training physiological or retraining pathologically impaired functions. The empirical data is shown to be obtained corresponding to the goals and tasks of the movement restoration system in the case of various diseases and brain injuries. The strongest stimulator of movement is proved to be so called kinesthetic sense, to reproduce consciously performed movements. Kinesthetic sense is a mean that is a necessary prerequisite for the rehabilitation of patients with ischemic stroke.*

Conclusions. *The psychological essence of biomechanical laws is defined in relation to the disorders of the psychomotor function of a person: 1) the rule of redistribution of functions of the affected limb; 2) the rule of functional copying of another person's movements; 3) the rule of ensuring the optimum in psychomotor activity.*

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Key words: *ischemic stroke, physical rehabilitation of patients, psychological essence of biomechanical laws, redistribution of functions of the affected limb, psycho-emotional state of patients, psychomotor activity.*

Introduction

It is well known that one of the basic characteristics of the nervous system is its plasticity that is the ability to form new interneuron connections in the nervous system. The multifunctionality of brain formations is manifested in the paradigm of the ability of the neurophysiological systems of the cortex and subcortex in new specific conditions to assume the functions of the loss of functional capacity of certain structures. Thus, in response to the alternative cessation of regional cerebral blood flow, the central nervous system develops as active structure and, in the most of its actions, facilitates health-generating activity (Malone, Ellis, Currier & Mann, 2006). The ability to restore functions has been lost as a result of damage to the motor cortex (locomotor acts, purposeful movements with the help of a hand (or both hands) of paralyzed people in extreme vital situations). This ability is associated with the activation of motivational structures in the individual's psyche. In this case it means the presence of a low starting barrier and a pronounced motivation in the holographic structure of the brain, which is suffered as a result of a stroke, but preserves integral information in the last parts of the brain (Almeida & Turecki, 2022). The holographic nature of the transformation of the surrounding world and stereotyped psychomotor reactions in a large number of cases allow to maintain an adequate psychomotor stereotype (Tabachnikov, Mishyiev, Kharchenko, Osukhovskaya, Mykhalchuk, Zdoryk, Komplienko & Salden, 2021). Under the conditions of presence of more serious volumes of lesions, the psychomotor stereotype adapts for a certain time and then remains in a stable state (Hardeman, Medina & Kozhimannil, 2016).

So, the influence of mental processes through the central and autonomic nervous system on the internal organs, the functioning of which, in turn, is mediated by the activity of the receptor

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apparatus, significantly affect the human psyche (Онуфрієва & Івашкевич, 2021). These relationships are confirmed in the psychosomatic manifestations of a variety of diseases, which include cerebral circulatory disorders (Grunebaum, Oquendo, Burke, Ellis, Echavarria, Brodsky, Malone & Mann, 2003). Moreover, the transformation of personality, mental adaptation, etc. take place, to one degree or another one, in any disease, forming a continuous sequence of symptoms, which is called the psychosomatic continuum (Oquendo, Malone, Ellis, Sackeim & Mann, 1999). According to scientists (Харченко & Курица, 2021; Kharchenko & Komarnitska, 2021), in this continuum cerebral stroke occupies a leading place, second only to paroxysmal arrhythmias and coronary heart disease. In this regard, functional disorders, expressed by different sensations of the disease, can be caused by disorders of mental adaptation, especially if it is manifested in the inadequacy of psychophysiological relationships, somatic health disorders (Tabachnikov, Mishyiev, Drevitskaya, Kharchenko, Osukhovskaya, Mykhalchuk, Salden & Aymedov, 2021).

Ischemic stroke is a disease that leads not only to disorders in the psychomotor sphere, to speech disorders, but also to disorders of other higher mental cortical functions: cognitive disorders (decreased memory, intelligence, concentration), emotional and volitional disorders, praxis (disorders that are manifested in the performance of quite complex psychomotor acts in the absence of paresis, disorders of sensitivity, coordination of movements), in the mathematical calculation of numbers (acalculia), disorders in gnostic activity, more often – spatial, disorientation in space and some others (Kharchenko & Vashchenko, 2021). The appearance of such disorders, in turn, does not contribute to the rapid recovery of lost functions as a result of the disease, causing impaired initiation of movements and dysfunction of psychomotor programs (Mykhalchuk, Pelekh, Kharchenko, Ivashkevych, Ivashkevych, Prymachok, Hupavtseva & Zukow, 2020). Patients show symptoms of decreased mental and psychomotor activity,

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anognosia (underestimation of fixed psychomotor defect), passive and indifferent attitude to their psychomotor defect, lack of activity in overcoming it, against which there is a decrease or complete loss of motivation to exercise. As a result, this attitude of the patient to the process of his/her recovery leads to significant social maladaptation, and it is difficult to get out of this state (Khwaja, 2012).

Therefore, the speed of recovery of impaired motor functions largely depends on the psychological state of the patient (Mann, McBride, Malone, DeMeo & Keilp). The development of such processes is largely associated with the localization of certain gaps in the lesion. If the foci of lesions in the frontal area are focused, apathetic-abulic syndrome may develop, which is characterized by a lack of self-motivation (spontaneity), interest in life (apathy), decreased functioning of volitional functions, intelligence and criticism. Restoration of self-care, walking skills in this group of patients is greatly complicated, many of them remain completely helpless in everyday life (Onufriieva, Chaikovska, Kobets, Pavelkiv & Melnychuk, 2020).

It is well known that the left hemisphere of the brain is the basis of logical, abstract, verbal thinking, a space for the realization of speech functions of the individual. The right hemisphere of the brain is functionally related to the perception and processing of auditory, visual, somato-sensory and motor material of non-verbal nature. In this case, the right hemisphere is characterized not so much by dismemberment and logical analysis of the reality, as the perception of holistic images. It is more characteristic not for conceptual, verbal perception, but for sensory and figurative ones.

According to empirical data (Hayden, Farrar & Peiris, 2014), under the diagnosis of such lesions recovery of psychomotor deficit occurred better for patients with left hemispheric lesions (despite the presence of aphasia) than for patients with right hemispheric localization of the process. According to scientists, this can be explained by concomitant disorders of higher brain func-

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tions (spatial-constructive disorders, spontaneity, slowness of mental processes) for patients with right hemispheric localization of stroke. The relationships between the degree of recovery of psychomotor functions and skills (walking, self-care, household and work skills) and the state of emotional-volitional, intellectual-gnostic spheres of personality were empirically confirmed.

It should be noted that comprehensive rehabilitation measures are reflected in the researches of many scientists (Villar, Blanco & del Campo, 2015). There are many different methods of psychodiagnostics, covering all known psychological processes, characteristics and conditions of a man. There are psychodiagnostic techniques as those ones that directly appeal to the consciousness of the respondent (for example, questionnaires). These techniques are called explicit. There are also so-called "implicit" techniques, which have the aim of unconscious human reactions (or projective techniques). The main disadvantage of techniques that appeal to the phenomenon of consciousness is the possibility of intentional distortion of test results (behavioral play), while studies of involuntary human reactions are more reliable. M. Luscher's color test is one of the most common projective techniques. The advantages of this test are the independence of the results from the age, gender and educational characteristics of the respondents, the ability to identify both stable personality traits and features of the current psycho-emotional state, which is especially important in monitoring the effectiveness of treatment. However, in the analyzed scientific literature we did not find data from studies of the psychological sphere of patients with ischemic stroke using a projective test, in particular, of the Methodology of M. Lucher (Цветовой тест М. Люшера, 2012).

Thus, taking into account the theoretical and methodological analysis of the scientific literature in our research, there are ***the objectives***:

1. To study the characteristics of disorders of psychomotor function and psycho-emotional state of patients with ischemic stroke according to the initial examination.

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2. To develop a method of physical rehabilitation of patients with ischemic stroke at the inpatient stage of rehabilitation, depending on the severity of psychomotor functions and features of the psycho-emotional state.

3. To outline psychological essence of biomechanical laws to which disorders of the psychomotor function of a person are subjected.

Methods of the research

Research methods. The following research methods were used to solve the tasks having been set in our research:

Psychological and pedagogical research methods:

1. The analysis of literature sources.

2. The method of psychological and pedagogical observation.

3. Psychological and pedagogical experiment (we used such methods: Роговик, 2013; Харченко & Михальчук, 2022a; Харченко & Михальчук, 2022b; Цветовой тест М. Люшера, 2012).

Results and their discussion

Patients showed increased tone in the flexion of the ankle joint and extension of the hip and knee joints. In other muscle groups, the tone was not increased, and in the upper extremities there was a decrease in muscle tone. Muscle strength was statistically significant ($\rho<0.01$) decreased in all groups of muscles having been studied.

In a case of the research of the extremities of the unaffected side, the following data were obtained: the volume of active movements was $55.68\% \pm 4.3$ of the appropriate volume of movements and the values are significantly higher (at the level of reliability $\rho<0.01$ according to Student's t-test). The rate of passive movements was higher than the affected party (at the level of reliability $\rho<0.01$ according to the Student's t-test) and amounted to $63.06\% \pm 3.9$ of the appropriate volume of passive movements and corresponded to the average values for the age group of respondents. The mean value of muscle strength was

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61.28% ± 7.3 – values are statistically significant (at the level of reliability $\rho<0.01$ according to Student's t-test) of the affected side. Muscle tone on the unaffected side was higher than normal and was 27.9% ± 3.6 of the maximum value (at a confidence level of $\rho<0.05$ according to Student's t-test).

In a case of the research of the muscles of the unaffected side in this group of patients, the volume of active movements was lower than the appropriate volume of movements and amounted ones to 73.44% ± 5.3 – these values are statistically significant at a confidence level of $\rho<0.01$ according to Student's t-test. The index of the volume of passive movements of the unaffected party was higher (at the level of reliability $\rho<0.01$ according to the Student's t-test) than the index of the affected party and amounted to 77.83% ± 2.1 compared with normal data. The mean muscle strength of the unaffected side was 70.65% ± 4.2 (at a confidence level of $\rho<0.01$ according to Student's t-test). The mean muscle tone of the unaffected side was also higher than normal and it was 2.4 ± 0.4 points (41% of maximum) (at a confidence level of $\rho<0.01$ according to Student's t-test).

The state of motor function of patients with ischemic stroke is characterized in such a way: on the affected side, the maximum values of active, passive movements of muscle strength and the tone are diagnosed in the subgroup "hemiparesis", the lowest – in the subgroup "hemiplegia". On the lacuna side of the lesion, the most pronounced muscle strength and tone are diagnosed in the subgroup "hemiparesis", the largest volume of active and passive movements, in turn – in the subgroup "plesia + paresis", "hemiparesis".

So, we'd like to propose a method of physical rehabilitation of patients with ischemic stroke at the inpatient stage of rehabilitation, depending on the severity of psychomotor functions and features of the psycho-emotional state.

We'd like to point out that recovery of psychomotor functions occurs mainly in the first 6 months after a stroke. Mean-

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while, the peak of recovery occurs in the first 2-3 months after a stroke.

One of the basic tasks of rehabilitation measures for patients with disorders of psychomotor functions is maintaining balance in a vertical position and independent movements of the patient. Considerable importance is given to this process by the patients themselves, who acquire a new degree of freedom in actions and a new social status, which is independent of outside help.

The task of preserving the stability of the body is reduced ensuring that the projection of the general center of gravity on the support surface is maintained. Taking into account the biomechanical features of the vertical posture of a person (small area of support, a high position of the center of gravity, growth of static moments in the joints of the legs in the distal direction), the following methods of ensuring stability of the posture are possible:

– stabilization of the angles in the leg joints (first of all, the ankles);

– stabilization of the body position.

Under the conditions of weakening of the inhibitory of differential influences of the cerebral cortex, the control influence on the motor sphere is restored from the structures of the vestibular-cerebral complex, which are manifested in the simultaneous influence on the formation of a pathological motor stereotype of tonic reflexes: labyrinthine tonic reflex, symmetrical cervical tonic reflex, asymmetrical cervical tonic reflex, grasping reflexes, reflexes from the head to the body and from the pelvis to the body, etc. At the same time, it should be noted that the variety of changes in the motor stereotype in the Wernicke-Mann pose, in our firm belief, is determined by the localization and the size of the lesion. Likewise, there is a significant increase in pathological anti-gravity reactions when the patient moves from a horizontal to a vertical position.

Physical culture, which is used for purely therapeutic purposes, adheres to the principle of "treatment by model", such a

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treatment with psychomotor exercises under the conditions of motor functions disorder. So, let's describe the mechanisms of motor recovery.

In the majority of patients after a stroke there is a partial or complete spontaneous recovery of the functions that were disturbed. Thus, we think that by the end of the first year after a stroke psychomotor disorders are observed in only 49.7% of patients, including the most significant ones – in 11.5%. At the same time, the speed and degree of spontaneous recovery depend on many factors, which primarily include the period of the disease (the duration of the stroke), the size and localization of the lesion lacuna.

Also we'd like to note with a great confidence that since the spontaneous recovery of psychomotor functions that had been suffered, significant disorders lead (in the absolute majority of cases) to the formation of compensatory processes that contribute to the development of pathological movement patterns. In such a way the main role in recovery is given to the formation of new psychomotor connections (new movements) with the help of targeted compensatory restructuring of basic body functions.

So, the process of the formation of new movements and motor skills in a great degree is commonly referred to such process, which in the scientific literature is called as "motor reaming". This process, to our mind, is lifelong. The motor capabilities are ontogenetically acquired, being generally denoted by the term "psychomotor skills", while the processes of their purposeful, conscious formation are explained in the concept of "psychomotor training".

The so called motor training (taking into account the traditions of foreign authors) is "reeducation". It is the basic principle followed by the most therapeutic gymnastics methods, which have the aim at restoring motor function disorders due to ischemic stroke.

So, there are various methods of therapeutic gymnastics based on the mechanisms of motor training. These are so-called

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"classical methods". They are the methods based on the need of the person to produce isolated movements and subsequently reproduce a complex (or complicated by others) psychomotor action. "Retraining" of each individual muscle and working out the isolated movements were the basis of a system of methodological techniques and physical exercises popular at the time, known as Kenny's sister method. So, retraining includes several consecutives, and some of them are performed by the instructor of methodical techniques. The reception of stimulation involves passive movement of the limb in the exact direction of movements, which is performed when the corresponding muscles are in a relaxed state. Some movements are specially performed without the conscious participation of the patient. Then the patient is informed about the features of the anatomical attachment of the muscle and mentally follows by the movement, which is performed passively. Only after the occurrence of involuntary contractions during purposeful stimulation the patient is allowed to perform fairly active movements. In account with the attractiveness of this method, the issue of denying muscle replacement remains quite controversial, because it is a compensatory reaction of the body.

We also emphasize a slightly opposite point of view on the research of muscular substitution. The scientists suggest to organize psychomotor training in the process of therapeutic gymnastics with the help of so-called "conditional movements". We believe that in the absence of normal proprioception the other ways should be found to strengthen the afferent impulse that causes movements, that is, to form new sensory ways. For this purpose, we suggest performing simple movements with symmetrical limbs at the same time. Movements are performed slowly, rhythmically and are purely stimulating in nature.

We'd like to propose a system of physical exercises in a case of spastic hemiparesis. We think that we'll distinguishe between passive, active-passive and purely active exercises, also with the aim of working out the most important isolated movements. Also

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we propose to attach a great importance to the introduction into gymnastic complexes of those techniques that take into account the role of afferent systems (sight, skin and proprioceptive sensitivity, vestibular apparatus, etc.).

In such a way the importance of the patient's active participation in the rehabilitation process is emphasized. We propose to include into the complexes of therapeutic gymnastics exercises with the aim of a clear distinction by patients of all shades of passive and active movements, which are also accompanied by a verbal assessment. According to our point of view, such exercises should enhance muscle and joint sensations, which are necessary for the formation of the patient's ability to perform isolated movements.

The basis of our rehabilitation technique is the dependence of coordinating motor mechanisms on the state of nervous regulation of muscle tone. Therefore, we consider the possibility of restoring any violation of motor control, not suppressing tonic reflexes, but to a large extent those ones that will stimulate the patient's voluntary movements. However, the method proposed by us does not take into account the sequence of the development of the coordinated interaction of static and dynamic skills.

We suggest the use of preserved muscle contractions, modeling and stimulating motor reactions from proximal joints to distal ones. The theoretical justification of this technique implies the presence of functional connections at the spinal level between contractions of various muscles having been involved into the main purposeful movements. Our author's method of rehabilitation is based on motor training that deals with conscious movements of patients with ischemic stroke. Disinhibition of the preserved motor centers is achieved through maximum proprioceptive stimulation, and their coordination is subsequently carried out.

Also, we pay considerable attention to the psycho-emotional state of patients with acute cerebral circulation disorders. We propose to overcome the negative emotions of fear with the help

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of parallel inclusion of autogenic training (AT) in the complex of medical gymnastics. Therapeutic gymnastics is performed by us as AT, contributed to the training of the neuromuscular apparatus, training by active relaxation, it stimulates the mobilization of motor reflexes.

Fundamentally new and promising in physical rehabilitation there are the methods of functional biomanagement with external feedback, having been used with the aim of training physiological or retraining pathologically impaired functions. Their effectiveness was proved being created on the basis of these data or obtained empirically, but corresponding to the goals and tasks of the movement restoration system in the case of various diseases and brain injuries. We use the strongest stimulator of movement, so called kinesthetic sense, to reproduce consciously performed movements.

"The classical methods" of medical gymnastics was listed above; they are of great practical and theoretical importance, since the vast majority of scientific issues partially or fully use the methodical recommendations of these authors. However, their general drawback is insufficient attention to the process of ontogenetic development of postural and dynamic functions, as well as insufficient consideration of the features of the psychological state of a person as a result of the ischemic stroke, which are of significant importance for the process of managing restorative measures, as well as for methodological techniques of learning new psychomotor actions, regarding the motivation of patients to the recovery process, to the methods of achieving maximum contact with the patient and increasing the role of his/her motivation in the process of recovery of a motor defect.

Conclusions

So, we described the clinical conditions of positive recovery of motor functions of patients with ischemic stroke. The features of correction of psychomotor disorders of patients with ischemic stroke were outlined. The somatopsychological charac-

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teristics of patients with ischemic stroke were given and the features of physical rehabilitation of patients with ischemic stroke were highlighted.

Such disorders of programming control of psychomotor activity and disorders of coordination of the performance of psychomotor activity were distinguished.

As for programming disorders of psychomotor activity of management, it was stated that in the scientific literature management of programs of psychomotor activity and psychomotor activity's plans were distinguished. According to this terminology, psychomotor activity control programs are a stereotyped sequence of commands in the central nervous system that determine the order of innervation of various muscles. Plans of psychomotor activity coordinate several motor programs and adapt them to modern conditions of the surrounding environment. The program of psychomotor activity involves a clear alternation in the facilitation of agonists and antagonists. Such a sequence of muscle activations leads to a smooth, well-directed movement, characterized by the maximum execution of speed reactions. By changing the time intervals between the activation of agonists and antagonists and by modulating the strength of individual muscle activations, it is possible to achieve (within the same motor program of psychomotor activity) different speed and amplitude of this activity.

Such disorders of the coordination of performance of psychomotor activity are characterized by the fact that in the process of the implementation of purposeful psychomotor activity in a certain way muscles are most often involved, which have to be contracted in a certain sequence and with a certain intensity. At the same time, we can note about some tolerance for errors, because more often the same movement result can be achieved due to different contraction patterns, but naturally there are boundaries beyond which psychomotor activity fails.

The desired result of displaying of psychomotor activity depends on a certain form of its performance. The coordination of

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the contracting muscles is ultimately done without any involvement of our consciousness. Therefore, it can be argued that such a system with many components, which should be expected to act together quite precisely, is easily susceptible to disturbances. One of the simple forms of disorder of coordination of psychomotor activity can be a kind of over-activity, when instead of clearly coordinated joint acts of different muscles, the muscle tension as a whole increases to a large extent, and at this high level this tension can be modulated with great difficulty in performance of psychomotor activity.

Psychological essence of biomechanical laws to which disorders of the psychomotor function of a person are subjected, was outlined:

1. ***The rule of redistribution of functions of the affected limb.***

The functional ability of the affected limb to support body weight is significantly reduced. This is especially noticeable in the single period of support: both the absolute and relative time intervals of the single support function decrease, as well as the duration of the support periods. But this kind of unloading of the sick side must be compensated, because the period of support of the healthy leg increases significantly. The change in periods of support has an obvious consequence; it is the increase in the transfer time on the diseased side, and a reduction of the healthy side.

2. ***The rule of functional copying of another person's movements.***

Pathological asymmetry is not beneficial to the body either from the point of view of energy or mechanics. The need to maintain the relative symmetry of the function of the right and left sides of the body leads to the following conclusion: the healthy side of the body (or a limb) has a considerable functional reserve than the diseased one, therefore, the reduction of functional asymmetry occurs by bringing the pattern of functioning of the healthy limb closer to that of the diseased one.

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3. ***The rule of ensuring the optimum in psychomotor activity***.

The functioning of all elements of the normal cycle of psychomotor activity is the basis of the individual's physiological optimality. Any deviations from physiological optimality require the inclusion of additional adaptive reserves, which are slightly changed on the affected side. It is possible to provide the patient with optimal functioning due to the functional tension of the healthy side.

Thus, the problem of restoring psychomotor functions of patients with ischemic stroke remains a rather urgent problem today and requires the further development of complex approaches to the correction of psychomotor disorders, taking into account the peculiarities of a mental state of patients who have suffered from ischemic stroke, the activation of the initial motor state, as well as fairly clear step-by-step criteria.

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Харченко Євген, Комарніцька Людмила. Психологічні особливості фізичної реабілітації хворих на ішемічний інсульт.

Мета статті: *1) вивчити особливості розладів психомоторної функції і психоемоційного стану хворих на ішемічний інсульт за даними первинного обстеження; 2) розробити методику фізичної реабілітації*

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хворих на ішемічний інсульт на стаціонарному етапі реабілітації залежно від тяжкості ураження психомоторних функцій і особливостей психоемоційного стану; 3) на основі отриманих емпіричних даних окреслити психологічну сутність біомеханічних законів, яким підпорядковуються розлади психомоторної функції людини.

Методи дослідження. *Використано такі психолого-педагогічні методи дослідження: аналіз літературних джерел, психолого-педагогічне спостереження, психолого-педагогічний експеримент.*

Результати дослідження. *Доведено, що принципово новими і перспективними у фізичній реабілітації є методи функціонального біоуправління із зовнішніми зворотними зв'язками, спрямованими на навчання фізіологічних або перенавчання патологічних порушених функцій. Показано, що отримано емпіричні дані, відповідні цілям і завданням системи відновлення рухів у випадку різних захворювань і пошкоджень головного мозку. Доведено, що найсильнішим стимулятором руху, який свідомо здійснюється, є кінестетичне почуття, актуалізація якого є необхідною передумовою реабілітації хворих з ішемічним інсультом.*

Висновки. *Окреслено психологічну сутність біомеханічних законів, яким підпорядковуються розлади психомоторної функції людини: 1) правило перерозподілу функцій ураженої кінцівки; 2) правило функціонального копіювання рухів іншої особи; 3) правило забезпечення оптимуму в психомоторній діяльності.*

Ключові слова: *ішемічний інсульт, фізична реабілітація пацієнтів, психологічна сутність біомеханічних законів, перерозподіл функцій ураженої кінцівки, психоемоційний стан хворих, психомоторна діяльність.*

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