Research Article

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Neuropsychological Principles of Rehabilitation Training in the Therapy of Patients with Facial Nerve Palsy

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ABSTRACT The problem of restoring the motor pattern in patients with facial nerve palsy (FNP) is a complex medical problem. The basis of effective treatment and rehabilitation in this case is not only scientifically based medical recommendations, but the selection of methods of exercise therapy is of great importance, which implies the active participation of the patient in the therapy process. Currently, there are no generally accepted documents aimed at raising awareness about FNP and teaching the patient specific methods of rehabilitation. In the N.V. Sklifosovsky Research Institute for Emergency Medicine patients with FNP have been receiving medical care under the Face Clinic program for more than a year. In addition to the algorithm of diagnostic and therapeutic measures, patients are trained starting from the first appointment. Specialists of the Research Institute developed a six-step rehabilitation education program for patients with FNP, aimed at lifestyle correction, prevention of complications, and also directly at teaching methods of daily physical impact (rehabilitation) at home. Patients receive information about individual risks of development and methods for self-identification of certain complications of the disease. The project specialists prepared training materials. The system of assistance within the framework of the Face Clinic program provides the patient with the opportunity to receive feedback from the attending physician quickly. The program is based on the concepts of functional systems (according to P.K. Anokhin), the concept of N.A. Bernstein on the physiology of activity and the principles of the school of rehabilitation training and neuropsychological rehabilitation (A.R. Luria–L.S. Tsvetkova).

Keywords: facial nerve palsy, rehabilitation, rehabilitation training, exercise therapy

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FN - facial nerve
ET - exercise therapy
FNP - facial nerve palsy

Facial nerve palsy (FNP) is a disease with the development of facial asymmetry due to a decrease or lack of strength in facial muscles, which leads to serious emotional and social consequences [1–3]. The scope of medical care for patients in this category is determined by standards, procedures, and clinical guidelines [4–7]. However, they are developed and directed to the doctor, include a list of laboratory, instrumental diagnostic methods, consultations of specialists in various fields, options for drug, non-drug and surgical methods of treatment, and also establish their frequency of use. There are no generally accepted documents aimed at the patient, in terms of clarification of recommendations, training, etc. The doctor gives recommendations and explanations during the appointment at his own discretion, often without taking into account the fact that the patient understood the information. The effect of therapy for any movement disorder cannot be achieved solely by medical interventions and directly depends on the degree of participation of the patient. Of course, it must be taken into account that a number of medical recommendations actually imply retraining in the control of mimic movements, but the patient's behavior during therapy as part of his adherence to treatment is also of great importance.

In the N.V. Sklifosovsky Research Institute for Emergency Medicine patients with FNP have been receiving medical care under the “Face Clinic” program for well over a year [8]. In addition to the algorithm of diagnostic and therapeutic measures, patients are trained starting from the first appointment. The training is aimed at correcting lifestyle, eliminating negative factors of influence, preventing the development of complications, as well as directly teaching methods of daily physical impact (rehabilitation) at home. Also, patients receive information about the individual risks of developing certain complications, their clinical manifestations and methods for self-identification. An important principle of interaction is the dialogue between the doctor and the patient, the discussion of the clinical situation and the choice of tactics by the patient based on the proposed options. As part of the program, training materials have been prepared - memos, videos, which, taking into account the clinical picture of the disease, are selected individually for each patient. The patient has the opportunity to promptly receive feedback from the attending physician.

Normally, a person consciously controls the movements of facial muscles in communication activities (transmission of information by facial movements and the production of speech and non-speech sounds) and during meals. The movements carried out are subject to cultural norms, mediated by speech and can be implemented arbitrarily. Thus, the problem of restoration of a motor pattern must be approached not only mechanistically, but also taking into account the psychological level of their organization - as the restoration of oral praxis and voluntary and symbolic movements. In the domestic tradition of neuropsychological rehabilitation (the school of Luria–Tsvetkova), the principles of rehabilitation training have been established, some of which can be successfully used in restoring facial functions in FNP [9].

1. The principle of defect qualification is expressed in the need to establish the place of each symptom in the overall picture of disorders. Primary symptoms are allocated, and they represent the direct manifestation of dysfunction. Primary symptoms in the overall clinical picture do not always come to the fore, on the contrary, they are often "masked" by secondary symptoms, associated with spontaneously arising compensatory reactions. Tertiary symptoms include manifestations of disintegration of any form of activity caused by dysfunction. A special place here is occupied by the pathological reactions of the individual to the disease.

2. The principle of programmed learning involves a pre-developed system of techniques and methods, where the choice of any of them cannot be random. Also, the choice cannot be determined by the severity of the symptom or the patient's subjective attitude towards it. It is determined by the stage of treatment and the area of proximal development in the recovery process for each individual patient. Thus, the program is developed on the basis of ideas about the structure of the defect and the possibilities of its consistent overcoming.

3. The principle of accounting for different levels of functional systems (according to P.K. Anokhin). The principle is based on the concepts of classical neurophysiology about communities of functional units self-

organizing for the implementation of a specific task, which include feedback information about the result obtained. The functional system contains a number of important mechanisms that can lead to a useful result only if they are sufficiently consolidated. At the same time, the mechanisms themselves are not arranged in the same way and are provided by different levels of the system. The determination of the level of the functional system at which the violation occurred is the basis for the qualification of the defect, which is necessary for the formation of a program of rehabilitation training [10].

4. The principle of new functional systems formation. The teachings of P.K. Anokhin about functional systems includes the concept of a "conceptual bridge" between the system level and subtle analytical processes, where the system level maintains an orientation towards solving the problem, and analytical processes are the functional links of this system. If one of the links has been damaged and the function cannot be implemented by the usual means, its restoration is possible through the creation of a new "conceptual bridge" through intra- and inter-system restructuring, when the load of the affected link is distributed to the intact links of the already broken system and systems that have not previously participated in implementation of the affected function. Thus, a new functional system is actually formed. L.S. Vygotsky called such work with various violations associated with the fallout of the normative mechanisms of a particular system (for example, in deafness and blindness) the search for workarounds.

5. The principle of relying on preserved mental functions interacting with the affected system. The formation of a new functional system is possible only on the basis of preserved links. Within the affected function, links can remain intact either from among the flexible ones, which are connected to the implementation of the task only under special conditions, or those that carry a specific load that is not similar to the load of the affected link. A great rehabilitation potential opens up when relying on preserved mental functions that do not directly participate in the disturbed process, but closely interact with it and have alternative means of implementing the functions of the disturbed link.

6. The control principle, which is based on the ideas of P.K. Anokhin, N.A. Bernstein and A.R. Luria about the need for a constant afferent flow to implement an action with an original intention. If the natural afferentation is disturbed, the parameters of the result (its specific properties or physical characteristics) can no longer occur in the acceptor of the results of the action, which creates the need to rely on external means of recording (mirror, photo, video).

7. The principle of taking into account the patient's personality. The rehabilitation training is impossible without the patient's active position, which is determined, first of all, by the premorbid features of his personality and his internal picture of the disease, where ideas about the nature of the disease and possible ways to overcome it occupy a large place.

Specialists of the N.V. Sklifosovsky Institute have developed a program of rehabilitation training for patients with FNP, which corresponds to the above principles and consists of six steps:

Step 1. Determination of the clinical situation, study scope and treatment options

The principle of taking into account different levels of functional systems is the basis for determining the topical location of the lesion (central nervous system or peripheral), leading to dysfunction. The first priority is to conduct a differential diagnosis of lesions of the facial nerve (FN). Acutely developed facial asymmetry can be a symptom of a stroke. In this case, the movement disorder is characterized by signs of central genesis, is associated with other disorders, and treatment is primarily aimed at saving life and preventing the patient from becoming disabled. Peripheral damage to the FN does not directly reduce the daily functioning of the patient, does not threaten his life, and mimic activity disorders are the main medical problem, which overcoming usually does not require inpatient treatment.

According to the literature, in 70% of patients with FN, full restoration of FN function occurs [11]. However, this study was observational without medical intervention. It is described that some means can improve the prognosis, while others can be aggressive and worsen the situation [7].

At this stage, the principle of defect qualification is clearly presented. Patients can apply at different periods of the disease with varying degrees of severity of symptoms and the development of complications. To build an adequate therapy program, it is important to establish which symptoms are primary, and which ones are formed as pathological compensation. For example, if, in addition to weakness of the muscles, their hypertonicity develops during FNP, then it is this muscle that needs to be corrected in the first place, since it prevents the increase in strength from the injured side.

Starting from the first consultation, it is important to take into account the characteristics of the patient's personality, establish his main request for treatment, determine the presence of fears associated with the disease, clarify his ideas about the mechanisms of disturbances and the possibilities of overcoming them. With a large flow of conflicting information, the authoritarian style of patient management becomes inappropriate, ineffective, and even dangerous. The patient should not be a passive object of medical intervention, but act as an active subject of his own recovery, which implies the implementation of the principle of cooperation between the patient and the doctor [12]. Sufficient awareness of the patient is an important basis for the formation of mechanisms for semantic self-regulation of behavior in the course of treatment. The readiness of the attending physician to discuss with the patient the options for predicting his recovery when choosing various therapeutic interventions increases the credibility of his recommendations and allows you to be wary of alternative methods of treatment. This is especially important against the background of the picture that has developed in the modern information field regarding the approaches and methods of treatment of FNP, when the average person may get the impression that there are certain means of intervention that are universal for all types of FNP. For example, physiotherapy exercises (exercise therapy) are called many effects that, depending on the stage of development of the disease and its pathogenesis, can both promote recovery and significantly worsen the prognosis. Another problem is some discrepancy between foreign clinical guidelines (2020) and Russian standards of medical care (2012), which require updating taking into account the expansion of the evidence base [4, 7].

Step 2. Unwanted actions with the face

The principle of programmed learning in FNP therapy implies the existence of an individual intervention plan, where the choice of each specific method is subordinated to the goal of this stage of treatment. The patient needs to be explained the goals of each stage and the therapeutic meaning of individual methods of influencing the face, to teach the correct execution of exercises. In addition to recommendations for implementation, the patient should have enough information about contraindicated intervention technologies, taking into account his clinical picture, a clear understanding of the causes of such contraindications and consequences has been formed.

During the initial consultation with the patient, a conversation is held about "unacceptable actions with the face": do not knead, do not warm, do not use active facial expressions in expressing emotions.

Step 3. Achieving facial symmetry

One of the important rules for the treatment and rehabilitation of patients with FNP is the "achievement of facial symmetry". With the development of FNP, movements on the affected side are limited (paresis) or completely absent (plegia). Their tonicity decreases, there is a risk of overstretching. The healthy side becomes prone to hyperfunction, muscle tone increases, they are prone to shortening. The midline of the face shifts towards the healthy side over time. Hypertonicity of the muscles of the healthy side of the face of varying severity is observed in 67% of patients on the 7th day of the disease [8]. Therefore, from the first days of the disease, we offer patients with FNP mechanical actions for relaxation and teach them (patch lifting of the affected side, relaxation of the muscles of the healthy side (exercise therapy or injections of botulinum toxin type *A*)) [13, 14], as well as adequate work with the healthy side face ("adjust" it, relax, train dosed muscle contraction). Thus, a new functional system is formed, where the load from the affected links is redistributed to the intact links of the existing system and those mental processes that closely interact. To ensure the principle of control, the afferent deficit must be compensated by external means of registration.

Step 4: Using a Mirror

For patients with FNP at all stages of recovery, we recommend providing feedback based primarily on visual control, using a mirror, photo and video recording, not only during exercise, but also in everyday life. The patient is advised to pay attention to his reflection in the mirror as often as possible, eat food in front of the mirror, perform strength exercises in front of the mirror and try to pay attention to his own facial expressions when communicating via video link. The patient has two tasks here: to control the symmetry of the face and to limit too active mimic movements (not to smile too broadly, not to frown strongly, etc.).

Recently, the issue of using a mirror in FNP has caused discussions, since some researchers do not recommend this feedback option, arguing that this is a decrease in the emotional background and demotivation of the patient [15]. The problem of emotional maladjustment caused by FNP is indeed widespread [1], but it cannot be overcome by ignoring the defect. Patients with such symptoms need a consultation with a psychologist, sometimes medication for mood correction and a course of psychotherapy aimed at harmonizing the internal picture of the disease and increasing compliance. We have developed a screening method for assessing the indicators of emotional distress in patients with FNP, which we recommend to carry out during the first consultation in order to promptly recommend a consultation with a specialized specialist if necessary.

From the point of view of neuropsychology, the use of external means of registering facial symmetry contributes to an increase in voluntary control of facial movements, which is built into a new functional system and becomes involuntary over time (see above, the principles of control and feedback). The patient develops the habit of keeping the face as symmetrical as possible, which significantly reduces the risk of complications. Therefore, it is not possible to retrain the patient in symbolic mimic movements without the use of a mirror, photography and video filming.

Step 5. Therapeutic exercise

A review of the scientific literature showed the high efficiency of physical rehabilitation in FNP [16]. The type of physical impact depends on the degree of damage to the nerve and muscles: paresis (decreased strength) or plegia (lack of strength). With plegia, the patient is recommended to perform passive exercises, with paresis — passive and active exercise therapy and active exercise therapy with graduated muscle contraction (range of motion, at which symmetry is possible) [8].

The duration of the disease is important. If at first a motor defect in the form of a decrease in muscle strength is decisive, then complications (hypertonicity of mimic muscles, synkinesis) develop further, and they determine the aesthetic defect.

In this context, it is interesting to consider the theory of N.A. Bernstein about the levels of movement organization [17]. In organizing the construction of movements, N.A. Bernstein identified 2 subcortical (*A* and *B*) and 3 cortical (*C*, *D*, *E*) levels. Level *A* (rubo-spinal) provides involuntary maintenance of muscle tone based on proprioception. Level *B* (thalamo-pallidar) provides synergies, stamps and the ability to alternate them correctly. Level *C* (pyramidal striatal) — the level of the spatial field allows one to take into account external circumstances in the construction of movement, relying primarily on visual afferentation. Level *D* (parieto-premotor) is the level of action . The movements here are of an objective meaningful nature, and levels *A* and *B* are of a subordinate nature. Level *E* is movements organized above the level of actions (*D*) and realizing sign-symbolic functions such as writing, gestural speech, emotional and expressive movements. Taking into account that during FNP, facial movements are disturbed at the lower levels of their construction, rehabilitation training occurs primarily due to increased activation of higher levels.

Thus, the principle of programmed learning is of key importance in rehabilitation by means of exercise therapy, since it is in this approach that the role of the patient's participation in his own recovery is the highest.

At the stage when synkinesis has developed, exercise therapy methods are aimed at neuromuscular retraining. These techniques are based on the principle of the formation of new functional systems, which we considered at the beginning of the article, by means of intra- and inter-system rearrangements, when the load of the affected link is distributed to the intact links of the already damaged system and systems that did not previously participate in the implementation of the affected function.

In clinical practice, when conducting neurological tests, the doctor offers standard instructions: raise your eyebrows up, frown, wrinkle your nose and show your teeth. However, we are faced with the fact that the patient does not always understand the instructions or does not understand the first time. In such cases, the doctor shows the instruction with his face or gives instructions based on figurative representations - be surprised, read the small handwriting, bare your teeth like a dog. A visual picture or reliance on an image facilitates understanding on the part of the patient. This is how another important principle of rehabilitation is implemented - reliance on intact mental functions that interact with the affected system. However, additional research is required to create an evidence base for the diagnosis and rehabilitation training in FNP.

Step 6. Complications and management of complications

In patients with FNP, the incidence of lagophthalmos from the first days of the disease is about 70%, the symptom regresses for a long time. Facial muscle hypertonicity of varying severity is observed in patients already on the 7th day of the disease on the healthy side in 67%, and in 93.3%. with incomplete restoration of the FN function after a year of the unilateral disease. In patients with incomplete recovery after FNP, synkinesis of varying severity develops over a period of 5 to 9 months in 15–100% of cases [8, 18–20].

The patient is explained the clinical manifestations of complications and ways to detect them at an early stage. The specialist also discusses the factors that can accelerate the emergence of strength and partial recovery of movement, but increase the risk of complications (active exercise therapy in the maximum range of motion, electrical stimulation) [8]. Thus, the patient is offered to make an informed choice between maximizing the recovery of strength and reducing the risk of complications.

CONCLUSION

The problem of restoring the motor pattern in patients with facial nerve palsy is a complex medical problem. In this case, effective treatment and rehabilitation are based not only on scientifically based medical recommendations, but also on the active participation of the patient himself in the therapy process. In fact, in the process of rehabilitation, the patient masters the basic principles and skills of rehabilitation and actively, consciously implements them at home. The offered program of rehabilitation training in the treatment of patients with neuropathy of the facial nerve is based on the principles of the theory of functional systems by P.K. Anokhin, concepts of activity physiology by N.A. Bernstein and the school of rehabilitation training and neuropsychological rehabilitation A.R. Luria–L.S. Tsvetkova. More research is needed on the effectiveness of this program.

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