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Modern Methods of Treatment of Amblyopia in Children

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Abstract: The paper reviews the literature data about the up-to- date methods of treating amblyopia in children that is deemed as a serious medical, social and economic problem. As reported, the amblyopia treatment shall be aimed to disinhibit retinal and corti- cal relations under exposure to different stimulants or irritators. A wide variety of amblyopia treatment methods used in an integrated way will allow improving and normalising visual functions in most patients. A review of the literature devoted to modern methods of treating amblyopia in children. The author notes that this pathology is a serious medical- social and economic problem. It is stated that the treatment of amblyopia should be aimed at disinhibiting retinocortical connections, achieved by exposure to various stimulators-stimuli. A significant variety of amblyopia treatment methods has been shown, the complex use of which provides improvement and normalization of visual functions in most patients.

Keywords: eye, visual acuity, cerebral cortex, stimulation.

Amblyopia is a serious medical, social and economic problem. The development of effective methods of treatment of this pathology is one of the most important tasks of pediatric ophthalmology [4, 12]. Amblyopia is the second most common (up to 6%), after myopia, the cause of decreased visual acuity in preschool and school–age children [6, 11, 12, 17]. Due to the late appointment of the appropriate correction of refractive errors, the development of refractive amblyopia is observed in 33-98.4% of children. The prevalence of refractive amblyopia in hypermetropia reaches 70% [12, 28].

By its nature, amblyopia is one of the different types of functional pathology of the higher parts of the central nervous system, and its pathophysiological basis is a persistent cortical inhibition of the function of central vision, developed as a result of sensory deprivation in early childhood. Based on numerous neurophysiological and clinical studies, it has been established that the development of amblyopia is associated with complex processes of disruption of interneuronal interactions at various levels of the visual system - from the sensory retina to the external cranial bodies and central divisions in the occipital lobe of the cerebral cortex [4, 10, 28, 30].

Amblyopia is a complex symptom complex of sensory and motor functional disorders. Its main manifestation was previously considered to be a decrease in visual acuity. However, as the pathogenesis and clinic of this disease were studied, a number of other disorders of central and peripheral vision, light, color perception, contrast, electrical sensitivity and lability, as well as accommodation ability were revealed [25, 26, 28].

Proposed in the XIX century occlusion and infusion - Currently, it has not lost its relevance in the treatment of patients with amblyopia. Its effectiveness ranges from 30 to 93%, depending on the timing of the start of treatment. However, the significant duration of occlusion, the inability of children to wear an occludor, the difficulties of constant control over the quality of occlusion in such patients and the insufficient effectiveness of the independent application of the method led to the need to develop a set of measures aimed at accelerating the processes of restoring visual acuity.

The achievements of science and technology achieved at the end of the twentieth century made it possible to create highly effective methods of treating amblyopia aimed at disinhibiting retinocortical connections. Various retinal stimulators have been developed and put into practice, the work of which is based on adequate (light, chromatic) and inadequate (laser stimulation, electrical stimulation, electromagnetic stimulation, reflexotherapy) stimuli - stimuli.

A special type of light effect on the retina is laser radiation. Under the influence of low - intensity laser radiation, a speckle structure is formed on the retina, which is a light stimulator. Laser stimulation contributes to the improvement of hemodynamics, metabolic processes, optimization of trophic processes, increased energy capabilities of cells and tissues, which in turn leads to an increase in the quality of visual functions [5, 9]. Under the influence of a gel - neon laser, an increase in visual acuity is observed in 46% of cases [23].

An important importance in the treatment of amblyopia today is attached to color and light stimulation. One of such methods is selective photostimulation: alternating eye photostimulation, color pulse therapy, structured color pulse maculostimulation, color therapy, iridoreflexotherapy, psychoemotional correction, etc. [13, 15, 23]. When exposed to the central region of the retina, photons fall on photoreceptors (cones), stimulating subtle photochemical processes in them, which activate the work of the entire visual analyzer from the sensory retina to the central parts in the occipital lobe of the cerebral cortex. After a course of selective photostimulation, visual acuity increases in 77.8% of cases [23]. The advantage of this method of treatment is its simplicity, physiology, absence of contraindications and complications, the possibility of use at any age.

The changes in the contrast sensitivity of the visual analyzer in amblyopia revealed during clinical studies served as an impetus for the development of a method of stimulation by presenting moving contrast arrays of different spatial frequencies to the patient. The effectiveness of this method ranges from 38.4 to 60.8% [7]. The opinion is expressed on the expediency of using accommodation training in the complex treatment of amblyopia. It is believed that such training reduces the duration of treatment and contributes to an increase in visual acuity of the amblyopic eye in 40-76.9% of cases [25].

Currently, great hopes are pinned on methods based on the implementation of the principle of biological feedback [1, 19, 21]. The essence of this method of amblyopia treatment is to train a certain function with simultaneous monitoring and giving signals to the patient about the correctness or wrongness of his actions. The authors proceed from their own data on the relationship between the state of vision function and the bio - electrical activity of the brain.

The relationship between the formation of the alpha rhythm and visual acuity was revealed. This method is aimed at teaching the patient to manage alpha activity of the brain. At the same time, control is established over it using external feedback signals – turning on and off the image on the monitor screen, i.e. visual feedback is used. According to the researchers' publications, the advantages of this method are the absence of contraindications and complications, high efficiency (increased visual acuity in 70-75% of cases) and stability of the results, short treatment time, patient motivation and interest, manufacturability and simplicity of the procedure.

Recently, various computer stimulation methods have been increasingly used in the treatment of amblyopia [8, 17]. Computer programs increase the efficiency of the defective part of the visual analyzer due to the patient's meaningful solution of visual tasks, they contribute to the activation of brain neurons and the restoration of interneuronal connections at all levels of the visual system. This method has a number of advantages. Due to the capabilities of computer programs, there is a gradual

complication of stimuli that are adequate stimuli for various channels and levels of the visual analyzer.

A number of computer programs have been developed and put into practice, of which the most optimal for the treatment of amblyopia are "Flower", which is part of the medical and diagnostic complex "Aka‑demik" and the program "Pleoptics 2+", which consists of four programs: "Shooting Gallery", "Ice", "Crosses", "Galaxy" [18]. Thus, in children with refractive amblyopia, after a course of pleoptic treatment using the "Crosses" program, an increase in visual acuity from 0.2 to 0.3 was noted in 66.7% of cases, depending on the degree of amblyopia [17].

Among the numerous methods of amblyopia treatment, the method of percutaneous electrical stimulation of the conductive pathways of the visual analyzer, which is based on the effect of weak electrical impulses on the sensory and neuromuscular apparatus of the eye, has been widely used [14, 26, 27].

Electrostimulation has the following therapeutic effects‑ you: increased visual acuity, expansion of accommodation reserves, expansion of visual fields, reduction of absolute and disappearance of relative cattle, improvement of indicators of electrosensitivity and electrolability of the visual system (physiological activity of cells).

These effects are based on two components: one at the level of the retina and the optic nerve, when, due to synchronous excitation of retinal cells and their fibers, the functioning of those elements that were viable but did not carry visual information is restored; the other ‑ at the level of the visual cortex, in which a focus of persistent hyperexcitability (prolonged post‑tetanic potentiation), which leads to the restoration of previously poorly functioning cells and powerful reverse afferentation. Electrical stimulation contributes to the destruction of a stable pathological condition and forms a new, close to normal state [27].

In recent years, bio‑regulatory therapy has become widespread for the treatment of various types of amblyopia as one of the promising areas in clinical medicine. The use of peptide preparations contributes to the restoration and preservation of the regulatory mechanisms of intercellular interaction, increasing the bioelectric activity of the cerebral cortex. With the combined use of modern physiotherapeutic methods of treatment with endonasal administration of cortex, visual acuity increased in 71.8% of cases [16].

Due to the fact that in amblyopia there is a violation of microcirculation of the affected eye and brain, according to a number of researchers, the use of nootropic drugs in the complex treatment of mildronate, picamilone, fezam, semax, etc. is appropriate [20, 22, 29]. Clinical studies of many ophthalmologists have shown that the best results in the treatment of amblyopia are achieved with the combined use of several stimulation methods [6, 10, 12, 19, 30]. This is explained by the fact that each of the methods affects one side of the pathological process, and their complex application provides a versatile the effect on the visual analyzer also gives a higher effect of disinhibition and stimulation of the functions of the amblyopic eye, expressed in an increase in visual acuity. The success rate of traditional complex treatment of amblyopia, according to various sources, ranges from 41.3 to 86.9%.

Thus, modern ophthalmology has a significant arsenal of amblyopia treatment methods, the complex use of which ensures the improvement and normalization of visual functions in most patients. At the same time, the search for new, more effective methods of treating amblyopia is still relevant.

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