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Research Article

Motivational Dominance and its' Role in Directed Correction of Vision Functions with Patients with Organic and Functional Cerebral Pathology

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Abstract

The authors researched a possibility of rehabilitation of patients with disorders of an eye movement system, diplopia and various types of strabismus after brain trauma, cranial surgery, stroke and other brain disorders using their original methods of binocular vision restoration. The most important condition for achieving positive effect of corrective compensatory and restorative procedures, including vision functions restoration and their further preservation in the limits of patients' physiological optimum, is establishment and maintenance of a specific motivational adequate-level dominance in the patients during rehabilitation procedures. Elaborated original methods of binocular vision restoration in organic and functional brain pathology resulting in disorders of eye movement functions allow to reveal particularities of functional activity of binocular centers and to correct their work. Motivational dominance, which includes several motivational components, is necessary in correction procedures for increasing their outcome and effectiveness.

Keywords: Organic and Functional Brain Pathology; Diplopia; Binocular Vision Restoration

Abbreviations

VVI: Virtual Visual Image; CNS: Central Nervous System

Topicality

Pathology of visual functions (diplopia, variations of strabismus, visual acuity impairment, visual field decay) is one of the patients' problems after craniocerebral trauma or cranial surgeries, as well as after stroke and other morphofunctional brain injuries. These diseases are considered as difficult to cure. Herewith the patients may have various types of troubles with eye movements, dizziness, body movement and gaze direction disorders.

In certain cases, diagnostic methods used in ophthalmology do not allow to reveal and ascertain the presence of fusion, which is a functional indication of binocular centers' condition, and to detect stereo vision centers remained in spite of presence of different types of strabismus and pathologic diplopia. There are several reasons for complication of a proper coordination between two eyes: disorder of one eye's or both eyes' movement control centers; repulsion of images on topographically identical receptive fields; decrease of visual acuity of both eyes when fusion is being established in spite of good visual acuity of the left and right eyes separately.

In difficult types of visual system disorders the most important condition for achieving good results of corrective procedures, such as compensatory and restorative effects of vision functions and their preservation in the limits of physiological optimum, is establishment and maintenance of a specific motivational adequate-level dominance [1] with the patients during rehabilitation procedures being developed.

Purpose of the Work

The purpose of our work is the research of specific features of participation of a dominant motivational factor in dynamics of restoration process of binocular vision in organic and functional brain injuries during application of original methods of binocular vision functional correction.

Materials and Methods

31 patients with different forms of diplopia and strabismus aged 14 - 50 years participated in our research, including 17 patients after craniocerebral injuries, 7 patients after brain surgeries, 4 patients after stroke, 1 patient after surgical resection of aneurysm temporal artery, 1 patient after coma, 1 patient after vestibular system physical test.

Original methods of binocular vision diagnosis and restoration in brain disorders developed by the authors have made it possible not only to reveal specific features of functional activity of binocular centers in the eye movement pathology, but to correct their activity eliminating diplopia as well as strabismus. All patients whom we trained for binocular vision functions rehabilitation had been observed and treated by neurologists and ophthalmologists. But application of common methods for binocular vision restoration by these specialists was inefficient.

Results of human binocular functions research using the devices "Binarimetr" (Figure 1) [2] and Stereometer Visus-4D (Figure 2) [3] were used as a basis for the authors' original vision correction program. Technical possibilities of these devices made it possible to develop unique methods of diagnostics and rehabilitation for difficult patients with morphofunctional brain disorders.

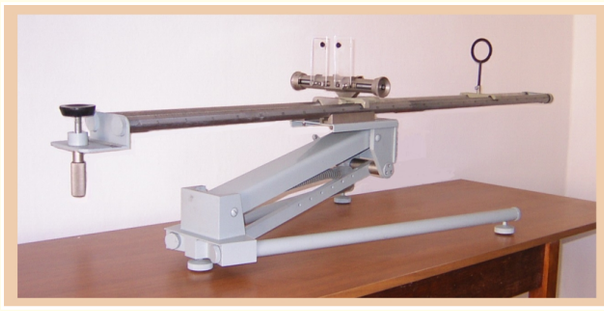

Figure 1: Device Binarimetr.

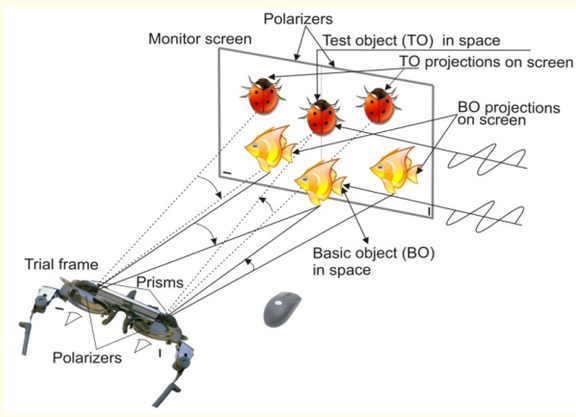

Figure 2: Scheme of Stereometer Visus-4D.

Research using "Binarimetr" made it possible to receive data which was the base for procedure package providing a possibility of the patient's perception of an ideal informational equivalent of a binocular vision norm, so called "virtual vision image" (VVI) [2]. Binarimetr is a unique device making it possible to reveal fusion without visual fields division, to assess and restore a feeling of visual depth and relief in near-natural conditions [2].

Stereometer Visus-4D [3] is a software application and a device with a polarization principal of the VVI receipt. The device gives a unique possibility to detect centers of binocular vision even in the most difficult cases of strabismus (convergent or divergent) with vertical and even with cyclic components. This method also makes it possible to set sensory-motor coordination and cure difficult types of strabismus, and besides that to develop and improve stereo vision and to examine its' quality.

The basic principle of research of vision functions in our work is a search by a doctor and a patient of a so-called virtual vision image (VVI), which emerges in the result of fusion of double images, which are in open space [2] or by using polarizers [3].

Our methods include diagnosis as well as procedures of binocular functions correction. The methods make it possible to detect the patient's fusion ability, in spite of presence of a strabismus angle, pathological diplopia, amblyopia and decrease of vision acuity to 0,05, and even in case of functional inhibition. We conducted a preliminary diagnostic research with all the patients. The research started from a general examination of the patients' visual organs condition, assessment of vision acuity at near and far distance. We studied every eye separately and movements of both eyes. Research of condition of visual system functions is important in preparation and performance of correction procedures for binocular vision restoration. The proposed type of research [4,5] using Stereometer Visus-4D [3,4] makes it possible to detect functional reserves of visual system, to make a binocular functions correction plan and to fix the scope of works.

The doctor formulated a task for every patient: to find the VVI in open space or using Stereometer Visus-4D. For reaching this goal by the patient the doctor manipulated by double images (a pair of black circles diameter of 16 or 24 mm) (Figure 3) in open space - for patients with convergent strabismus and using Stereometer Visus-4D - for patients with divergent, vertical and cyclic strabismus. The goal was reached due to constant verbal communication between the doctor and the patient while the doctor was making constant assessment of condition of visual images emerging in the patient. Fulfilment of the above task was possible only in conditions of the patient's highly motivated concentration of attention on the process of seeing as it is and fusion search, when the patient was asked but not demanded not to perceive/"see" images as sharp ones. The patient was asked periodically to describe verbally his or

her personal visual images perceived during observation of double images and to draw on a piece of paper the visual images seen. The patients' pictures and verbal descriptions helped the doctor not only to conduct the research but to control directly the restoration process of binocular vision. Every patient searched fusion under an individually designed plan taking into account his or her specific CNS disorders. Only symptoms of binocular vision disorders were alike. Therefore, location of a pair of circles was fixed individually in every case of disorder, depending on doubling conditions and type of strabismus.

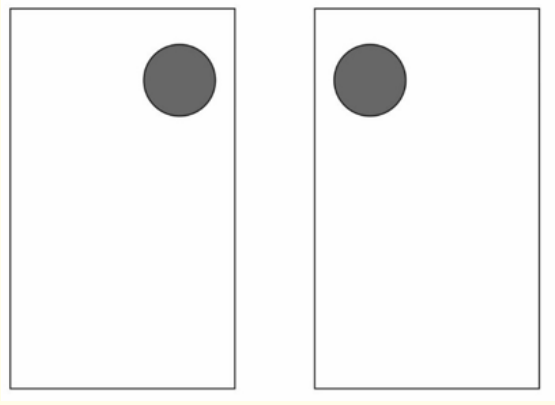

Figure 3: A pair of circles for diagnostics and restoration of binocular vision.

On the next stage the determined parameters of double images were combined with stable fusion - the VVI perception a) in open space when a head posture was not fixed or b) using Stereometer Visus-4D when the head posture was fixed strictly forward.

During the training process proper perception of the VVI served as a control measure (by the doctor) and as a self-control measure (by the patient) of a positive dynamic of visual functions restoration.

Controlling the position and distance between the pair of images and distance to the pair of images the patients restored a fusion amplitude, eliminating step by step doubling and strabismus.

For fusion improvement the distance between the pair of images was changed by 2 - 4 mm on the Binarimetr or the Stereometer during every training session. Distance between the pair of images was also changed by 0,1 - 0,3 mm, allowing a patient being adopted to every minor load. The final outcome of these training sessions was fusion without a strabismus angle in open space.

In addition, a patient made exercises and perceived the VVI using the Binarimetr and moving his/her head left and right, up and down in open space, as well as looking at the pair of images, which were moving left and right, up and down.

After fusion restoration in all gaze directions during movements of the eyes and the head, the patients made exercises for stereo vision restoration and fixation, and monocular and binocular acuity improvement.

Fulfilment of all exercises by the patients was obligatory and affirmatively motivated by the doctor encouraging them to make further progress after achieving good results. For maintenance of motivational dominance the doctor let the patients know their achievements and results of these achievements' fixation at every training session.

Training sessions were held 1 - 2 times per week depending on complexity of a vision system disorder. Other days of a week patients did exercises at home using the pair of images with which the best result was achieved during the training session.

Depending on the type and scope of organic and functional brain diseases corrective program was developed for the training period from several weeks to 2 years, including trainings at home for 10 - 20 minutes per day.

Usually a patient needs to be motivated to succeed [6], including the following elements of motivation: the patient's desire to create together with the doctor an individual scheme of functional correction; trust in the doctor and motivation to fulfill the doctor's instructions; desire to perceive and observe the VVI in training conditions; motivation to regular trainings with VVI for achieving the best result.

In other words, a patient was demanded to have a voluntarily managed and constantly renewable feeling of "desire" to achieve restoration of binocular vision functions approaching to physiological norm.

In response to the changing images' location during all training exercises we actually provided a process of proportionally increasing little-graded influence on the CNS resulting in restoration of a binocular vision system. A dominant motivation was a system organizational factor of this process as well as orientation to the VVI perception as a component of the dominant motivation. As PK Anokhin mentioned [7], it is a motivational factor subject to classical laws of dominance that not only forms an energetic and guiding

principle of functional reorganization of a binocular vision system but implements a large-scale rehabilitation of vision functions in organism as a whole providing elements of their development.

According to FS Meerson's statement [8] about biological phenomenon of adaptational stabilization of structures, in the process of fixation of the result achieved a structural trail of adaptation emerges on different levels of binocular system providing morpho-functional support on a new composed morpho functional organization of binocular vision.

Results and Discussion

State of fusion was found in all 31 patients during diagnosis. 14 out of 17 patients with craniocerebral injuries achieved restoration of binocular vision. Doubling and strabismus were eliminated, including in particular stereo vision and acuity restoration. 3 patients with cyclo-diviation and diplopia, in spite of presence of binocular centers of fusion, have not been able and will not be able in future to eliminate cyclo-diplopia because of disorder of the CNS centers which manage upper and oblique muscles of the eye movement system.

The patients with brain surgeries received good results: doubling was eliminated, binocular vision was restored in case the gaze was straight, vision acuity was improved, dizziness was eliminated. One of these patients who had two craniotomy surgeries proceeds with exercises for improving of vision and stereo vision acuity. Three patients could not proceed with treatment.

In two patients after stroke doubling was eliminated and vision field was extended, but not restored in a farthest gaze direction to the right. In one patient after stroke doubling was eliminated in one gaze direction but it was necessary to develop binocular eye movements when the gaze was directed to the right. But the patient could not proceed with treatment.

In one patient with aneurysm of the right temporal artery resulting in horizontal and vertical diplopia, diplopia was fully eliminated, but he proceeds with exercises for vision acuity because of presbyopia.

In one patient with a vestibular disorder divergent and vertical strabismus and double vision were fully eliminated, normal binocular vision, stereovision and vision acuity were restored.

One patient after coma with divergent strabismus with vertical and cyclic components and horizontal, vertical and cyclic doubling reached good results: vertical and cyclic components of strabismus were eliminated, the angle of divergent strabismus was decreased, fusion reflex is being developed, the patient proceeds with treatment - it is still necessary to develop convergence and increase vision acuity.

Thus, 14 patients with cerebral injuries, 3 patients after cranial surgeries, 2 patients after stroke, 1 patient with aneurism of the temporal artery, 1 patient with vestibular system disorder achieved maximum results - elimination of double vision and the angle of strabismus.

All these patients did trainings according to the above methods using "Binarimetr" [2,4] and Stereometer Visus-4D devices [3,4]. But on every stage trainings were held by individual scheme taking into account every patient's particularities of the visual function disorder. An important factor of these patients' success was a motivational dominance to succeed which was supported by the results achieved and was the driver to achieve the final goal - elimination of strabismus and pathological doubling.

Conclusion

Functional and organical disorders give rise to a conflict of congenital and acquired processes and tendencies in brain. Besides as A.A. Uhtomsky wrote [9]: "In the kingdom of relativeness such as CNS is, constant struggle of activation and inhibition exists".

Tension (endogenous energization) caused by this conflict and struggle induces a dominance phenomenon. In view of this, usage of the term "motivational dominance" in our research is justified and reasonable. Constantly supported work is specific for motivational dominance. Being a conservative component of support at the beginning, in the next moment of its' life motivational dominance becomes a progressive component: it makes an active selection of "applicable and needed" impressions out of many supportive impressions, in particular during the training process for achieving visual function restoration. These are features of work of motivational dominance aimed at functional development during the training process as well as during self-determination of self-activity [9]. AA Uhtomsky [9] recommended: "If you want to maintain one and the same vector on one and the same level it is necessary to train this dominance, to cultivate it carefully, to supervise it not allowing it to be hyper excited but allowing it to be in tune with the current conditions in the brain centers on one side and with environment on the other side all the time".

Motivational dominance consisting of several motivational components is necessary during rehabilitation procedures and is used to increase their outcome and effectiveness.

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