The role of elimination of functional scotoma in the treatment of comitant strabismus (clinic case)

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Abstract.
INTRODUCTION. Long-term strabismus causes various complications, one of which is functional scotoma or binocular haploscopic suppression. PURPOSE: The main purpose of this article is to show that the elimination of a functional scotoma caused by a complication of strabismus is very important for the elimination of strabismus. MATERIAL AND METHODS: A 15-year-old schoolboy with complaints of internal strabismus came to our clinic for surgical correction of strabismus. The patient underwent standard eye examinations and was checked whether or not there were movement restrictions in the muscles that move the eyeball. The degree of deviation was measured by Hirschberg's test, alternating prismatic cover test according to generally accepted rules. The examination of the objective angle of strabismus was carried out in the synoptophore. The subjective angle of strabismus, as well as the presence of haploscopic binocular vision, was examined both in the synoptophore and in the “Klinok” computer program. In order to prepare for the operation, appropriate therapeutic exercises were prescribed in the synoptophore and in a special computer program to restore haploscopic binocular vision. RESULTS: BCVA OD=0.9; OS=0.8; EZO 30PD without correction, 15PD with correction. Binocular haploscopic suppression was found. After a 10-day course of orthoptics treatment, haploscopic binocular vision was restored. Deviation angles decreased both without correction and with correction. After a course of diploptic treatment, carried out after a 1-month break, normal binocular vision with correction was achieved. CONCLUSION: Elimination of functional scotoma and restoration of haploscopic binocular vision facilitates the subsequent stages of strabismus treatment, sometimes allowing to obtain normal binocular vision and achieve orthotropy even without surgical operation.

Keywords:
functional scotoma
haploscopic binocular vision
binocular haploscopic suppression
ortoptics
INTRODUCTION. Strabismus is a disease of the motor apparatus of the eyeball, more common in children (1). The period of appearance of this disease coincides with the time of development of the visual system and the formation of binocular vision. Not eliminating this disorder in the preschool period leads to a further deepening of the problem in the later school period (2). Not eliminating strabismus in time causes permanent loss of the ability to form binocular vision, unilateral or bilateral decreasing of vision, and the development of amblyopia.

As a result of a long stay of the eyes in a disbinocular position, a functional scotoma (functional suppressive scotoma, binocular haploscopic suppression – BHS) may also appear. Under natural conditions, a functional scotoma is present in all concomitant strabismus, otherwise there would be diplopia. But the detection of a functional scotoma in haploscopic devices depends on the degree of disturbance of normal binocular fusion and is not found in all cases of concomitant strabismus. Diplopia, which naturally causes functional scotoma, is corrected by bifoveal fixation in haploscopic devices. In this case, haploscopic binocular vision (HBV) occurs in eyes whose binocular connections have not been deeply damaged. However, with deeper disorders, haploscopic binocular vision is not achieved, which is a sign of functional scotoma. The presence of a functional scotoma is a serious obstacle to diploptic treatment and the restoration of binocular vision, as well as to the restoration of binocular vision in the postoperative period. For this reason, its timely detection and elimination with special exercises on the appropriate devices directly affects the effectiveness of both non-surgical and surgical methods (4).

PURPOSE: The main purpose of the article is to show that the elimination of a functional scotoma caused by a complication of strabismus is very important for the elimination of the disease.

MATERIAL AND METHODS: With complaints of internal strabismus, a 15-year-old schoolboy came to the clinic for surgical correction of strabismus. Strabismus appeared at the age of 3 for the first time. After consultation with the
doctor, an appropriate hyperopic correction was prescribed and existing weak degree of ambliopia was treated. However, during the entire period of management, even with correction the orthotropic state was not achieved, residual esotropia of 10-12 PD remained.

At the clinic, the patient was tested for uncorrected and corrected visual acuity. Cycloplegic refraction is prescribed. The oculomotor muscles were examined for limitation of movement. The degree of deviation was measured by Hirschberg's test, alternating prism cover test. The examination of the objective angle of strabismus was carried out on a synoptophore (mayor amblioscope), manufactured by the Japanese company. The determination of the subjective angle of strabismus, as well as the presence of HBV, was carried out both on the synoptophore and using the computer program "Klinok". In cases, when haploscopic fusion absence, the images, gradually approaching each other, shifted in the opposite direction without merging. Shifting images in the opposite direction without merging was accepted as presence of a functional scotoma, and the point of its intersection was regarded as the degree of a functional scotoma. When examining in the computer program "Klinok", the point of shifting images in the opposite direction without obtaining HBV, was evaluated as the location of the functional scotoma.

For eliminating functional scotoma, the patient was prescribed a 10-day course of treatment. After a month break, the 2nd course of orthoptic treatment was prescribed to enhance HBV and restore binocular single vision. At the end of the courses of treatment and after 1 month and 3 months from the last course of treatment, repeated examinations were carried out.

Treatment was carried out in the synoptophore and the "Klinok" computer program. After adjusting the synoptophore to the interpupillary distance of the patient, the handles of the apparatus were brought to the point of functional scotoma determined in the patient. At this point, the light of the objects on the handles alternately turned on and off automatically. In the early days, the blinking speed was low, with each day it was gradually increased. The treatment
procedure was prescribed for 10 days with 20 minutes each day. HBV was checked at the end of each treatment day. During treatment, the patient used a complete cycloplegic hyperopic correction.

At the same time, treatment began in the computer program “Klinok” with a 30-minute break. The treatment was carried out daily for 15 minutes in glasses with a red-green filter under conditions of hyperopic correction. The green-red objects appearing on the screen were set to automatic alternating flashing at the point of functional scotoma. HBV was examined daily at the end of the course of treatment.

**RESULTS:** When contacting the clinic: the patient's visual acuity without correction VisOD=0.4; VisOS=0.4; and BCVA OD=0.9; OS=0.8. Cycloplegic refraction: ROD=Sph.+4.0D Cyl.+1.0D ax180; ROS=Sph.+4.5D Cyl.+1.0D ax 180.

There were no restrictions in the movements of the eyeballs in the diagnostic directions of gaze (Fig.1).

The deviation angle was measured at near and far distances, without correction and with correction. The results of strabometry did not depend on the examination distance, but different results were obtained depending on the correction (table). Apparently, hypermetropic correction reduced the angle of deviation, but the residual angle of esotropia was present in all studies. In the study of the subjective angle of strabismus, binocular haploscopic suppression was revealed both in the synoptophore and in the computer program. In the Worth test, vision was OD-monocular in all cases.
For restoring HBV, it was prescribed a 10-day course of treatment in the synoptophore and the "Klinok" computer program. On the 6th day of treatment in synoptophore, HBV was obtained, it means a functional scotoma was eliminated. The point where the HBV was obtained, that is, the degree of subjective angle of deviation, corresponded to the point at which there was a functional scotoma (10PD), almost did not differ from the degree of objective angle (12PD). In the following days of treatment, the presence of HBV remained stable. Functional scotoma disappeared by the end of the procedure on the 8th day of treatment in the computer program; in the following days it was not detected in any case. At the end of the 10-day course of treatment, the functional scotoma was eliminated, the deviation angle determined in the synoptophore and the computer program decreased. When performing the Worth test at near distance with correction, diploptic binocular vision was obtained. Re-examination after a 1-month break, it was revealed a recurrence of functional scotoma. The 2nd course of treatment was prescribed, and on the 2nd day of the course, the presence of HBV was revealed in both methods of examination. On the following days of the course, diploptic treatment was

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continued on both devices for eliminating minor deviations (8.0 PD in the synoptophore, 6.0 PD in the computer program). At the end of the 2nd course of treatment, the deviation angle decreased in all tests without correction, and disappeared with correction (Fig.2). Binocular single vision was obtained at near distance Worth test with correction, diploptic vision was obtained at the far distance examination with and without correction.

Figure 2
After treatment

On examination 1 month after the 2nd course of treatment on the background of total cycloplegic correction, the patient had intermittent exotropia. Because of this, the degree of hyperopic correction was reduced by 1.0 diopters. A follow-up examination after 3 months revealed orthophoria with correction and EZO 15PD without correction.

As can be seen, if concomitant strabismus is not treated on time, it causes deeper complications (5). These complications prevent the desired results in the treatment of strabismus. One of such obstacles is the occurrence of functional scotoma. From our experience, it seems that functional scotoma is a rather serious obstacle for the treatment of not only non-accommodative, but also accommodative strabismus and should be eliminated as soon as
possible. Repeated examinations should be performed no later than 1 month after HBV recovery. Because these connections are still weak and tend to break. Repeated courses of treatment lead to the strengthening of these associations, and in our experience even to the restoration of binocular single vision.

**CONCLUSION:** Thus, it is very important to eliminate the complications before starting the treatment of strabismus. Elimination of functional scotoma and restoration of HBV facilitates the work of various treatment stages, sometimes even without surgery, it allows to obtain normal binocular vision and to achieve orthotropy.

**References:**


