

FACTORS INFLUENCING THE OUTCOME OF SURGICAL TREATMENT OF CONCOMITANT STRABISMUS

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Abstract. *We conducted a retrospective analysis of the medical records of 100 children with concomitant converging strabismus of both eyes who were undergoing inpatient surgical treatment in the eye department of the 1st clinic of the Samarkand State Medical Institute from 2018 to 2023. The age of the patients was 4-8 years (mean age 6.5 ± 0.55 years). There were 58 girls, 42 boys. In 28 children, strabismus developed from birth; 72 – aged from 2 to 5 years. In the preoperative period, all patients underwent optical correction, orthoptic treatment in the conditions of specialized kindergarten No. 79 for children in Samarkand, and also received treatment in outpatient clinics from an ophthalmologist at the place of residence. To form binocular vision, we used synoptophore, amblyotrenner, muscle trainer, mosaic, irritation of the macula area with light, diploptic and pleoptic. Essential for the treatment of strabismus are its form, period of limitation, conditions of visual acuity with and without correction, refraction of the eye, the presence of amblyopia, the age of the patient, the starting angle of deviation, the diligence of the patient and their parents, the beginning of the treatment period, as well as concomitant diseases. There was a correlation between the outcome of treatment and the initial angle of deviation and the time of its occurrence.*

Keywords: *concomitant strabismus, surgical treatment, convergence, angle of deviation, optical correction of ametropia, pleoptic and orthoptic-diploptic treatment, binocular vision.*

Introduction. Strabismus continues to occupy a leading place in the pathology of the visual organ in children. On average, it occurs in 2 to 3% of cases. In the treatment of strabismus, 3 effectiveness criteria are taken into account: cosmetic effect, improvement of visual acuity and restoration of binocular vision. The final result of the treatment depends on many factors: heredity, age, age at detection of strabismus, angle of deviation, refractive errors, optical correction, the presence of concomitant eye diseases, duration of surgical treatment, as well as orthopto-pleoptic treatment. In addition to a cosmetic defect, which is very psychologically painful, strabismus is accompanied by a serious disorder of binocular functions. This complicates the visual activity of patients with strabismus and limits the possibility of choosing a profession. Despite the fact that in most cases, optical correction of ametropia, pleoptic and orthoptic-diploptic treatment lead to the recovery of patients with strabismus, 40-60% of children require surgical treatment. The rate of orthotropia after the first operation ranges from 40 to 90%, and the rate of reoperation is 10-50%. Issues of dosing operations on the extraocular muscles are of great importance for the surgeon due to the danger of hypereffect. Due to the hypereffect of surgery on the extraocular muscles, deviation of the eye in the opposite direction may occur - the so-called secondary reverse strabismus, divergent after convergent or convergent after divergent. This problem arises especially acutely when it is necessary to correct convergent strabismus, since the internal rectus muscle has the closest attachment to the limbus and is responsible for one of the most important

functions of the oculomotor system - convergence. Reverse divergent strabismus after correction of convergent strabismus occurs in 10 - 25% of cases. To solve this problem, it is necessary to use surgical treatment methods that would preserve the biomechanical features of the extraocular muscles. Particularly difficult for the doctor is the task of eliminating strabismus with small angles (up to 15° according to Hirschberg). Convergent strabismus with small angles accounts for up to 46.5% among children receiving treatment in specialized kindergardens. The effectiveness of orthoptic treatment for this group of patients is quite high: 64.4% of patients receive bifoveal fusion and 47.5% orthotropy. In half of the children who do not experience a cure using the conservative method, surgery is necessary. Until now, no safe and effective method has been proposed for eliminating small angles of strabismus. Smaller volumes of attenuation are usually insufficient to eliminate strabismus; larger volumes often lead to a hypereffect. The solution to these questions was the subject of our research.

The purpose of the work is to study the effectiveness of surgical treatment of concomitant strabismus and the factors influencing the outcome of the operation.

Material and methods. We conducted a retrospective analysis of the medical records of 100 children with concomitant converging strabismus of both eyes who were undergoing inpatient surgical treatment in the eye department of the 1st clinic of the Samarkand State Medical Institute from 2018 to 2023. The age of the patients was 4-8 years (mean age 6.5 ± 0.55 years). There were 58 girls, 42 boys. In 28 children, strabismus developed from birth; 72 – aged from 2 to 5 years. In the preoperative period, all patients underwent optical correction, orthoptic treatment in the conditions of specialized kindergarten No. 79 for children in Samarkand, and also received treatment in outpatient clinics from an ophthalmologist at the place of residence.

To form binocular vision, we used synoptophore, amblyotreneer, muscle trainer, mosaic, irritation of the macula area with light, diploptic and pleoptic. Essential for the treatment of strabismus are its form, period of limitation, conditions of visual acuity with and without correction, refraction of the eye, the presence of amblyopia, the age of the patient, the starting angle of deviation, the diligence of the patient and their parents, the beginning of the treatment period, as well as concomitant diseases. There was a correlation between the outcome of treatment and the initial angle of deviation and the time of its occurrence. All patients with concomitant strabismus underwent a complete ophthalmological examination. To assess the state of the functions of the organ of vision and the refractive apparatus, the following research methods were carried out: determination of visual acuity using the Orlova and Golovin-Sivtsev tables, study of eye position and range of motion in 8 meridians, determination of the strabismus angle according to Hirschberg using a Helmholtz mirror ophthalmoscope, as well as a synoptophore, study of the refraction of eyes with narrow and wide pupils using an autorefractometer, as well as by skiascopy: refraction was determined by cycloplegia by instillation of a 1% atropine solution in an age-appropriate dosage to exclude side effects, and sometimes a 1% tropicamide solution 2 times with an interval of 5 minutes in children younger children and using a PRK “Supore” autorefractometer (China), examination of the anterior segment, conducting media of the eye, fundus using a slit lamp (biomicroscopy). The condition of the fundus was studied by the methods of reverse and direct ophthalmoscopy, determination of the nature of vision by the 4-point Belostotsky-Friedman color test, determination of accommodation and convergence using the Accommodation Convergence Trainer apparatus.

Functional treatment included courses of pleoptic, orthoptic and diploptic treatment, as well as courses of physiotherapy and electrical stimulation to influence the muscular system of the eye, retina, and optic nerve. The course of treatment at the initial stage consisted of adequate spectacle correction and occlusion. Orthoptic treatment included: synoptophore, biviotrainer, muscle trainer. The refraction in these patients in all cases was hypermetropic, from +0.75 D to +5.75 D (on average +2.75 D). All children were consulted by a pediatric psychoneurologist, since children with strabismus often suffer from diseases of the central nervous system, childhood neurosis, and have psychological problems (fears, anxiety, communication difficulties, low self-esteem, self-doubt, etc.). as well as a pediatrician to exclude somatic diseases.

With unilateral strabismus, the effect of symmetrical eye position is noticeably worse than with concomitant strabismus, on average after a course of treatment it is 45%. With alternating strabismus, symmetrical eye position was observed in 65% of cases. All patients were operated on under general anesthesia, which was used to perform recession of the internal rectus muscles of both eyes according to a standard technique developed in the Department of Vision Protection in Children of the Helmholtz Moscow Research Institute of Eye Diseases. To determine the scope of surgical intervention for concomitant strabismus, the dosage scheme for surgical treatment of convergent strabismus proposed by E.S. was taken as a basis. Avetisov, Kh.I. Mahkamova.

Results and discussion. Functional treatment included courses of pleoptic, orthoptic and diploptic treatment, as well as courses of physiotherapy and electrical stimulation to influence the muscular system of the eye, retina, and optic nerve. The course of treatment at the initial stage consisted of adequate spectacle correction and occlusion. Orthoptic treatment included: synoptophore, biviotrainer, muscle trainer. The refraction in these patients in all cases was hypermetropic, from +0.75 D to +5.75 D (on average +2.75 D). The patients were distributed according to the magnitude of the strabismus angle: a deviation angle of 10-15° was observed in 22 patients (22%), a deviation angle of 15-25° was observed in 50 patients (50%), and a deviation angle of 25-28° was observed in 28% of patients. Studying the immediate postoperative period in 64 patients with concomitant strabismus, the angle of strabismus was eliminated, and orthophoria was observed. Patients with a residual strabismus angle were 24, and they had a hypoeffect. Of these, in 12 cases a hypereffect was observed, that is, secondary divergent strabismus was observed. With a strabismus deviation angle of 10-25° according to Hirschberg, elimination of strabismus was achieved in 85% of cases. When the deviation angle is more than 25°, the effect of the treatment is noticeably reduced, that is, a symmetrical position of the eye occurs in 60% of cases, in other cases it noticeably improves, that is, the angle of strabismus decreases, but the hypoeffect remains.

If treatment for strabismus began in preschool age, then the effect of the treatment is much better than that of treatment started at school age. Comparatively better results were observed in patients who began treatment at the age of 3-5 years, which is 80%. With the early development of strabismus (up to a year), the cosmetic effect of the treatment is very low and amounts to 15-20%. Among children operated on between the ages of 5 and 7 years, bifoveal fusion and binocular vision improved markedly; in children over 8 years of age, no bifoveal fusion was noted in any of them, despite vigorous orthoptic exercises. At the same time, with strabismus for a period of 9 years, a symmetrical position of the eyes, that is, a cosmetic effect, was observed in 15% of the patients we examined. In case of strabismus no more than 4 years old, in the postoperative period from pre- and postoperative orthoptic-pleoptic treatment, binocular vision was restored in 52% of

cases, from 5 years or more - 40%. Before treatment, binocular vision was not observed in any patient. In 6 cases there was simultaneous vision, and in all other 94 cases there was monocular vision. As is known, orthopto-surgical-orthoptic treatment of concomitant strabismus leads to the restoration of binocular vision, on average in 30% of patients. One of the reasons for the comparatively low percentage of functional recovery is the late start of treatment for strabismus (5–7 years), as well as for the restoration of binocular vision, the use of mainly synotypic devices that promote the development of haploscopic vision, which differs significantly from true binocular vision. In order to increase the effectiveness of treatment of concomitant strabismus, we have developed a new pathogenetic-oriented treatment system, including: early penalization, early surgical elimination of strabismus and diploptic treatment. It has been established that to carry out diploptic treatment, appropriate conditions are necessary: sufficiently high visual acuity of at least 0.5 in both eyes and symmetrical eye position.

For this purpose, within the framework of diploptics, the preventive and therapeutic effect of penalization was studied in 100 patients aged 3–8 years and its effect on visual acuity, the magnitude of the strabismus angle, as well as the state of binocular sensory functions was determined. We used 3 methods of penalization: penalization for near, for distance, and alternating penalization. The number of patients with visual acuity of 0.5 or more in an amblyopic or more often squinting eye after 6 months of treatment increased by 40%, the symmetrical position of the eyes was restored in 50% of patients, that is, on average, conditions for diploptic treatment were created in 45% of patients. It should be noted that under the influence of penalization, before other functions of the eye, the symmetrical position of the eyes is restored after 3 months from the start of treatment, in 40% of patients a cosmetic effect is observed, however, relative stabilization of strabismus in 50% of patients occurred after 6 months. This circumstance played an important role in determining the indications for surgical elimination of strabismus and made it possible to reduce the preoperative period to 6 months (with the traditional system it is 1-1.5 years) and move the surgical stage to an earlier age of 3 - 4 years, which significantly brought closer diploptic treatment at the age of formation of binocular visual functions. The results obtained allow us to conclude that the main purpose of penalization is to create conditions for diploptic treatment and determine the indications and timing of surgical elimination of strabismus. The effect of surgical treatment on the state of binocular functions was studied in 100 patients operated on at the age of 4–8 years. Data indicate the high effectiveness of surgical treatment in early and preschool age; deviation was completely eliminated in 80% of operated patients. A positive effect of early surgical intervention on binocular sensory functions was also noted - this was manifested by the elimination of the phenomenon of functional inhibition in 65% of patients and a significant increase in the number of patients (from 10 to 40%) with the phenomenon of diplopia. Early correction of strabismus made it possible to carry out diploptic treatment at the age of 4-6 years.

Diploptic treatment included the following techniques: the computer program “Diploptics” on the Forbis apparatus. At this age, among the known methods of diploptics, we successfully used the method of restoring the bifixation mechanism. Each patient, depending on the effectiveness, received from 1 to 4 courses of treatment using the indicated method, the intervals between courses were 2–3 months, the course of treatment included 20 sessions. For most patients, exercises were performed 2 times a day for a session lasting 20 minutes; the state of binocular vision was judged by examining the patient on a 4-point Belostotsky-Friedman device from a distance of 5 meters under conditions of full optical correction. Binocular vision appeared in 4 patients. In the group of

patients we examined, the overwhelming majority of patients (98%) had monocular vision. After treatment, binocular vision was restored in 55 out of 100 patients, with binocular vision returning to normal in 40 patients after the first two courses of treatment, and in 15 patients after 3-4 courses of treatment. The results obtained indicate the high efficiency of methods for restoring the bifixation mechanism and the possibility of using children of early and preschool age; Moreover, this method was most effective after the first two courses of treatment: a significant difference in statistical indicators was revealed after 1–2 and 3–4 courses ($t = 2.62$; $P < 0.01$).

Thus, the new pathogenetically oriented system of complex treatment of concomitant strabismus, including: early penalization, early surgical elimination of strabismus and diploptic treatment, made it possible to prevent amblyopia, shortened the preoperative period to 3–6 months, and reduced the number of patients subject to surgical treatment at the age of 3–6 months. 4 years, ensured the restoration of binocular vision in an average of 55% of patients and opened up opportunities for the development of methods of dosed and individual influence on the fusion apparatus in order to further increase the effectiveness of the treatment of concomitant strabismus.

We studied the state of visual acuity of an amblyopic eye on the formation of binocular vision. Among children who developed strabismus by the age of one, low visual acuity (below 0.08) was noted in 80% of cases, and over the age of 3 years it averaged 25%. In the group we examined, after treatment, on average, binocular vision was 45% of cases.

Conclusion. Thus, after surgical and conservative treatment for concomitant strabismus in the patients we examined, the cosmetic effect in 50% of cases was symmetrical, in 40% of cases there was a hypoeffect, the residual strabismus angle, on average, was $5-10^\circ$ according to Hirschberg, which was quite satisfactory patients, and in 10% of cases a hypereffect was observed. The hypoeffect is psychologically perceived by the child's parents as less painful than the hypereffect, which often requires repeated surgery. From the moment when visual acuity (VA) could be adequately assessed in patients (not earlier than 3 years), an analysis of visual acuity was carried out. VA was compared without optical correction and with correction; VA in patients with optical correction averaged 0.58 ± 0.09 .

The state of binocular vision in patients with strabismus was assessed using a 4-point color test with this function at a distance of 5 and 1 meter no earlier than 3.5-4 years. The predominant type of refraction in the patients we examined was moderate hyperopia. The results of the study showed that all groups of patients were characterized by a high volume of 7.6 diopters. Apparently, the excess strain of accommodation of the squinting eye when viewing the zone of closest vision causes excess convergence, which is one of the pathogenetic factors of convergent strabismus.

Interestingly, excessive strabismus tension occurs in almost all patients with strabismus. This indicates the need for a set of exercises aimed at normalizing accommodation. With monolateral strabismus, anisoaccommodation is pronounced, which ranged from 0.1 to 3 diopters (on average 0.8 diopters). With alternating strabismus, anisoaccommodation is less pronounced, from 0.1 to 0.04 diopters (on average 0.25).

Thus, the results of the study indicate a violation of the accommodative ability in patients with strabismus, this dictates the need to include in the examination plan for these patients - determining the state of accommodation and carrying out the necessary set of measures, which will contribute to a more hormonal restoration of the binocular function of the eyes.

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