



Problems in the Surgical Treatment of Concomitant Strabismus

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ABSTRACT

Surgical treatment of conjugate non-accommodative and partial-accommodative strabismus gives positive cosmetic effect in the majority of operated eyes (from 50 to 100%) according to different authors. Wide variation in the value of positive effect is associated with heterogeneity of functional state of operated eyes, age of operation, and follow-up time. Several methods of strabismus surgery (recession/cutting, muscle duplication, and adjustable sutures to the muscle) are currently used.

Keywords:

Concomitant strabismus, botulinum toxin, anisometropia

Introduction

There is little variation in treatment efficacy between different methods. Botulinum toxin injection into the thickness of the muscle is an alternative treatment. This method is currently less common and has several limitations and complications. The development of optimal methods for surgical correction of anisometropia in children is promising in improving the treatment of strabismus.

Conjoint (non-paraletic) strabismus refers to a condition when one of the eyes is permanently or periodically deviated from the common fixation point, which in almost all patients leads to binocular vision impairment. Binocular vision is impaired perception of the outside world, movement and spatial orientation. Only 1-3% of patients with strabismus may have binocular vision [Avetisov E.S.]. As a rule, this condition is noted in cases with a small angle of deviation of the eye and its prolonged existence. Strabismus may very often cause visual acuity to deteriorate more frequently in the squinting

eye. This condition is called dysbinocular amblyopia. Consequently, strabismus is not only a cosmetic defect, but it may also limit the professional abilities of the patient. Strabismus in both children and adults is both a psychophysical and social problem, making it difficult to establish social relationships. The prevalence of strabismus varies from 1% to 3% in preschool children according to different authors [1]. Age influences the heterogeneity in the prevalence of different types of strabismus [2,11]. Convergent strabismus (exotropia) is more common at an early age. Confluent strabismus (exotropia) occurs at an older age. According to Krasilnikov V.L. [9], the frequency of strabismus increases from 2.5 ‰ at the age of 3 to 14.9 ‰ at the age of 6.

Traditionally, strabismus is divided according to the nature of its origin into accommodative, partially accommodative and non-accommodative. Accommodation strabismus is usually treated conservatively. This involves the use of pleoptic, orthoptics and diploptic

techniques. Surgical techniques are included in the treatment package for partial accommodation and non-accommodation strabismus. For horizontal strabismus, surgery is performed on the horizontal muscles of the eyeball.

The aim of strabismus surgery is to achieve symmetry in or near symmetry of the eyes position necessary for developing binocular vision, increasing the visual field and achieving a better appearance as well as improving the patient's psychological state, which contributes to his/her self-esteem.

The absolute contraindications to the operation are: insufficient optical correction, paralysis of the sixth nerve with incomplete spontaneous regeneration and asymmetric binocular vision. A relative contraindication in children is amblyopia treated in advance.

The history of strabismus surgery goes back to the end of the eighteenth century [3, 13]. The first surgical interventions for horizontal strabismus (esotropia) were myotomies of the medial rectus muscle. Diffenbach of Germany performed the first formal myotomy in 1839. He was followed by many authors such as Roux, Velpeau in Paris and Bonnet in Lyon, the latter performing tenotomies instead of myotomies. In 1883 de Wecker described the muscular fold and Blaskovich described the muscular resection. Thus, by the end of the nineteenth century, the surgical treatment of esodeviation was supported by methods aimed at weakening the medial rectus oculi muscle (tenotomies, myotomies) and strengthening the lateral rectus oculi muscle (folding and resection). During the twentieth century, advances in anaesthesiology and the quality of suture material led Jameson (1922) to replace tenotomy with muscle recession. Since then, strabismus surgery did not undergo significant changes until 1970, when Koppers created the retro-equatorial myopexy. Thus, two types of surgical techniques are now available to surgeons: classic surgery, recession, resection and their variants. The traditional direct muscle access is described by Avetisov [1]. An incision of the conjunctiva and tenon capsule is made directly above the muscle in the vertical direction. The total length of this incision is 10-12 mm, and a continuous incision suture is

applied at the end of the operation. This incision is used quite often, as it allows easy and convenient work on the muscle to perform any manipulation. A dosage scheme for recession and resection depending on the magnitude of the angle of strabismus has been proposed [2]. An alternative to resection is the horizontal muscle fold. This method reduces surgical trauma and does not deliberately disrupt the ciliary circulation.

The operation can be performed on one or both eyes. There are some conflicting opinions among researchers in this regard. For example, LeeHJ et al [2,9] observed surgical results were better in the bilateral recession group than in the recession and crease antagonist muscle group. Group 2 showed a higher recurrence rate of exodecia, while group 1 showed a more stable course. Randomised controlled trials by other authors [3,6] showed that unilateral recession and resection of the medial rectus muscle were comparable to bilateral recession surgery in terms of postoperative outcomes in exotropia. However, unilateral recession/resection procedures in patients with exotropia ≥ 45 PD led to more favourable long-term results [9].

There are also conflicting opinions regarding small angle strabismus surgery. According to some authors, bilateral recession with alternating exotropia is the correct solution [2,3]. However, other authors [8] believe that resection (duplication) of the external rectus muscle in a hyperfunctioning state is more clinically effective compared to recession of the internal rectus muscle in a hypofunctioning state, and is the operation of choice. The Kraus recommendation to use a tightening suture technique for small angles is noteworthy [2,5].

Our preference in horizontal strabismus surgery for any angle of deviation is to start with recession of the hyperfunctioning muscle. The surgery is performed on both eyes. With residual deviation, the second stage is the resection of the muscles that are in a state of hypofunction in both eyes. Our experience shows that surgery on one eye can lead to a disturbance of the symmetry in the size of the eye gaps.

Over the last decades, various options for the use of tightening sutures have been proposed in

strabismus surgery [8]. A review of the literature shows that there is no evidence that adjustable sutures are preferable to non-adjustable sutures in cases of simple and predictable strabismus [1,8].

The Minimally Invasive Strabismus Surgery (MISS) approach has been proposed by the group [5]. This term is used for strabismus surgery that minimises tissue destruction. The muscles are not accessed through one large opening, but through several keyhole openings placed where necessary for the surgical steps. If necessary, tunnels are created between the incisions to allow for additional surgical steps. Transconjunctival suturing techniques are used to keep the keyhole holes small. The incisions are always placed as far away from the limbus as possible. This (according to the authors) will reduce the risk of postoperative corneal complications and ensure that all incisions are covered by the eyelids, thus minimising postoperative visibility and patient discomfort. The benefits of minimising the anatomical tears between the muscle and surrounding tissue include better preservation of muscle function, less swelling and pain, and easier reoperation. MISS openings allow for all types of strabismus surgery, namely straight muscle recessions, resections, creases, reoperations, retroequatorial myopexies, transpositions, recessions or creases of the oblique muscles, and adjustable sutures even with limited mobility. According to several researchers [1,9], the MISS method seems to be more effective in the immediate postoperative period, because there were fewer complications with conjunctival and eyelid edema. Long-term results did not differ between the two groups (wide opening of the conjunctiva and the MISS method).

Strabismus surgery can be accompanied by complications such as sclera perforation, muscle displacement, muscle loss, severe infection, scleritis, cysts on the conjunctiva, vision loss, and postoperative nausea. The frequency of these complications is very low. A group of authors performed an extensive analysis of possible complications of strabismus surgery [15]. The most common postoperative complication is hypoeffect, sometimes

hypereffect. Convergent strabismus changes into divergent strabismus, and vice versa [4,5,6,14]. A total of 60 complete reports of adverse events and complications were obtained during the study period. Approximately 24 000 strabismus operations were performed in the United Kingdom, giving an overall incidence of 1 in 400 operations (95% binomial confidence, 1 in 333-500 operations). The most frequently reported complication was ocular perforation (19 [0.08%]), followed by suspected muscle displacement (16 [0.067%]), severe infection (14 [0.06%]), scleritis (6 [0.02%]) and muscle mass loss (5 [0.02%]). Overall, complications were reported in equal numbers in adults and children; however, scleritis was significantly more common in adults. Poor or very poor clinical outcome was reported as 1 operation per 2400.

Damage to structures adjacent to the muscles and perforation of the sclera should be prevented by careful surgical technique and effective magnification (35). Orbital inflammation and anterior segment ischaemia can usually be treated effectively. Muscle slippage can be prevented with effective suturing, and "lost" muscles can usually be repaired. Conjunctival cysts and wound irregularities can be prevented by careful technique, although in some cases reoperation may be necessary. Postoperative alignment may be compromised by variability in preoperative measurements and long-term drift, especially toward exotropia. Postoperative nausea and vomiting may result from narcosis.

Postoperative administration: antibiotics and lubricating eye drops are administered during the first week after surgery. In the early postoperative period patients should be monitored for postoperative infection, conjunctival divergence.

Another form of strabismus correction is the injection of botulinum toxin into the muscle layer of the oculomotor muscles [2,4,7]. Botulinum toxin as a drug therapy was introduced by Dr Alan Scott over 20 years ago. The first clinical applications of botulinum toxin type A (BT-A) were for the treatment of strabismus and periocular spasm. Botulinum toxin type A is often effective in convergent

strabismus (esotropia) with small and medium angles for any reason and may be an alternative to surgery in these cases. The use of BT-A for strabismus varies widely between cities and countries with no apparent reason. Botulinum toxin type A may be particularly useful in situations where surgery for strabismus is undesirable. This may be in elderly patients unfit for general anaesthesia, when the clinical condition develops or is unstable, or if the operation is unsuccessful. Botulinum toxin type A can temporarily relieve symptoms in many cases of bothersome diplopia, regardless of the cause. Ptosis and acquired vertical deviation are the most common complications. Visual-threatening complications are rare. Repeated use of BT-A is safe. However, there is a case report [7] of haemorrhage into the vitreous body and retinal haemorrhage following injection of botulinum toxin into the extraocular muscle. A number of authors have successfully used Botox after traditional strabismus surgery to correct residual angles of strabismus. Based on long-term follow-up, several authors have concluded that botulinum toxin type A (BoNT-A) injections are indicated for treating different types of strabismus and oculomotor palsy. It is a short procedure that can reduce the effects of general anaesthesia, causes minimal scarring compared to surgery, and can be proposed as an early treatment for unstable strabismus [4]. Views on the optimal age of surgery for strabismus are also controversial. In 2005, a report was published on the results of the Early or Late Surgical Treatment of Paediatric Strabismus Study. According to this study, stereoscopic vision was better in children who underwent surgical treatment for convergent strabismus at an early age (6 months to 2 years) than in those who underwent surgery at an older age. However, the debate about the optimal timing of "early" surgery has been going on for almost 15 years [10].

The European Study[34] of Early and Late Childhood Strabismus Surgery (ELISSS) concluded that 13.5% of children operated on around 20 months of age, compared to 3.9% ($P=0.001$) of those operated on around 49 months, had gross stereopsis (Titmus Housefly) at 6 years. The reoperation rate was 28.7% in

children operated on early compared to 24.6% of those operated on late. Kashenko et al [7] analysed the results of surgical treatment of concomitant strabismus in adults. The authors found that surgical treatment contributes to restoration of symmetrical eye position, in most cases leads to elimination of functional scotoma suppression and creates conditions for binocular vision formation and functional rehabilitation of patients. Almost the same conclusion was reached by other researchers [11]. Aznuryan I.E. et al. analyzed the results of operation in 57 children with acquired strabismus, operated on according to their own technique [3]. They studied immediate and long-term (up to 12 months) results of internal straight and external straight muscle fold recession operations on one eye, dosed in accordance with "STRABO" scheme. After 12 months, correct eye position and stable binocular vision were obtained in all 57 children. KurupSP et al. [2,7] presented the results of surgical treatment of partially accommodative strabismus. Eighty-four patients were examined. Stereopsis using the TitmusStereoTest was demonstrated in 51 (61%) patients by the final visit. The mean follow-up time was 4.4 ± 2.8 years (0.8 to 11.0 years). Of 84 patients, 56 (67%) had a favourable location.

Our long experience [12,13] suggests that the optimal age for strabismus surgery in children is 4-6 years of age. With a normal anatomical structure of the eye, our observations suggest that binocular vision was restored in the long term (over 15 years) in almost all patients. One of the main causes of adverse outcomes of strabismus surgery is the presence of anisometropia. Therefore, the development of optimal methods for anisometropia correction in children is an urgent problem of modern ophthalmology. Strabismus surgery in adults gives good results in the absence of anisometropia. Diplopia which occurs after the operation in adults disappears with the lapse of time. Strabismus surgery in adults has many psychosocial benefits. This is reflected in the finding that the majority of surveyed adults with strabismus would spend part of their life expectancy getting rid of their strabismus [2,8].

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