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Monografía breve

The Functional Benefits of Adult Strabismus Surgery—It is Not Cosmetic!

Stephen P. Kraft, MD, FRCSC[1]
Department of Ophthalmology and Vision Sciences, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

Summary
Surgery for strabismus in adults (defined as persons above the age of visual maturity, or age 8 to 9 years) leads to many functional benefits, including relief of diplopia, eyestrain, headache, and torticollis, and reduced risk of injuries in the elderly. This paper briefly presents the functional benefits of non-surgical treatment, and then presents six lines of evidence that adult strabismus surgery is actually «restorative», or «reconstructive», therapy, and should not be labeled as «cosmetic». It also discusses additional myths or misconceptions about adult strabismus treatment and presents the truths about this condition.
Key words: *Adult strabismus, cosmetic, functional benefits, sensory anomalies, strabismus, surgery.*

INTRODUCTION

In this article, *adult strabismus* will refer to strabismus in patients who are beyond the age of visual maturity, which is generally considered to be age 8 to 9 years (1-3). References to adult strabismus go back as far as 2750 BCE and 300 BCE (4, pp 5-6), where effigies to deceased persons portrayed esotropia. It has been clear for many centuries that a person with an obvious eye deviation is considered «different».

The interpersonal and psychological problems faced by adults with noticeable eye turns have been well-documented for almost 200 years. In his text on strabismus, published in 1841, Alfred C. Post (1806-1886), an ophthalmic surgeon in New York, wrote:

> The most striking effect of strabismus is the deformity which it occasions, frequently subjecting the patient during childhood to ridicule and insult, and being throughout life a source of mortification and mental disquietude (5, p 13).

In fact, its negative effects on personality, leading to traits such as introversion, lack of confidence, avoidance of eye contact, and to employability concerns, can be felt as early as age 5 or 6 years (6,7). Having to bear such stresses throughout the formative years of life into the teenage years and beyond can have serious behavioral, social, and psychological consequences (8). These concerns justify the referring of patients with strabismus of any age for treatment.

Even though there is an extensive literature dealing with adult eye muscle disorders and their treatment, there are several misconceptions about the subject that are still prevalent among eye care professionals. A common belief is that adult strabismus treatment is mainly «cosmetic», with little functional gain for the patient (9-11). In fact, the term «cosmetic treatment» implies a change from a *normal* situa-

[1] Professor

tion to a *different* but *still normal* one (9,12). However, an eye turn is an *abnormal* anatomic and physiologic state, and realigning the eyes *restores* the binocular situation to a normal or less abnormal one. Therefore, the appropriate term for this correction is *restorative* or *reconstructive* therapy (9,12,13 p 566).

As a result of mislabeling the surgery as «cosmetic», effective therapy for adults with strabismus--particularly surgery--may not be offered or may be delayed for an unnecessarily long time due to lack of knowledge or awareness of its benefits on the part of the primary eye care practitioner or the patient (14). In addition, in recent years, reimbursement for surgeons for adult strabismus surgery has been at risk in some jurisdictions in North America because of the mistaken notion that it is only a cosmetic treatment (10).

Most eye practitioners would agree that relief of diplopia, pain, and asthenopia that result from strabismus are «functional» benefits. Non-surgical therapies have a good chance of reducing discomfort and disability for patients with symptoms related to their eye misalignment (11,15). However, there is less awareness of the value of surgical realignment of the eyes in adults, other than the obvious improvement in appearance. There is no doubt that realigning a misaligned eye generates a cosmetic benefit to the patient in terms of appearance, but much more important is the change from an *abnormal* motor and sensory situation to a more *normal* or natural one, which can achieve many functional benefits (10,11,13 p 566,16).

This article will discuss three topics:

1. A brief summary of non-surgical options for treating adult eye muscle problems.
2. The six categories of functional benefits of surgery for adult strabismus.
3. Other common misconceptions about treating strabismus in this age group.

NON-SURGICAL TREATMENT FOR ADULT STRABISMUS: FUNCTIONAL BENEFITS

Before presenting the case for the functional advantages of surgically realigning an eye in an adult, it is important to discuss the benefits of non-surgical and pre-surgical treatments. These modalities aim to relieve symptoms, as is the case with surgery when it is indicated. It should be clear that these interventions are far from «cosmetic» ones. Since the spectrum of treatments for strabismus extends from medical therapies through to surgery, it follows that the awareness of functional benefits should apply equally to both aspects (11).

There are several treatments other than surgery that can be helpful in treating the symptoms and signs of strabismus:

- «Tincture of Time».
- Optical therapy (lenses and prisms).
- Eye exercises.
- Occlusion.
- Pharmacologic agents.

There are several conditions that either resolve on their own or do not need active treatment, such as ocular motor nerve paresis due to microvascular cause and a microtropia that is not symptomatic. However, temporary treatment for diplopia may be needed in some patients. Another functional benefit of treatment is the relief of ocular-related torticollis due to an incomitant strabismus. Prisms, either temporarily applied (Fresnel) onto or ground into lenses, can control the diplopia and allow patients to continue performing daily activities of importance to them (17 pp 149-50, 18). Prisms can be incorporated into glasses as a long-term solution for diplopia in non-resolving muscle problems, with relief of any accompanying compensatory head posture.

Optimal correction of refractive errors is a mainstay in the treatment of strabismus conditions. This principle is especially important for anisometropia, high refractive errors, and significant astigmatism. Incorrect refractive corrections can cause a variety of symptoms including asthenopia, diplopia, headaches, and blurred vision (11). More specifically, there are eye muscle issues that can arise from refractive surgery and cataract treatment in adults (19-22). The most common symptoms experienced by these patients are diplopia and asthenopia. A large number of these problems can be relieved by ap-

propriate refractive correction. Determining the cause of symptoms in many of these cases can be challenging even for the most experienced ophthalmologist or orthoptist. Adult strabismus can cause post-operative binocularity issues for a sizable minority of patients of our refractive surgery and cataract colleagues. If surgery is required to solve them, then it is obvious that it is more than just a «cosmetic» issue.

There are specific disorders in which eye exercises are felt to be of proven value (23). These include simple convergence insufficiency, as well as convergence insufficiency combined with accommodative weakness. The latter requires a combined optical and orthoptic approach (24). Occasionally, surgery is the only reasonable alternative that will alleviate the symptoms of these conditions.

A last resort for troublesome diplopia or monocular diplopia that cannot be solved by surgical or non-surgical methods is blocking the vision of the deviated eye. Instead of a disfiguring patch, more appealing alternatives include a Bangerter filter, a MIN lens, or simple translucent tape. Use of occlusion creates a loss of binocular field and stereopsis, which can create functional difficulties for a patient who previously had binocular vision.

Finally, pharmacologic options used in adult strabismus include oral agents to treat such disorders as myasthenia gravis and inflammatory conditions. Recent trials have shown efficacy for immunomodulators in controlling the active orbitopathy in thyroid eye disease (25). These medications ease pain and discomfort associated with the eye muscle problem or the underlying disease, and at the same time may resolve the accompanying diplopia and other symptoms.

Agents injected directly into the extraocular muscles have been an alternative to strabismus surgery since the late 1970s to treat a wide variety of eye muscle problems. These include preparations that can selectively weaken or strengthen ocular muscles (26-28). These drugs can also be useful adjuncts to surgery in treatment of entities such as large-angle strabismus and in situations where there is a risk of anterior segment ischemia.

SURGICAL TREATMENT FOR ADULT STRABISMUS: FUNCTIONAL BENEFITS

Surgery is often needed to correct strabismus in visually mature patients. The benefits of this *restorative* surgery can be analyzed in six categories, each of which challenges any assumption that this is simply a cosmetic intervention:

- Eliminating symptoms.
- Regaining binocular vision (fusion and stereopsis).
- Restoring the static field (panorama) of binocular vision.
- Restoring the dynamic field of binocular single vision (BSV).
- Improving psychosocial functioning.
- Justifying the cost-effectiveness and quality-of-life benefits of adult strabismus surgery.

1. Eliminating Symptoms

Two of the most troublesome symptoms experienced by adult patients with strabismus are diplopia and torticollis. Compensatory head postures (CHPs) can occur in incomitant strabismus, strabismus fixus with misalignment of each eye, and nystagmus. Delays in addressing a surgically treatable posture can cause secondary musculoskeletal changes in the neck and spine, and possible osteoarthritis if it is chronic. Success rates of strabismus surgery in eliminating diplopia have ranged from 55 to 94%, with a mean of 71% (29). Surgery to correct strabismus or nystagmus can eliminate torticollis in over 80% of cases (30). A study of 299 adult strabismus patients showed that surgery led to significant improvements in non-work-related tasks of daily living (walking, driving, reading, and leisure activities), job-related problems, and eye-related symptoms (including diplopia, eyestrain, and vision-related headaches) (31).

Uncorrected longstanding strabismus and strabismus acquired later in life cause several functional disabilities in older patients. A large study of medicare beneficiaries in the United

States showed a higher incidence of falls and musculoskeletal injuries in those with strabismus (32). In addition, the deficits in binocular vision can adversely affect balance and posture control during walking and going up or down stairs. These deficits can be improved and the risks of falls reduced by realigning the eyes in both young and older patients (33,34).

2. Regaining Binocular Vision (Fusion)

A large body of literature has confirmed that up to two-thirds of patients beyond the age of visual maturity regain binocular sensory fusion. These studies utilized various tests of binocular function, including the Worth 4-dot test, Bagolini striated lenses, and Titmus or Lang stereotests (1,3,32,35-37). Another important finding from these studies is the fact that regaining fusion was not limited to patients who developed strabismus after the age of visual maturity. In fact, 50% of patients with onset of strabismus in childhood regained sensory binocular vision following surgery in the adult years, whether or not they had undergone previous surgery in the childhood years (1,36,37). Patients with strabismus show impaired binocular summation, a vision experience that requires straight eyes and good vision in both eyes. If one or both of these two factors are absent, the patient may have a visually disabling property called binocular inhibition. The summation can be restored when the angle of deviation is reduced to a small angle or eliminated. One neurosensory property that is dependent on summation is gait control, and patients who have strabismus have been shown to be below normal for ratings of posture and gait (9,38).

Many adult patients who undergo surgery and do not show sensory fusion on the conventional fusion or stereopsis tests postoperatively will still demonstrate a long-term small stable angle motor result (2). The maintenance of a small stable motor angle suggests that motor fusion may play a role in stabilizing the result, even in the absence of demonstrable sensory fusion.

3. Restoring the Static Field of Binocular Vision

One of the under-recognized benefits of adult strabismus surgery is the normalizing of the static binocular field of vision, or the «panorama» of the binocular field. This field can be measured on older instrumentation including the Goldmann or arc perimeter, or by using computerized visual field testing devices. This benefit is especially noticeable for patients with esotropia. Several studies have confirmed that the horizontal extent of the binocular field is truncated by up to 30% on one or the other side as a result of the eye being turned inward (9,10).

Losses of the static binocular field have been correlated with a higher risk of motor vehicle accidents (39). Successful surgery for esotropia restored the panorama of binocular field to normal in over 90% of patients in two series (40,41). Expansion of the field in the vertical direction is also possible after corrective eye muscle surgery on the vertical muscles (42). The functional benefits of these interventions on patients' confidence while driving, and the improved road safety, cannot be overstated (11,12,39).

4. Restoring the Dynamic Field of Binocular Single Vision

One of the most useful tests to document disability due to strabismus is the dynamic field of binocular single vision (BSV). The patient's field of fusion is plotted on a Goldmann or arc perimeter, or with automated perimetry, using either a spot or fusion target as the patient moves the eyes along meridians from the primary position into the periphery (43). The plot provides a diagrammatic depiction of the area of single vision and the region of the field in which the patient experiences diplopia. The field can be scored using a template that is weighted to the most important functional areas, which are the areas within 30 degrees of primary position and the downgaze field (43). Plotting and scoring the field of BSV help confirm the severity of the disability for insurance and medical-legal

purposes. These plots can also can quantitate the improvement in the diplopia-free field after strabismus surgery and, therefore, objectively demonstrate the benefits of the realigning of the eyes (12,16,43). The expansion of patients' fields of BSV correlates with their subjective feelings of improvement in activities of daily living including reading, walking up and down stairs, and driving (43).

5. Improving Psychosocial Functioning

Many studies in recent years have addressed the social and subjective disabilities of adults with strabismus. Amblyopia and strabismus impact negatively on adults' subjective visual function, well-being, self-image, interpersonal relationships, schoolwork, and enjoyment of sports (44,45). Up to two-thirds of surveyed strabismic adults reported adverse consequences at some time in their lives due to their eye condition (45). Strabismus creates a serious barrier to gaining employment, with the impact being more severe for female than for male applicants, and issues are worse for patients with esotropia than those with exotropia (8,46).

Successful alignment surgery can reverse many of these negative social and psychologic stresses (45). In one study, patients whose eyes were straight after surgery showed marked reduction in severity of disability indicators, when compared to patients who had noticeable residual deviations (31). Another report of 31 adults who underwent surgery for longstanding horizontal strabismus showed major improvements in several psychosocial indicators including confidence, attractiveness, self-esteem, sociability, and ability to relax in social situations (47).

6. Quantitating the Cost-Effectiveness of Adult Strabismus Surgery and Quality of Life Issues

Several well-designed studies have applied cost-utility analysis to support the premise that adult strabismus surgery is a cost-effective medical intervention. A large prospective study in the United States showed a mean value gain of 2.61 quality-adjusted life years (QALYs) after strabismus surgery in adults and a cost-utility of the surgery of US$1600/QALY, both of which represent «very cost-effective» values (48). A similar analysis in Japanese adult strabismus patients undergoing surgery showed an increase in 0.99 QALYs and a comparable excellent cost utility of US$1303/QALY (49). These values are competitive with the benefits calculated for cataract surgery and for vitrectomy for diabetic retinopathy (15,48).

Another parameter for measuring cost-effectiveness is a quality of life (QOL) questionnaire, which is a validated method to assess the personal impact of many different medical conditions. Questionnaires have been developed in the last 15 years to assess the impact of strabismus and diplopia on patients, and to quantitate the subjective improvements after eye muscle surgery. One study used the standard visual function-14 (VF-14) questionnaire, which is used to assess the QOL impact of several eye conditions. The authors found significant negative subjective and quantitative effects on QOL measures in adults with strabismus and amblyopia (44).

Other groups have shown a severe QOL impact of diplopia and strabismus on everyday activities such as reading, self-confidence, driving, workplace issues, and other aspects of daily living (50-52). These QOL deficits improve significantly after strabismus surgery both in short term and long term, even in patients without diplopia (51-53). Questionnaires have also been created to assess the specific impact of diplopia on activities of daily living as well as personality (54). Successful surgery shows a definite QOL benefit for patients affected with double vision (49,51,52).

OTHER MISCONCEPTIONS TO CORRECT

There are several other misconceptions about adult strabismus surgery that have to be addressed in order to dispel the claim that it

is cosmetic (9-11). All of these are longstanding reasons why patients with adult strabismus have been discouraged by some eye care practitioners from seeking treatment or being denied referral for possible surgery (11,14). The misconceptions include:

• Amblyopia in one eye can prevent many of the functional gains.

• Diplopia is commonly encountered as a long-term complication.

• Success rates for adult surgery are lower than in children.

1. Impact of Amblyopia on Gaining Functional Benefits of Surgery

Although it may seem counterintuitive, the presence of amblyopia is not an impediment to patients' gaining many of the benefits of strabismus correction, as long as the amblyopia is not severe (under 6/60). In two studies, the restoring of the static binocular field of vision was just as successful whether or not amblyopia was present (40,41). In addition, amblyopia did not limit the potential regaining of peripheral fusion in a large study of adults who underwent corrective surgery (36,37).

2. Risk of Diplopia after Strabismus Surgery

There is a myth among eye care practitioners that there is a high risk of diplopia after realigning the eyes in adults (11,14,36). For this reason, many patients are unnecessarily denied the chance for surgery or other alternatives to restore normal alignment (14). In fact, it is uncommon for patients who have successful surgery to suffer intractable and prolonged diplopia. This premise holds true irrespective of the duration and age of onset of the eye misalignment (1,16).

A retrospective study of more than 800 adult patients undergoing surgery showed that among patients whose eyes were aligned to within a few prism diopters of orthotropia, the incidence of chronic diplopia in primary position was only 1.4 % (1). Other studies have confirmed a low rate of chronic diplopia after corrective surgery, ranging from 1 to 7% among patients who did not report diplopia preoperatively (29). Although the risk of postoperative diplopia must be discussed with an adult before surgery, it should not be overstated to a patient who is deciding whether to go ahead with a procedure that has many potential benefits (16).

3. Success Rates of Surgery in Adults Compared to Children

The reported rates of success in adult strabismus surgery, in reducing the angle of deviation to a few prism diopters or less, range from 70 to 92%, with follow-up of up to 10 years after surgery (1,3,15,29,36,37). These rates are comparable to those for surgery in children. A recent prospective study showed that the rate of successful realignment in patients above the age of visual maturity was similar to the rate for those below that age (31). Furthermore, several studies confirmed that the duration of strabismus did not limit the potential improvement in the eye alignment, panorama of vision, or regaining of fusion (35,36,40,41).

CONCLUSIONS

Adults with strabismus have an abnormal sensory and motor state that leads to a host of physical and psychologic disorders as well as social disadvantages. Treatments for eye muscle problems in this age group include non-surgical and surgical options, which have a high rate of success in eliminating or significantly improving the accompanying motor and sensory anomalies and in treating ocular torticollis. These corrective measures reduce symptoms and lead to numerous measurable functional improvements that prove the *restorative*, or *reconstructive*, nature of these therapies. Finally, it is hoped that the evidence presented will end the erroneous labelling of surgery for strabismus in adults and older children as «cosmetic».

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