

The efficacy of strabismus surgery in adults: a review for primary care physicians

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ABSTRACT

Many adult patients with strabismus are under the misconception that nothing can be done to correct the problem or that treatment is associated with a high degree of risk. Moreover, many optometrists, comprehensive ophthalmologists and primary care physicians are similarly misinformed. In fact, most adult patients with strabismus can be successfully treated, with ~80% of patients achieving satisfactory alignment with one surgical procedure. In addition, adult strabismus surgery carries a relatively low risk, with serious complications being anecdotal and rare. The majority of adults will experience some improvement in binocular function after strabismus surgery even if the strabismus has been longstanding. Most commonly this takes the form of an expansion of binocular visual fields; however, some patients may also regain stereopsis. Consequently, strabismus surgery in adults is not merely cosmetic in most cases. There are many psychological and interpersonal benefits to adult strabismus surgery. These benefits are highlighted by the finding that the majority of adults with strabismus would trade a portion of their life expectancy to be rid of their ocular misalignment. Although adult strabismus surgery has been shown to be highly cost-effective, many adults with strabismus can be successfully managed by non-surgical means. If an adult with strabismus is under the impression, or was told, they cannot be treated, or that treatment is risky, they should consider a referral to an ophthalmologist specifically specialising in strabismus.

INTRODUCTION

Strabismus occurs relatively commonly in adults, with an estimated incidence of ~4% in the USA.¹ If an adult develops strabismus after visual maturity (~9 years of age), they will typically have diplopia. This presentation often occurs as the result of extraocular muscle paresis secondary to head injury, neurological disease, orbital fracture or Graves orbitopathy. In some cases it can be idiopathic or due to decompensation of a previously mild and asymptomatic latent eye muscle imbalance. My own clinical experience suggests that most patients with adult onset of strabismus, ie, accompanied by diplopia, are referred to appropriate eye care professionals for optical management with prisms or for surgery.

When an adult has strabismus that was either untreated in childhood or developed because of a recurrence of a childhood problem, they typically suppress one eye and do not see double. My experience with this patient population suggests that there are many misconceptions about the efficacy of treatment. These misconceptions include:

(1) nothing can be done for an adult with strabismus; (2) strabismus surgery is not effective in adults; (3) there is a high risk associated with strabismus surgery in adults including a substantial risk of intractable postoperative diplopia; (4) surgery is just 'cosmetic' and does not improve binocular function. A retrospective review of the pre-referral experience of the last 200 non-diplopic adults I operated upon consecutively with residual or recurrent strabismus from childhood substantiates my perception. Almost one-third of them were under the misconception for many years that nothing could be done for their strabismus. Most of these patients had been under the regular care of a primary care physician, and almost half had been under the regular care of an eye care practitioner, yet they had never been told that any correction of the strabismus was possible. Interestingly, thirty-two patients (16% of total) specifically reported that they had asked their regular eye doctor about surgical correction of their strabismus and were told that correction was not possible, there was a high risk of postoperative diplopia, or that surgery would be 'only cosmetic'. Of the 200 patients, 174 (87%) achieved excellent ocular alignment with one strabismus surgical procedure and were pleased with the outcome. Many expressed great dissatisfaction over the fact they had been misled for many years that correction was not possible or that it carried high risk. The purpose of this report is to address the aforementioned misconceptions about adult strabismus surgery, and to review success rates and risks of strabismus surgery in this population

SUCCESS RATES OF ADULT STRABISMUS SURGERY

Obviously adults with strabismus represent a heterogeneous population with respect to aetiology. The complexity of the strabismic conditions in this population is variable and encompasses some of the most challenging strabismic disorders, including paralytic strabismus, strabismus after prior surgery in childhood, strabismus after orbital trauma or tumours, and strabismus associated with Graves orbitopathy. As such, any success rate taken from a large heterogeneous series may not be applicable to any specific patient with a unique problem. However, a review of several large series of strabismus surgery in adults suggests that around 80% of patients will achieve satisfactory alignment with one surgical procedure.²⁻⁵ This success rate increases for those patients who undergo an additional surgical procedure to improve on an initial suboptimal outcome. Satisfactory alignment is generally defined as within 5° of perfect alignment, because misalignments that are less than 5° are

usually not noticeable to the untrained observer and will allow some degree of binocularity. Although adult strabismic patients with suppression, and who do not regain a high level of binocularity after surgery, may have less stability over time than those who do develop high level fusion, the majority do show stability of ocular alignment after surgery (figure 1).

SAFETY AND RISKS

Strabismus surgery carries a low risk with respect to mortality and morbidity. It is often performed under general anaesthesia, which carries an estimated mortality risk that ranges from less than 1 in 200 000 to 1 in 300 000 in the adult population.⁴ Increasingly strabismologists are performing strabismus surgery under regional or topical anaesthesia, which decreases that small risk even further. Serious vision-threatening complications such as endophthalmitis (intraocular infection) or clinically significant scleral perforations have been reported anecdotally, but are exceedingly rare.^{2 3}

Perhaps the biggest downside with adult strabismus surgery is more a limitation than a risk; not all patients achieve satisfactory alignment with one operation. This is not necessarily something to dissuade patients from having surgery, but something that needs to be part of the discussion that leads to informed consent. As previously stated, ~20% of adults will need more than one surgical procedure to attain satisfactory ocular alignment, depending on the nature of their strabismus.^{2 3} In my experience, most patients accept this limitation if they have a clinically significant and bothersome strabismus.

There is considerable misunderstanding about the risk of persistent postoperative diplopia in adults undergoing surgery to correct a longstanding strabismus. In one series of 424 adults undergoing strabismus surgery, only three patients (0.7%) developed persistent double vision after surgery.⁵ Furthermore, all three were known to be at risk of this rare complication based on preoperative sensory testing, yet they elected to have surgery anyway. A strabismus specialist who is knowledgeable about advanced aspects of sensory testing can tell with a high degree of certainty who is at very low risk of postoperative double vision. In almost all patients in whom this rare complication occurs, the symptoms subside with time or can be ameliorated with optical management or further surgery.

DOES STRABISMUS SURGERY IN ADULTS IMPROVE BINOCULAR FUNCTION?

Binocularity is the ability to blend together the slightly different images seen by the two eyes. Binocularity is not an all-or-nothing phenomenon; there are different grades or depths of binocularity. At its most highly developed level, it allows stereopsis, which is the highest grade of depth perception—the type of depth perception that can be appreciated with 3-D glasses. A minimum

requirement for any binocularity is near-perfect ocular alignment, with any residual deviation being less than 5°. Stereopsis not only requires excellent eye alignment, but also requires good vision in each eye. It is known that the single most important factor in determining if a patient with strabismus will regain stereopsis after strabismus surgery is the number of months of constant ocular misalignment; the longer the duration of the misalignment, the lower the chance of developing stereopsis.^{6–8} Children who develop infantile esotropia (an inward deviation of one or both eyes or ‘crossed eyes’) before 6 months of life rarely develop high levels of stereopsis if their eyes are not aligned by a year of age.^{9–11} However, many adults with strabismus may have had several years of proper ocular alignment in early childhood before the development of strabismus. Many of these patients will develop stereopsis if their eyes are aligned years later.¹² I have witnessed patients showing essentially normal stereopsis immediately after successful strabismus surgery, when their eyes had been misaligned for as long as 50 years.

Prior studies report that between 66% and 86% of adult patients undergoing strabismus surgery will develop an improvement in binocularity after surgery, and that some patients with longstanding strabismus and suppression can even develop high-grade stereopsis.^{1 12–15} It is reported that up to 75% of patients with longstanding strabismus with onset before visual maturity will show increased binocular fusion after strabismus surgery.^{1 13 16} In one study of 21 adult patients with a mean age of 59 years, 67% regained some stereopsis after strabismus surgery, and 44% regained high-grade stereopsis; none showed binocularity before surgery.¹⁴ In another study of 72 adults undergoing strabismus surgery, 51% showed an improvement in stereopsis after surgery.¹⁵ There are even reports of improved binocularity in patients with a history of infantile esotropia who undergo surgery as adults.¹

Stereopsis, however, is not the only hallmark of binocularity. Patients with esotropia who suppress one eye have a narrowed binocular visual field by about 25° on the side of the suppressed eye, when both eyes are open.¹⁷ This can easily be appreciated by the reader by looking straight ahead and closing one eye. It will immediately become apparent that peripheral vision is constricted on the side of the closed eye. When the eye is opened, there is a noticeable widening of the peripheral vision. Successful surgery to align an esotropic eye predictably results in an immediate widening of the peripheral visual field. In one consecutive series of 35 adults undergoing surgery for esotropia, 34 (97%) showed this binocular visual field expansion regardless of the duration of the strabismus, their visual acuity, or the presence of amblyopia in the misaligned eye.¹⁷ Amblyopia is decreased visual acuity that does not immediately improve with spectacle correction in the absence of a visible structural abnormality of the eye. It occurs when an eye has been suppressed due to either strabismus or an asymmetric refractive

Figure 1 (A) This 45-year-old woman has a large exotropia of her left eye which has been present since childhood. She suppresses her amblyopic left eye and has no binocularity. (B) At 52 years of age, 7 years after undergoing strabismus surgery, she still shows excellent ocular alignment.

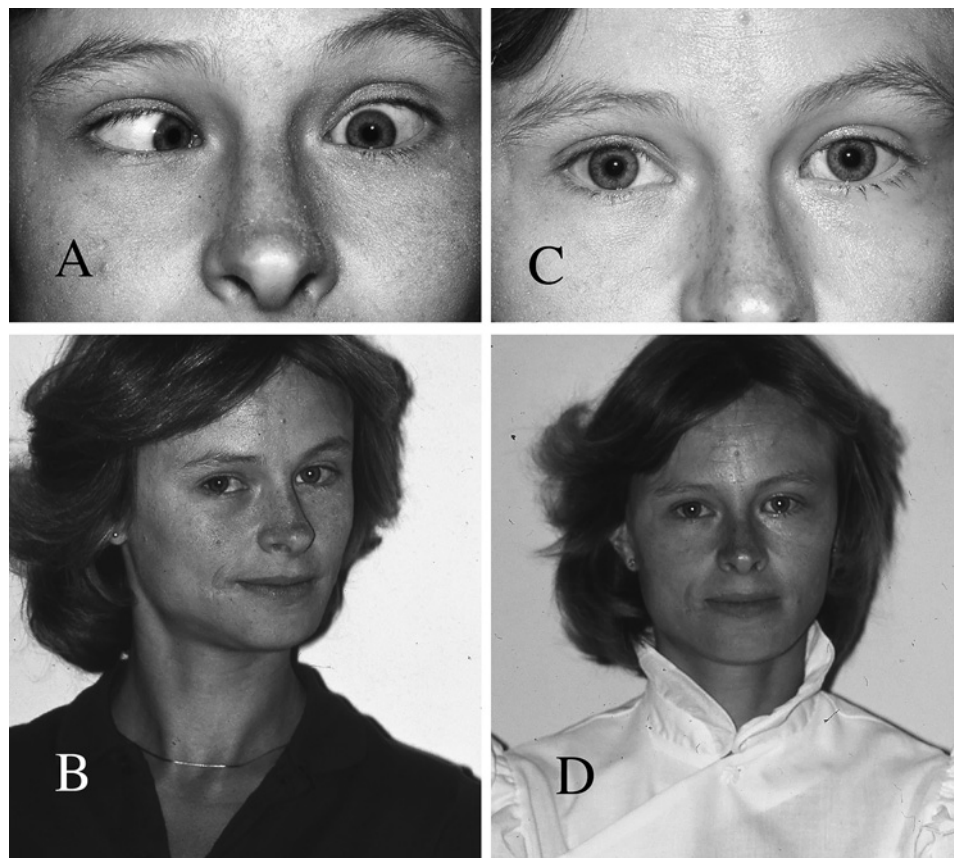


error. Binocular field expansion is not a trivial issue. It has been shown that visual field constriction correlates highly with an increase in motor vehicle crashes.^{18–20} In addition, strabismus surgery improves dynamic visual fields, which is important for activities such as navigating stairs or driving a motor vehicle.²¹ Interestingly, some patients with constant exotropia (an outward deviation of one or both eyes, or ‘wall-eyes’) have a ‘panoramic’ vision or wider binocular field, which may reduce to normal after the exotropia is corrected. In spite of this, I have never had an exotropic patient complain of this loss of panoramic vision after successful strabismus surgery.

It is reductionist to say that an adult with strabismus will not ‘use their eyes together’ if they are surgically aligned. As with other aspects of binocular function, ‘seeing with both eyes together’ is not all or nothing. Tests with a special device called the Bagolini lens can test if patients have peripheral binocular fusion—for example, seeing with both eyes together for objects in their peripheral visual field. It has been shown that, with this testing modality, 86% of adults with strabismus will develop peripheral binocularity if successfully aligned surgically, regardless of the nature of the strabismus or the presence of amblyopia.¹³ In addition, it was shown that developing peripheral binocularity was predictive of long-term stability in eye alignment after surgery.

Many patients with strabismus may compensate for the misalignment by adopting an abnormal head posture. This often occurs in patients with a palsy of cranial nerves III, IV or VI, as well as in misinnervation syndromes such as Duane syndrome, if the eyes are more satisfactorily aligned in an eccentric gaze. It also occurs in some patients with nystagmus, if the nystagmus damps (is less active) in certain gaze fields. A chronic head tilt or face turn can lead to cervical orthomuscular symptoms, which can be alleviated by strabismus surgery (figure 2).

Figure 2 (A) This 39-year-old woman has a paralysis of her left VIth cranial nerve which resulted from a motor vehicle crash. She is shown here attempting to look to her left. Her right eye fully adducts, but the left eye cannot move lateral to the midline. (B) Because her eyes are well aligned in right gaze, she assumes this large compensatory head face turn to the left to avoid double vision. (C) The same patient 1 year after strabismus surgery. Her eyes are well aligned. (D) One year after strabismus surgery she no longer needs to assume a face turn to avoid double vision.



PSYCHOLOGICAL AND INTERPERSONAL BENEFITS OF ADULT STRABISMUS SURGERY

There are mounting data that the presence of strabismus has serious and lasting effects of a psychological and interpersonal nature. Studies have reported that the majority of adults with strabismus feel that their ocular misalignment has substantial adverse effects with respect to their quality of life, self-image, interpersonal relationships, ability to secure employment, social anxiety and visual functioning.^{22–27} Adults with strabismus also showed higher levels of distress than age- and gender-matched controls.²³ These subjective impressions on the part of strabismic adults have been confirmed objectively. It has been shown that adults with strabismus are viewed with a significant negative social prejudice, are considered less intelligent, are less likely to be hired for a job, and are less likely to be promoted in the military.^{28–30} Dating agencies report that visible strabismus negatively influences the ability to find a partner.³¹ The importance of these findings is reflected in the finding that the majority of adults with strabismus would trade a portion of their life expectancy in return for being rid of strabismus and its associated effects.³²

Although these psychological and interpersonal issues do stem from having an abnormal appearance and abnormal eye contact, they are certainly real and go beyond being simply a cosmetic issue. Inability to get a job, or work in certain professions, is as much a physical handicap as having an orthopaedic or cardiovascular problem that prevents certain activities.

Is adult strabismus surgery ‘only cosmetic?’

Referring to strabismus in an adult as being a cosmetic problem can demean its significance. A cosmetic problem describes a feature that is perfectly normal, but one that a person is not happy with. It is not normal to have misaligned eyes. Surgery to

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correct strabismus corrects a pathological condition and does not merely enhance a subjective sense of beauty. As such it is better described as being restorative or reconstructive rather than cosmetic.^{21 33 34}

NON-SURGICAL THERAPIES FOR TREATING STRABISMUS

Many adults with strabismus can be managed with non-surgical modalities. These include proper correction of refractive errors, prisms, eye exercises and chemodenervation of extraocular muscles with botulinum A neurotoxin.³⁵ For example, the increasingly popular use of monovision (optically correcting one eye for distance and the other for near) to prevent the need for bifocals in patients with presbyopia can have a deleterious effect on ocular alignment.^{36 37} Elimination of the monovision state and prescription of a bifocal may reverse the strabismus. In addition, untreated or inadequately treated hypermetropia (far sightedness) is a common cause of decompensated esotropia in adults as they approach presbyopia—typically in their late 30s.³⁸ Proper correction of hypermetropia may correct the strabismus without surgery.

COST-EFFECTIVENESS OF ADULT STRABISMUS TREATMENT

Studies of adult strabismus surgery show it to be highly cost-effective, more so than adult cataract surgery.^{32 39 40}

SUMMARY

In summary, adult strabismus surgery is highly successful, extremely cost-effective, and carries a very low risk of serious complications. Correcting strabismus in an adult can have a positive effect on visual functioning, psychological and interpersonal metrics, and even ability to obtain employment. The

Key learning points

- ▶ Strabismus surgery in adults is highly successful.
- ▶ Strabismus surgery in adults carries low risk.
- ▶ Strabismus surgery in adults usually results in some improvement in binocular function.
- ▶ Strabismus in adults causes serious psychological and interpersonal issues.
- ▶ Correcting strabismus in adults is rarely 'only cosmetic'.
- ▶ Not all adults with strabismus require surgery for successful treatment.

Current research questions

- ▶ What new pharmacological agents will be able to effectively strengthen extraocular muscles?
- ▶ What is the role of orbital connective tissue in causing routine and complex strabismus?
- ▶ What surgical techniques and pharmacological agents can prevent the formation of fat adherence in complex strabismus reoperations?
- ▶ Can stability of eye alignment in Graves orbitopathy be predicted by MRI in order to allow earlier surgical rehabilitation?
- ▶ How can a paretic extraocular muscle be reinnervated, either electrically or via nerve transplantation?

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results are highly valued by patients. Many adults with strabismus are under the misconception that treatment is not possible, is risky, or carries a low degree of success. These misconceptions are often enhanced by eye care practitioners who are not fully aware of the success that is likely with adult strabismus treatment. If an adult patient has strabismus, consideration should be given to referral to an ophthalmologist who has specific expertise in treating adult strabismus.

SELF-ASSESSMENT QUESTIONS (TRUE (T)/FALSE (F); ANSWERS AFTER THE REFERENCES)

1. Intractable diplopia is a common occurrence after surgery in adults with longstanding strabismus.
2. If an adult has longstanding strabismus, surgical correction is only of cosmetic benefit.
3. The success rate of strabismus surgery in adults is fairly high.
4. Most esotropic adults will experience an expansion of their binocular field after strabismus surgery.
5. According to one study, the majority of adults with strabismus would trade a portion of their life expectancy in turn for being rid of their strabismus.

Competing interests None.

Patient consent Obtained.

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ANSWERS

1. F
2. F
3. T
4. T
5. T

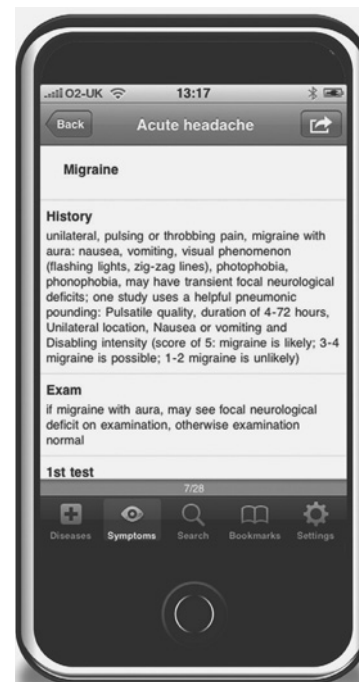
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