

Treatment options for adult strabismus

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In the past, misaligned eyes were considered to be only a pediatric problem. We now realize that it is a common problem in the adult population, affecting as many as 4% over the age of 15 years. There are multiple problems associated with this condition, including psychosocial problems, bias and discrimination, communication skills and adverse vocational opportunities. In addition, these patients may have significant physical handicaps, including double vision, suppression, loss of stereopsis and fusion, abnormal head posture and abnormal field of vision. Driving skills may also be impaired. There is often a long delay in appropriate strabismus correction in these patients due, in part, to antiquated professional advice. The importance of strabismus treatment in adults and the outlook for successful treatment with modern techniques is the rationale behind this review. The heartfelt overwhelming joy that patients express when told that their years of suffering may be over with modern treatment options is extremely moving.

Misaligned eyes in adults has increasingly become a focus of eye muscle doctors. Management of these problems can be difficult; however, good clinical and functional outcomes are now being reported [1–10]. The American Academy of Ophthalmology has recently stated that the surgical treatment of strabismus in adults is generally safe and effective [11]. Furthermore, some adults with strabismus can be treated without surgery (e.g., with glasses and/or prisms). Many reports have indicated that strabismus is associated with both functional deficits and psychosocial problems [4,12–17]. The normal function of the visual system requires that the eyes be properly aligned so that the image can be simultaneously perceived by the occipital cortex. Repositioning the eyes for normal function is not a cosmetic problem to beautify something that is already normal, such as a face lift. Many reports have shown that realigning the eyes does have significant success in re-establishing binocularity as well as returning psychosocial functioning to a normal realm. The following is a review of the problems of eye misalignment as well as advantages in correcting those problems.

Types

Adult strabismus can be categorized according to the age of onset. Those that occur in early childhood are referred to as before visual maturation onset (BVM) [18]. In BVM cases with amblyopia, strabismus surgery does not improve the amblyopia but may improve peripheral fusion. Those that occur after the ages of 9 or 10 years are

referred to as after visual maturation onset (AVM). Misalignment from childhood is usually associated with suppression of one eye (no double vision). With adult onset, suppression may be impossible with constant double vision.

Adult strabismus can also be categorized by the ability of the patient to control the deviation. The deviation can be constant, intermittent or well controlled but, in many cases, stressful to the patient.

It is also divided according to the direction of the deviation. It can be a crossing problem (esotropia [ET]) or an outward deviation (also known as wall-eyed), referred to as exotropia (XT). A vertical deviation is referred to as hyperopia (HT) and, by convention, we refer to the eye that is higher. RHT would refer to the right eye being higher or the left eye being lower. Likewise, the term hypotropia is used to indicate the eye that is lower. A cyclotropia refers to an eye that is rotated compared with the other eye. This can be excyclotropion or incyclotropion. Thus, you can have an intorsion or an extorsion that is often measured in degrees. ET, XT and HT are all measured in prism diopters, which are equal to approximately one half of a degree of visual angle.

Incidence

The approximate incidence of strabismus is 4% in the general population. In a country of 300 million, of which 240 are adults (16 years of age and older), one could surmise that there are almost 10 million adults in the USA with

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strabismus. This is certainly a very common disorder that may be seen in relatives, friends and in the public at large.

Importance of strabismus

One of the most common forms of nonverbal communication is eye contact. We all maintain eye contact when communicating with others. When there is a misalignment of one's eyes, it can lead to quite serious psychosocial problems [15–17,19,20]. People with this condition will often avoid eye contact. Studies have shown that people with strabismus report difficulty with self-image [12], securing employment [14], interpersonal relationships, school, work and sports [15]. These problems do not go away after childhood but continue into the teenage and adult years. Subjects have demonstrated higher levels of distress on the Hopkins Symptom Checklist compared with controls [17]. Strabismus creates a significant negative social prejudice and can have a detrimental impact on socialization and employability. Drivers with esotropia have limited temporal peripheral vision. Traffic accidents and conviction rates are twice as high in these patients as in those of age- and sex-matched controls [21].

In addition to the above areas of concern, there have recently been a number of quality-of-life (QoL) studies to determine the importance of good eye alignment to the QoL of the patient. The average adult strabismus patient undergoing surgery would give up 10% of his remaining life expectancy to be rid of his strabismus problem. The level of importance of this condition to patients is comparable with that of a mild stroke. The improvement in the quality-adjusted life years (QALYs) comes at a cost of approximately US\$3000–6000 per surgery. With a mean life expectancy in these patients of 36 years, the cost per QALY (3.6 years) is approximately US\$1632 [22]. In the USA, treatments with an associated incremental cost utility of US\$50,000 per QALY or less are generally considered 'very cost effective'. Thus, adult strabismus is a very significant problem for these patients and is cost effective to correct.

Past attitudes

Old attitudes have persisted despite extensive research and advancement in the treatment of adult strabismus.

Such misguided impressions have been:

- Nothing can be done about misaligned eyes after a certain age

- Straightening the eyes will cause double vision
- Straightening the eyes is only cosmetic
- The problem will always come back
- The eye surgery is very risky
- Eye muscle surgery is not very successful
- This surgery is very painful
- Many patients are too old to have this done
- Patients should just get used to this handicap
- Eye-alignment surgery requires extensive hospitalization and long-term curtailment of normal activities
- Eye-alignment surgery involves removing the eye, adjusting it and putting it back in the socket

Patient comments regarding their misaligned eyes

Patient comments regarding their misaligned eyes include:

- Who would want to hire someone with an obvious and distracting disfigurement?
- At a grocery store checkout line, a six-year-old boy points at you and, in a loud voice, says "Mommy, what's wrong with that lady? Her eyes are crossed"
- I cannot bear to look at myself in the mirror
- Are you looking at me or that wall?
- People think I'm dumb
- Why didn't somebody tell me this could be fixed
- I was told nothing could be done. That makes me angry
- My crossing has prevented me from getting an advancement in my job
- At business meetings, I find it very difficult to look people in the eye

New attitudes

Over the past 10–15 years, there have been extensive studies published regarding adult strabismus. In patients with misalignment but no double vision before surgery, persistent double vision occurs in less than 1%. None of the patients developed double vision after surgery if no double vision occurred with corrective prism before surgery [23]. According to one study, 86% of patients will regain binocularity following strabismus surgery; even those with amblyopia have binocularity in 68% [6]. Improved field of binocularity occurs in esotropic patients [5,10]. Those with abnormal head tilting or turning clear in the majority of cases. There is improved psychosocial functioning and better opportunity

for employment and economic success [12,14,24]. A significant improvement of alignment occurs in more than 80% of this age group [2,18,25].

In a joint statement of the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) and the American Academy of Ophthalmology, strabismus was defined as an abnormal condition. Strabismus surgery seeks to restore or reconstruct normal ocular alignment and is not a surgical enhancement for cosmesis.

Indications for strabismus surgery include diplopia, which can occur particularly in adults with misalignment developing after visual maturation. This is particularly the case in medical or neurologic conditions, such as diabetes, Graves disease, brain tumor, head trauma or stroke. The surgeon strives to align the eyes and eliminate diplopia in the primary position and into the periphery as much as possible. Many patients can still find a corner of their vision where diplopia may persist. Another concern is newly developed strabismus in adults, which may represent an emergency.

Goals of treatment

Goals of strabismus treatment include:

- Elimination or reduction of any constant or intermittent misalignment of the eyes
- Elimination of visual confusion, defined as having two different images superimposed onto the same space, which is particularly a problem for driving, especially at night
- Restoration of binocular vision occurs in the majority of patients, giving some depth perception
- Elimination of preoperative diplopia
- To eliminate intolerance of prism glasses or patching
- Restoration of the field of vision, particularly for esotropic patients
- Elimination of abnormal head posture, particularly in patients with adult onset strabismus associated with a compensatory head posture, such as a face turn or a head tilt
- Improve psychosocial and vocational status

Types of treatment

There are several ways of improving strabismus in adults, including the use of glasses, prisms, botox injections, patching and surgery. Surgery involves weakening an eye muscle, usually by detaching the muscle at its insertion and reattaching it closer to its origin. The muscle can be resected or tightened by placing a suture

several millimeters from its attachment to the globe and, after resecting the terminal portion of the muscle, the suture is reattached to the original insertion site, thus strengthening the muscle. Muscles can also be transposed to different parts of the globe or even to the bony orbit in rare cases.

Advances in surgical treatment

Over the last 15 years, there have been many advances in the treatment available and in the understanding of the results of strabismus surgery. Patients can be put to sleep for a brief period, usually less than 1 h in most cases. This procedure can also be carried out under a local anesthetic, where the patient is kept semi-awake but the eye is deadened with an anesthetic. These patients do not see or feel any aspect of the surgical procedure. We now know the importance of a good preoperative health check to be sure patients can tolerate the procedure or modify appropriately. Adjustable sutures are being used where the suture controlling the position of the eye is adjusted sometime during the postoperative period before the muscle becomes scarred back firmly to the eye. Most surgeons perform this in the operating room at the time of surgery, in the recovery room after surgery or in the doctor's office a day or two later. Some have adjusted a muscle 3–7 days postoperatively by returning to the operating room in the rare situation (incidence <5%) where there is a significantly unexpected result. This may cause less discomfort than adjustment in the office but may be less precise. Most patients are pleased to know that there are two chances to make the adjustment as accurate as possible. Still, changes can occur as the eye heals over a period of months, necessitating further correction.

Another new development is the introduction of minimally invasive muscle surgery. A better understanding of the ultimate outcome of strabismus surgery is being enhanced using computer-based outcome studies. The strabismus surgeon now has many new techniques available to modify his surgical approach, such as marginal disinsertion and posterior fixation sutures.

Prognosis

Most patients obtain significant improvement from adult strabismus therapy [2,18,25]. However, each case has its unique characteristics and therapy must be individualized. Most patients can get back to their normal activity within 2–3 days. In 2–3 weeks, the majority of the

redness will be gone and, within 2–3 months, most cases will be completely healed. There are probably 25% of strabismus patients who will need some further treatment sometime during the rest of their lives; however, this further treatment is usually possible. In general, strabismus surgery is safe and has a low rate of complications. In addition to the risks associated with anesthesia, persistent double vision occurs in less than 1% of patients who did not have double vision before surgery.

Availability of care

There are currently approximately 1000 strabismus specialists in the USA, most of whom are interested in helping adults with strabismus problems. For further information about an adult strabismus specialist in your area, please contact your own eye doctor. They will know who is specializing in this specific area. You can also get further information from the American Association for Pediatric Ophthalmology and Strabismus website [101]. They have a directory as well as a section devoted to adult strabismus.

Future research

This is one area where there is a great deal of research and advancement ongoing. Ophthalmologists recognize the importance of this field and the tremendous cost benefit of resolving these problems for their patients. There is still a lack of randomized, controlled trials comparing

different techniques. Also, most studies report process rather than outcome variables, which are most relevant for our patients. Therefore, a more patient value-oriented measurement of outcomes would be welcome. One advancement is the introduction of the Amblyopia and Strabismus Questionnaire [26,27].

Another promising development is in the evolution of chemodenervation agents [28,29], such as ricin, which has a longer effect (>2 years) than botox and which may be titrated, or chemoconstriction agents.

Conclusion

Medicine has and continues to change dramatically. Life expectancy was 47 years of age no less than 100 years ago. As recently as 25 years ago, the accepted attitude was that nothing can or should be done about adults with misaligned eyes. Over the past 17 years, there has been a plethora of enlightening articles on the possibilities, techniques, outcomes and benefits of correcting misaligned eyes in adults. This area of medicine has kept up with the advances in other areas of medicine. Educating ourselves and the public will help end this scourge in the lives of these patients. Further information, including a bibliography on this topic, can be found on the Adult Strabismus section of the AAPOS website [101].

Future perspective

Up-to-date medical information seems to travel slowly in many corners of medicine. However, I would predict that the next 10–15 years will see a major shift in the attitudes of the public from an appearance-only benefit to a functional benefit in the treatment of adult misaligned eyes. There will be a great deal of research into the genetic basis of strabismus as well as manipulations of the muscle myofibrils to alter the course of strabismus. One major advancement has been the better understanding of the use of muscle pulleys, which may lead to a better surgical approach [30,31]. This should lead to an advancement of surgical techniques to more accurately correct the huge variety of strabismus patterns that occur. Our results will be further enhanced when a computerized database of evidence-based outcomes becomes available. There will be a marked increase in the number of pediatric strabismus specialists who also care for the adult population. We anticipate there will be as many advances in this field over the next 17 years as there has been over the past 17.

Executive summary

- Misaligned eyes in adults can be treated at any age.
- Misaligned eyes in adults can be long-standing from a childhood problem or of recent onset due to a medical problem.
- Good eye alignment facilitates both good vision and binocular vision.
- Eye misalignment often impairs the patient's self-image and social confidence due to poor eye contact.
- Strabismus creates a significant negative social prejudice impacting socialization and employability. This problem is magnified in third-world countries.
- Improved alignment postoperatively occurs in more than 80% of these patients.
- In patients who have no preoperative double vision, intractable postoperative double vision is a very rare complication.
- Treatment options include glasses, prisms, botox, surgery and patching.
- There is a tremendous need to educate the medical community and the lay public that adults with strabismus can be treated.

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Website

101. American Association for Pediatric Ophthalmology and Strabismus www.aapos.org