

Strabismus

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Dear Colleagues,

In this issue of *eye Insights*, we highlight two treatments for the management of strabismus: botulinum toxin and adjustable sutures. We include indications for their use, techniques to incorporate them into practice, and outcomes. A list of peer-reviewed journal articles is included for further reading.

According to the American Association for Pediatric Ophthalmology and Strabismus (AAPOS), it is estimated that 4% of the U.S. population has strabismus. Pediatric ophthalmologists and adult strabismus surgeons specialize in the delicate eye muscle surgery required to align the eyes. For a list of doctors who specialize in strabismus, please visit the online AAPOS directory.

We hope you find this issue of *eye Insights* useful in your practice. Back issues are available online at masseyeandear.org. If you have questions or comments, please email us at eyeinsights@meei.harvard.edu.

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What is Strabismus?

Strabismus is misalignment of the eyes. It is described by the direction of the misalignment:



The causes of strabismus in children and in adults are varied and include:

- A third, fourth, or sixth cranial nerve palsy
- Muscle infiltration in thyroid eye disease and idiopathic orbital inflammatory disease
- Congenital dysinnervation syndromes (e.g. Duane retraction syndrome)
- Traumatic orbital or brain injuries

Many cases can be idiopathic.

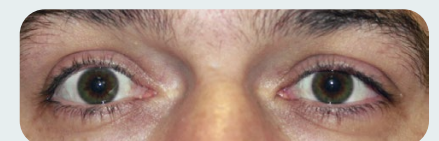
Those who are born with strabismus often develop amblyopia, a maldevelopment of vision, if left untreated.

In addition to problems with vision, strabismus affects a person's appearance and communication because it diminishes one's ability to make eye contact. Adults with strabismus have reported that their self-esteem, communication, driving, and reading skills have improved with successful treatment.

Correcting Esotropia



Before



After

Correcting Exotropia



Before



After



ASK THE
EXPERT

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TREATMENT OPTION

Botulinum Toxin

Botulinum toxin (BT) for the management of strabismus was approved by the FDA in 1989 based on work by pediatric ophthalmologist Alan B. Scott, MD. BT can be the first-line treatment for certain forms of strabismus.

Indications

Acute comitant esotropia in children: BT can be injected to both medial rectus muscles early in the disease process. Treatment is noninferior to surgery, has lower cost and total anesthesia time, and is quicker to schedule than traditional incisional surgery.

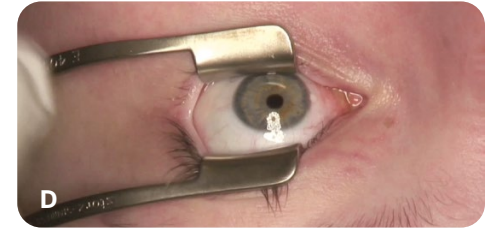
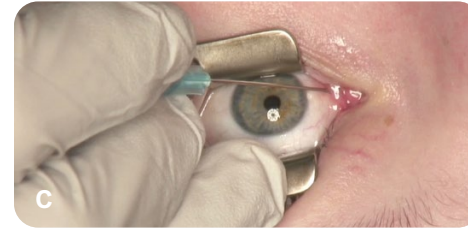
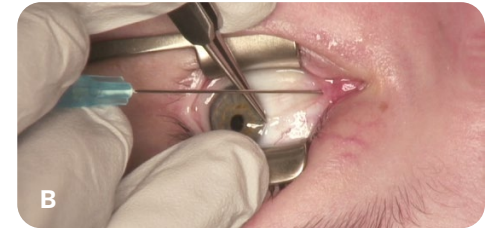
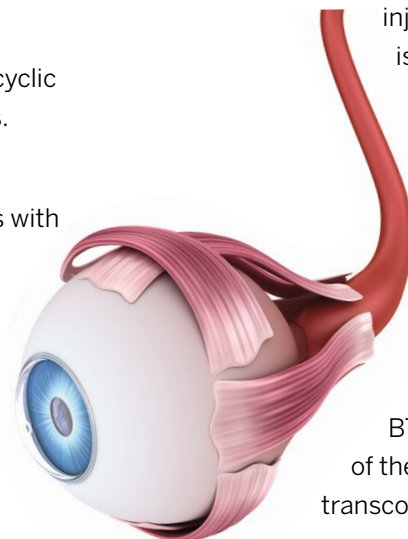
Congenital esotropia: BT can have a high success rate as a primary mode for treatment of congenital esotropia less than 30 prism diopters. It can also be used to augment medial rectus recessions in very large-angle esotropia.

Strabismus in patients with thyroid-associated orbitopathy: BT can be used early in the disease process, when the angle of strabismus is small and might not have stabilized.

Acute 6th nerve palsy: Even though the use of BT can be controversial in acute 6th nerve palsies, it can be considered in children to maintain binocularity as well as in adults who are bothered by the double vision.

Cyclic esotropia: BT can eliminate the cyclic deviation in this rare form of strabismus.

Variable strabismus in the setting of neurodevelopmental delays: Patients with neurodevelopmental delays may have variable angles of strabismus, making it difficult to devise a surgical dosage plan for incisional surgery. In such cases, BT can decrease the angle of strabismus over time, titrating the injections to the desired result.



A patient receiving botulinum toxin for the management of strabismus.

Technique

The most commonly used preparation of BT for the management of strabismus is onabotulinumtoxin A (Botox®, Allergan). BT can be diluted to either 5 units/0.1ml or 5 units/0.05ml and injected using a 27-gauge, 1.5-inch needle.

Adult patients: The injection can be performed with topical anesthesia. In the past, an electromyographic-guided needle has been used, but it is cumbersome and not required to safely and accurately inject. After a topical anesthetic has been administered, a cotton-tipped applicator soaked with the anesthetic can be applied over the

injection site while the patient is looking away from the muscle that is being treated. The injection is carried out transconjunctivally directly into the belly of the muscle.

Pediatric patients: General anesthesia is required to safely inject BT directly into the belly of the extraocular muscle transconjunctivally. This can be

done either by holding the muscle with toothed forceps or by rotating the eye in the opposite direction of the muscle.

Outcomes

BT injection has a high success rate of more than 85% for the management of acute comitant esotropia in children. For congenital esotropia less than 30 prism diopters, the success rate is about 75% after a single injection. Additional injections might be required over time.

Further Reading

Wan MJ, Mantagos IS, Shah AS, Kazlas M, Hunter DG. Comparison of botulinum toxin with surgery for the treatment of acute onset comitant esotropia in children. *Am J Ophthalmol.* 2017;176:33-39.

Wan MJ, Gilbert A, Kazlas M, et al. The effect of botulinum toxin augmentation on strabismus surgery for large-angle infantile esotropia. *Am J Ophthalmol.* 2018;189:160-165.

Escuder AG, Hunter DG. The role of botulinum toxin in the treatment of strabismus. *Semin Ophthalmol.* 2019;34(4):198-204.

TREATMENT OPTION

Adjustable Sutures

Standard strabismus surgery involves altering the position or length of the extraocular muscles to improve ocular alignment. The muscle is reattached to the globe at a set position.

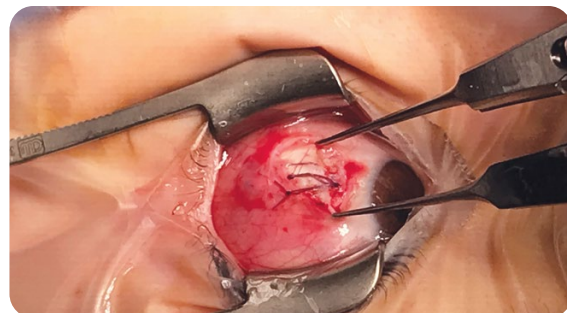
The adjustable suture technique was introduced to refine the result immediately after surgery in both adults and children. It is the favored technique at Boston Children's Hospital and Massachusetts Eye and Ear for complex strabismus cases.

Indications

- Complex strabismus in adults and children, including but not limited to:
 - Paretic strabismus
 - Restrictive strabismus (e.g., thyroid-associated orbitopathy, congenital fibrosis of the extraocular muscles)
- Strabismus surgery to eliminate double vision
- Re-operations

Technique

Strabismus surgery with adjustable sutures is similar to nonadjustable surgery and is most commonly performed under general anesthesia. After adjustable sutures are placed, patients may be evaluated immediately and up to one week postoperatively to determine whether the position of the muscle requires adjustment.



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A patient receiving adjustable sutures with the short tag noose technique for the management of strabismus.

Adult patients: The adjustment may be performed under topical anesthesia in an office-based setting.

Pediatric patients: The team at Boston Children's Hospital and Massachusetts Eye and Ear has developed a protocol to perform a propofol-based sedated suture adjustment. This uniquely allows the team to offer this technique to the youngest patients.

Outcomes

Although the adjustable suture technique was popularized in the 1970s, the approach has been refined to allow for delayed suture adjustment within postoperative week one and for sedated suture adjustment when needed. Currently, level I evidence comparing surgical outcomes between adjustable versus nonadjustable techniques does not exist. Nevertheless, multiple large,

retrospective comparative studies suggest a better success rate in strabismus surgery when adjustable sutures are used. This is especially true for complex strabismus cases.

Further Reading

Nihalani BR, Whitman MC, Salgado CM, Loudon SE, Hunter DG. Short tag noose technique for optional and late suture adjustment in strabismus surgery. *Arch Ophthalmol*. 2009;127:1584-1590.

Nihalani BR, Hunter DG. Adjustable suture strabismus surgery. *Eye (Lond)*. 2011;25:1262-1276.

Zhang MS, Hutchinson AK, Drack AV, Cleveland J, Lambert SR. Improved ocular alignment with adjustable sutures in adults undergoing strabismus surgery. *Ophthalmology*. 2012;119:396-402.

Phanphruk W, Alkharashi M, Bilge A, Hunter DG. Sedated suture adjustment in children undergoing adjustable suture strabismus surgery. *J AAPOS*. 2017;21:196-200.

Kassem A, Xue G, Gandhi NB, Tian J, Guyton DL. Adjustable suture strabismus surgery in infants and children: a 19-year experience. *J AAPOS*. 2018;22:174-178.e1.



Referral Guidelines

Patients with variable or complex forms of strabismus likely benefit the most from the adjustable suture technique. Ophthalmologists may consider referring these patients to a pediatric ophthalmologist and adult strabismus surgeon who can incorporate the use of adjustable sutures and botulinum toxin into the approach to strabismus.

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