Literature Review

Literature Review: Treating Pediatric Patients with Amblyopia, Acute Acquired Comitant Esotropia, and Small-to-Moderate Angle Intermittent Exotropia

Marc Taub, OD. MS, EdD

Randomised trial of three treatments for amblyopia: Vision therapy and patching, perceptual learning and patching alone (Published by: *Ophthalmic Physiological Optics,* 2025)

Authors: Rosa Hernandez-Andres, Miguel Angel Serano, Adreian Alacreu-Crespo, Maria Jose Luque

Amblyopia is about more than simply visual acuity. The condition impacts sight, binocular vision, accommodation, eye movements and perceptual skills. Traditional treatments include patching, atropine and vision therapy.

New to the treatment paradigm is the use of computer-based programs, including those using virtual reality to encourage binocular vision. This study compared three treatments (patching, patching combined with vision therapy and perceptual learning) vs. a control group.

Eighty-eight children aged four to 12, with a mean age of 7.11 ± 2.19 years, were recruited for the study. The children with amblyopia (n=52) were randomly assigned to one of the three treatment groups. Inclusion criteria for the amblyopic group were monocular amblyopia with spherical refraction up to +/-9 compensated with spectacles, interocular difference in VA (IOD-VA) ? 2 lines, strabismus up to 35pd, and no other surgery other than for strabismus. Those taking medication that might impact visual or cognitive functions, or those with neurological/developmental disorders or ocular pathology, were excluded.

Patching was performed after school under adult supervision for 2 hours per day. Monocular perceptual learning took place via a program designed by the authors. An achromatic schematic face (eyes, mouth and circular outline) was superimposed on a noisy achromatic background. The participants were instructed to click on the smiling face. As a prize, the children received stars for the correct clicks. Visual acuity was based on the entering visual acuity in the amblyopic eye, and contrast was progressively reduced based on performance. After 3 months, the duration of gameplay was increased to 24 hours for children between ages four and six and 36 hours for older children.

The patching and vision therapy group also patched for 2 hours after school, but for only 3 days per week. This group also completed monocular activities at home (20 minutes if younger or 30 minutes if older) in three categories of activities: accommodation (Hart chart at three distances), eye-hand coordination (filing in letters, mazes), and ocular motility (Marsden ball, pursuit eye movements with a penlight). Every 2 weeks, the supervising adult was given new activities. The outcome measures were visual acuity, stereoacuity and IOD-VA. Their treatment period was also 3 months.

Statistically significant changes were observed between the three variables for all three treatment groups. The patching group showed the smallest effects in visual acuity and stereoacuity. Compared to the control group, all variables showed significance except stereoacuity for the patching group. In comparing the three groups, visual acuity showed significance between the patching vs monocular perceptual learning and the patching vs patching + vision therapy. Compared to baseline, the patching + vision therapy group showed the greatest gain in visual acuity; both monocular perceptual learning and patching + vision therapy showed the largest gains in stereoacuity, and monocular perceptual learning demonstrated the greatest improvement in IOD-VA.

This study demonstrates the importance of active treatment in the approach to amblyopia, as the improvement in visual acuity, stereoacuity and IOD-VA was greatest in either the monocular perceptual learning or patching + vision therapy groups. One interesting point to consider is how the two treatments were both monocular, and yet there was a binocular impact as seen in the stereoacuity. If this transfer were possible, it begs the question of the effect of binocular vision therapy or perceptual learning, either with or separate from patching. With the influx of computer-based binocular programs or a vision design focusing on a binocular approach, this is a logical next step.

(Reference: Ophthalmic Physiol Opt. 2025 Jan;45(1):31-42. doi: 10.1111/opo.13395. Epub 2024 Oct 12.)

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Three-year Outcomes of Botulism Toxin Versus Strabismus Surgery for the Treatment of Acute Acquired Comitant Esotropia in Children (Published by: *American Journal of Ophthalmology,* 2025)

Authors: Michael TB Nguyen, Crystal SY Cheung, David G. Hunter, Michael J. Wan, Ryan Gise

A child with esotropia in the chair can strike fear in the hearts of even the toughest optometrist. After ruling out the worst-case scenarios like brain tumors, optometrists ultimately have to diagnose and provide the most appropriate treatment.

Depending on the nature of the esotropia, traditional treatments include plus lenses, surgery or even vision therapy. A newer treatment involves injecting the intraocular muscles with botulinum toxin (BTX). BTX is less invasive, less expensive and allows for more expeditious treatment. This study compared BTX and traditional surgery in a population of children with esotropia.

A record review of patients who underwent treatment for esotropia between 2000 and 2020 for acute, acquired comitant esotropia was completed at Boston’s Children’s Hospital. Two treatment options were compared: BTX and traditional strabismus surgery. For the BTX group, the toxin was injected into both medial recti muscles under general anesthesia. In most cases, five units of botulism toxin were used. The patients were between two and 10 years of age at the time of onset and were required to have at least 36 months of documented follow-up. Also required in the documentation was the onset had to occur within 6 months of the initial assessment.

Exclusion criteria included previous treatment with either BTX or surgery, the presence of neurological/developmental abnormality, relevant pathology based on imaging, greater than 3D of hyperopia, or greater than 10pd reduction in magnitude with hyperopic correction. The primary outcome was success at 36 months, which was defined as: 1. 10pd or less horizontal deviation measured by prism-and-alternate cover test; 2. Retreatment within 36 months (BTX or surgery); 3. Evidence of binocular vision based on the Titmus fly test or fusion on the Worth 4 dot at 1/3m.

The success rate was significantly higher in the BTX group (89%) than the surgery group (59%) at 6months (p=.005) but there was no difference at 36 months (BTX, 72% vs surgery, 56%; p=.24). At both

6 and 36 months, the median deviation and median stereoacuity were not significantly different. At 6 and 36 months, five of 44 and 12 of 44 patients failed treatment in the BTX group; eight of these patients underwent retreatment. In the surgery group, these values were 13 of 32 and 14 of 32 in the same periods, respectively, with 10 patients receiving retreatment. No serious or permanent complications from either treatment were recorded. Postoperative ptosis was found in 45% and exotropia in 48% of the BTX group, with an average resolution of 6 weeks and 5 weeks, respectively. Of note, the time from onset to assessment, onset to treatment, and assessment to treatment were all significantly lower in the BTX group.

The authors concluded that botulism toxin treatment was noninferior to traditional surgery at 36 months. While “noninferior” is being used statistically by the authors, the BTX group showed a higher success rate and a lower rate of retreatment. Those children were identified earlier, and treatment provided quicker.

Based on the results of this retrospective study, I would go one step further than the authors in their conclusions that BTX should be considered the first-line treatment for acute, acquired comitant esotropia in children younger than 10 years of age. This topic should be broached and discussed with parents before an ophthalmological referral. Finding a specialist who offers this treatment is also crucial. A prospective study would be the most logical next step for these authors.

(Reference: Am J Ophthalmol. 2025 Apr:272:1-7. doi: 10.1016/j.ajo.2024.12.025. Epub 2025 Jan 3.)

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Effect of office-based vergence and anti-suppression therapy on binocular vision and accommodation in small-to-moderate angle intermittent exotropia: A randomised clinical trial (Published by: *Ophthalmic Physiological Optics,* 2025)

Office-based vergence and anti-suppression therapy for the treatment of small-to-moderate angle intermittent exotropia: A randomised clinical trial (Published by: *Ophthalmic Physiological Optics,* 2024)

Authors: Martin Ming-Leung Ma, Ying Kang, Mitchell Scheiman, Qiwen Chen, Xuelian Ye, Liuqing Pan, Jiayu Deng, Guangxing Su, Guohui Zhang, Xiang Chen

Currently, there is no consensus treatment for intermittent exotropia. Surgical treatment brings with it a high reoperation rate. Non-surgical treatment includes patching, prism, vision therapy and overminusing. Vision therapy, despite the lack of randomized clinical data, has shown success in treating intermittent esotropia, but many of the studies were completed prior to the advent of a validated outcome measure. The two papers discussed (same study population) compared vision therapy to an observation group for children with intermittent exotropia.

Forty children ages 6 to 17 were enrolled at the Zhonghan Ophthalmic Center in Guangzhou, China. The participants received either 16 weeks of office-based vergence and anti-suppression therapy (OBVAT) with home reinforcement, or were simply observed. One supervised therapy session of 60 minutes was completed weekly, along with 15 minutes of home reinforcement 5 days per week. The therapy protocol was adapted from the Convergence Insufficiency Treatment Trial, as distance vergence and anti-suppression activities were added. The inclusion criteria included a distance exodeviation between 10 and 30pd with a near deviation no greater than 10pd than the distance. Stereoacuity had to be 400 arcsec or better, and the Office Control Score had to be greater than Grade 2 at distance and between zero and four or orthophoric at near. The Office Control Score is a five-point scale with the following grading characteristics:

- 5 = Constant Exotropia
- 4 = Exotropia > 50% of the 30-second period before dissociation
- 3 = Exotropia < 50% of the 30-second period before dissociation
- 2 = No exotropia unless dissociated, recovers in >5 seconds
- 1 = No exotropia unless dissociated, recovers in 1-5 seconds
- 0 = No exotropia unless dissociated, recovers in

No history of vision therapy, strabismus surgery, nystagmus, amblyopia or restrictive/paretic strabismus was allowed. No medication known to impact accommodation or vergence, a history of ocular/neurological disorder or learning disability that would interfere with therapy was permissible. Testing was completed at 8 and 17 weeks. The data from the 17-week visits is presented.

The following measures showed significant difference between the OBVAT and observation groups: Office Control Score at distance (p=0.008), Fusion Maintenance Score (p=0.007), vergence facility (p=0.005), near Worth 4 dot (p=0.001), and positive (p<0.001) and negative fusional vergence (p=0.001) at distance and positive (p<0.001) and negative fusional vergence (p=0.004) at near.

The OBVAT participants were more likely to show ?1 point of improvement in Office Control Score at 17 weeks (p=0.006), but the same could not be said for those showing ?2 points of improvement (p=0.67).

The following measures did not show significance: Office Control Score at near, distance, and near stereopsis, the Newcastle Control Score, angle of deviation via cover test at distance or near, Chinese Intermittent Exotropia Questionnaire, near point of convergence, amplitude of accommodation, and distance Worth 4 dot.

Only eight of the 20 participants in the OBVAT group completed all of the activities in the protocol. Of those 12 who did not, they completed on average 22.4 +/-6.2 of the 30 procedures.

Office-based vision therapy is a viable option for children with intermittent exotropia and an alternative to surgical correction. These two papers showed the impact on the control of the tropia and various measures of binocular vision and fusion. Of note, while all participants completed the 16 weeks of therapy, less than half completed the therapy treatment protocol. It could be surmised that if therapy had been completed, the improvement levels might have been even better. While this data provides support for those who offer vision therapy, it also serves as a wake-up call to primary care optometrists to alter their referral patterns for children with intermittent exotropia.

(References: Ophthalmic Physiol Opt. 2025 Jan;45(1):50-66. doi: 10.1111/opo.13415. Epub 2024 Nov 8. Ophthalmic Physiol Opt. 2024 Mar;44(2):356-377. doi: 10.1111/opo.13264. Epub 2023 Dec 26.)

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