Medicine®

OBSERVATIONAL STUDY

OPEN

# Acute Acquired Concomitant Esotropia

## *Clinical features, Classification, and Etiology*

*Jingchang Chen, MD, PhD, Daming Deng, MD, Yuan Sun, MD, PhD, Tao Shen, MD, PhD, Guobin Cao, MD, Jianhua Yan, MD, PhD, Qiwen Chen, MB, and Xuelian Ye, MB*

**Abstract:** Acute acquired concomitant esotropia (AACE) is a rare, distinct subtype of esotropia. The purpose of this retrospective study was to describe the clinical characteristics and discuss the classification and etiology of AACE.

Charts from 47 patients with AACE referred to our institute between October 2010 and November 2014 were reviewed. All participants underwent a complete medical history, ophthalmologic and orthoptic examinations, and brain and orbital imaging.

Mean age at onset was $26.6 \pm 12.2$ years. Of the 18 cases with deviations $\leq 20$ PD, 16 presented with diplopia at distance and fusion at near vision at the onset of deviation; differences between distance and near deviations were $< 8$ PD; all cases except one were treated with prism and diplopia resolved. Of the 29 cases with deviations $> 20$ PD, 5 were mild hypermetropic with age at onset between 5 and 19 years, 16 were myopic, and 8 were emmetropic with age at onset $> 12$ years; 24 were surgically treated and 5 cases remained under observation; all 24 cases achieved normal retinal correspondence or fusion or stereopsis on postoperative day 1 in synoptophore; in 23 cases diplopia or visual confusion resolved postoperatively. Of the 47 cases, brain and orbital imaging in 2 cases revealed a tumor in the cerebellopontine angle and 1 case involved spinocerebellar ataxia as revealed by genetic testing.

AACE in this study was characterized by a sudden onset of concomitant nonaccommodative esotropia with diplopia or visual confusion at 5 years of age or older and the potential for normal binocular vision. We suggest that AACE can be divided into 2 subgroups consisting of patients with relatively small versus large angle deviations. Coexisting or underlying neurological diseases were infrequent in AACE.

Editor: Edoardo Villani.
Received: September 13, 2015; revised: October 29, 2015; accepted: November 17, 2015.
From the State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-Sen University, People's Republic of China (JC, DD, YS, TS, JY, QC, XY); and Department of Neurosurgery, the Second Affiliated Hospital of Guangzhou Medical University, People's Republic of China (GC).
Correspondence: Jianhua Yan, Department of Pediatric Ophthalmology and Strabismus, State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-Sen University, 54 Xian Lie Nan Road, Guangzhou, People's Republic of China (e-mail: yanjh2011@126.com).
JC and DD equally contributed to this study.
Funding: the study was supported by a grant from Guangdong Provincial Scientific Technological Research Fund, China (no. 2014A020209031). This manuscript is a unique submission and is not being considered for publication or has not been published by any other source in any medium.
The authors have no conflicts of interest to disclose.

ISSN: 0025-7974
DOI: 10.1097/MD.0000000000002273

(*Medicine* 94(51):e2273)

**Abbreviations**: AACE = acute acquired concomitant esotropia, D = diopter, LE = left eye, PD = prism diopter, RE = right eye.

## INTRODUCTION

Acute acquired concomitant esotropia (AACE) represents a relatively rare, distinct subtype of esotropia, which occurs in older children, adults, and even the elderly.[1–4] It was reported that AACE made up 0.3% of childhood strabismus.[5] AACE is characterized by a sudden onset of concomitant esotropia with diplopia.[1–3,6,7] In 1958, Burian and Miller reported 5 cases of AACE and described the 3 categorical features of AACE, which have been accepted as the fundamental symptoms and the pivotal work in this area.[1] Since then, findings from a number of reports have added to this work.[2–4,6–13] However, cases series in most of these reports were quite limited, and, there remain disputes over its etiology, clinical features, and classification. In this report, we present 47 cases with AACE, describe its clinical characteristics and management, and discuss its classification as well as its relationship with neurologic diseases.

## PATIENTS AND METHODS

Charts of patients diagnosed with AACE were reviewed. These records were derived from cases seen from October 2010 to November 2014 at the Pediatric Ophthalmology and Strabismus Services of the Zhongshan Ophthalmic Center of Sun Yat-Sen University. This study adhered to the tenets of the Declaration of Helsinki and was approved by the ethics committee of the Zhongshan Ophthalmic Center of Sun Yat-Sen University (Guangzhou, China).

Patients who met the following criteria were included in this study: (1) concomitant esotropia with acute onset (deviation in all directions of gaze differing by $\leq$2 prism diopters when primary deviations were $\leq 20$ prism diopters and by $\leq$5 prism diopters when primary deviations were $>$20 prism diopters), (2) patients experiencing diplopia or visual confusion, and (3) best corrected visual acuity of not $<$0.5 in each eye. Patients with a history of eye surgery or those with a reduction of $\geq 10$ PD in their esotropia with a full hyperopic spectacle correction for 1 month were excluded.

Comprehensive medical histories, ophthalmologic, and orthoptic examinations were performed on all patients. The age at onset was determined by the ophthalmologist according to the medical history and patients' photographs. Deviation size was assessed using prism and alternate cover tests in the cardinal position gazes with refractive correction. Synoptophore was used to evaluate the 3 grades of binocular single vision. Cycloplegic refraction was performed after administration of

1% atropine ointment once daily for 3 days in patients under 7 years old and 1 % cyclopentolate eye drops every 5 min for 3 times for those >7 years old. A full cycloplegic refraction was prescribed for those with refractive errors ≥ 1.0 diopter (D) (spherical equivalent). Additionally, all patients received brain and orbital computed tomography scans, and, in some cases, magnetic resonance imaging. Neurological examinations were performed and comprehensive medical histories were taken for cases with intermittent esotropia or variable deviations to rule out cyclic esotropia and myasthenia gravis.

## RESULTS

A total of 47 cases were included in this study, with 18 cases showing deviations ≤ 20 PD (Figure 1) and 29 with deviations > 20 PD (Figure 2). There were 25 men and 22 women. Age at onset was 26.6 ± 12.2 years (range: 5.0–59.0 years). The follow-up period was 1.8 ± 0.9 years (range: 0.5–4.0 years). Slitlamp and funduscopy examinations revealed no abnormality. Mild hypermetropia was observed in 5 cases, 9 cases were emmetropic, and 33 had myopia. Cerebellopontine angle tumors were present in 2 cases and 1 patient experienced spinocerebellar ataxia. All cases showed normal retinal correspondence or fusion or stereopsis in the synoptophore before therapy. Diplopia or visual confusion resolved in 40 cases following prism or surgical treatment.

Clinical features of cases with deviations ≤ 20 PD are summarized in Table 1. Of these 18 cases, none had a family history of strabismus; 1 case resulted following 24 h of driving; 1 case who presented with esodeviation accompanied by nystagmus and poor coordination of gait and was subsequently diagnosed as spinocerebellar ataxia as revealed from genetic testing; 1 case had a history of chemotherapy and radiotherapy for nasopharyngeal cancer 8 years prior; 14 cases had diplopia at distance but single vision at near vision; 2 cases initially had distance diplopia and later developed near diplopia; 2 cases had both distance and near diplopia at onset; 17 cases were myopic (−0.75 to −9.75D) and 1 case was emmetropic; 15 cases with myopia were using refractive corrections at presentation; in the synoptophore, all 18 cases showed preoperative normal retinal correspondence and stereopsis; brain and orbital imaging were not remarkable; the duration between onset and treatment ranged from 2 weeks to 10 years; diplopia resolved after being corrected with bilateral base out prisms of 2 to 7 PD in all but the one case of spinocerebellar ataxia.

Clinical features of cases with deviations > 20 PD are summarized in Table 2. Of these 29 cases, none had a family history of strabismus; brain and orbital imaging in 2 cases revealed masses in the cerebellopontine angle which consisted a 15 × 11 mm lipoma or a 40 × 23 mm cholesteatoma; 5 cases involved mild hypermetropic (+1.0 to + 1.75D) with age at onset between 5 and 19 years, 16 cases were myopic (−0.75 to −11.75D) with age at onset between 15 and 59 years, and 8 cases were emmetropic with age at onset between 12 and 38 years; 3 cases experienced visual confusion, 1 case had diplopia at distance whereas both distance and near diplopia were present in the others; 4 cases showed an occasional orthophoria; 1 case whose brain imaging revealed cholesteatoma showed bilateral nystagmus; in the synoptophore, 29 cases showed preoperative normal retinal correspondence or fusion or stereopsis; 4 cases had a minimal (<−1) bilateral lateral rectus muscle underactions; 16 cases were subjected to unilateral medial rectus recession and lateral rectus resection, 7 cases received bilateral or unilateral medial rectus recession, 1 case involved a unilateral lateral rectus resection, 5 cases remained under observation; age at surgery was 26.0 ± 2.7 years (range: 5.5–64.0

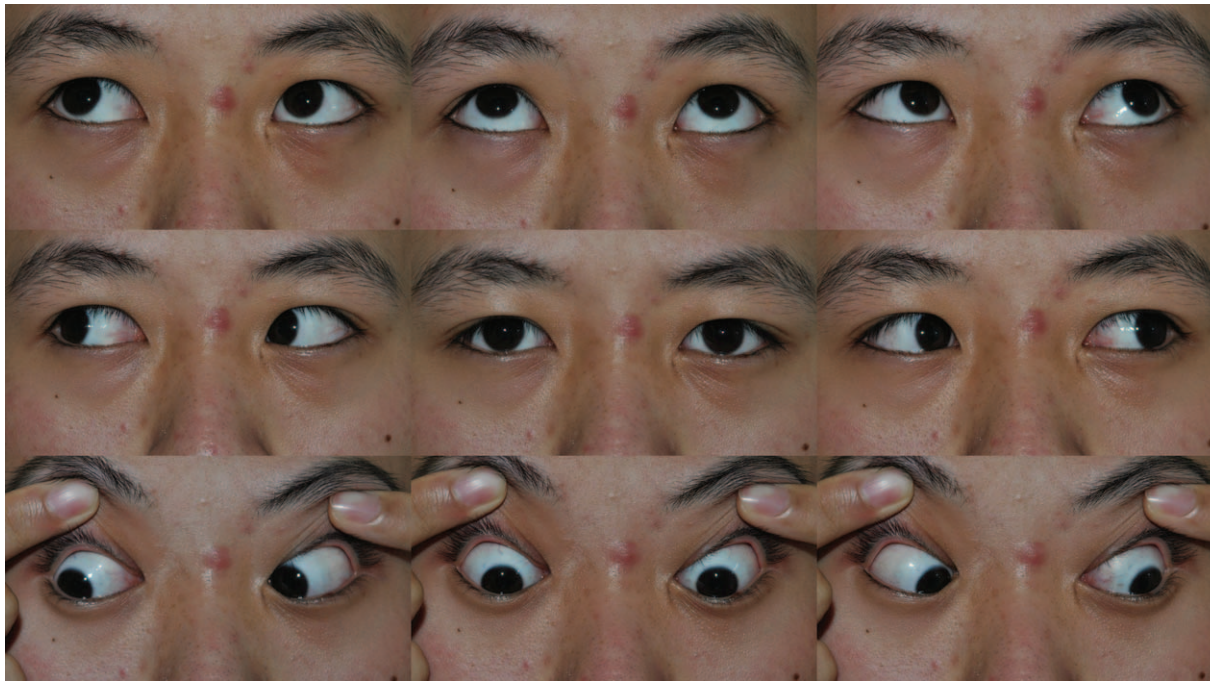

**FIGURE 1.** Composite 9-gaze photograph of an AACE patient with a relatively small angle. A 17-year-old boy with distance diplopia for 2 years, presented 20 PD of concomitant esotropia, normal ocular version and duction, normal stereopsis in synoptophore, and a myopia of 2.25 D. His diplopia resolved following treatment with bilateral base out prisms of 7 PD. AACE = acute acquired concomitant esotropia.

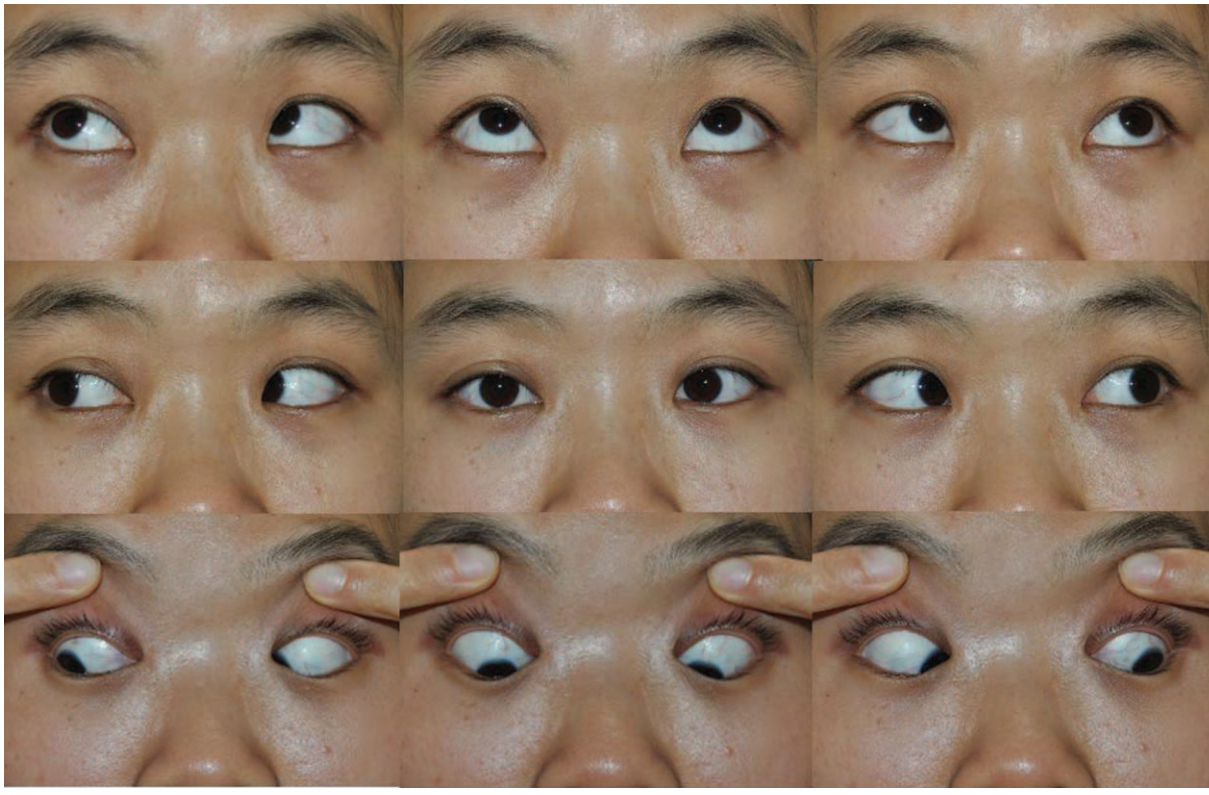

**FIGURE 2.** Composite 9-gaze photograph of an AACE patient with a relatively large angle. A 26-year-old girl with diplopia for 2 years, presented 40 PD of concomitant esotropia, normal ocular version and duction, normal stereopsis in synoptophore, and a myopia of 6.0 D. Her diplopia resolved following left medial rectus recession and lateral rectus resection. AACE = acute acquired concomitant esotropia.

years); the duration between onset and surgery was $2.4 \pm 0.3$ years (range: 0.5–5.0 years); the interval between diagnosis and surgery was $0.4 \pm 0.1$ years (range: 0.1–1.0 years); in 23 cases diplopia or visual confusion resolved at 1 day to 2 months postoperatively and diplopia remained in 1 case for residual deviation; all 24 cases achieved normal retinal correspondence or fusion or stereopsis on postoperative day one in synoptophore; with the exception of 1 case, all 24 cases were aligned within 10 PD or less of orthotropia; no recurrences were observed at postoperative follow-up as performed at 0.5 to 3 years; no improvements were observed for the patients under observation.

## DISCUSSION

Acute acquired concomitant esotropia (AACE), or acute late-onset concomitant esotropia, are generally agreed to be characterized by a sudden onset of concomitant esotropia with diplopia after infancy or in older children and adults.[1–4,6] Some reports describe AACE as being an acute-onset condition confined to children $\geq 5$ years of age, which might be one of the primary features that differentiates it from acquired non-accommodative esotropia.[2,14] However, in several other studies it was reported that the acute deviation developed during infancy and early childhood[7,8] and diplopia was an inconsistent feature.[4,8] Here, we reviewed a large case series of AACE, and, the salient characteristics observed were: (1) concomitant non-accommodative esotropia with acute onset, (2) an accompanying diplopia or visual confusion, (3) potential for normal binocular vision and highly favorable surgical outcomes for those with deviations >20 PD, (4) $\geq 5$ years old at the time of onset, and (5) no tendency for spontaneous resolution.

Burian and Miller are generally considered as having performed the initial pivotal work in the field of AACE.[1]

**TABLE 1.** Clinical Features of Cases With Deviations $\leq 20$ PD (n = 18)

| | Age Onset (Year) | Refraction (Spherical Equivalent) | | Fusion($^0$) Before Corrected With Prism | | Deviation (PD) | |
|---|---|---|---|---|---|---|---|
| | | RE | LE | Convergence | Divergence | Near | Distance |
| Average | $32.3 \pm 10.8$ | $-3.5 \pm 2.3$ | $-3.3 \pm 2.2$ | $9.6 \pm 6.3$ | $6.1 \pm 1.6$ | $9.3 \pm 4.4$ | $11.3 \pm 3.9$ |
| Range | 16.0 to 51.0 | 0 to −9.5 | −0.25 to −9.75 | 4.0 to 28.0 | 2.0 to 10.0 | 3.0 to 20.0 | 5.0 to 20.0 |

LE = left eye, PD = prism diopter, RE = right eye.

**TABLE 2.** Clinical Features of Cases With Deviations >20 PD (n = 29)

| | Age Onset (Year) | Refraction (Spherical Equivalent) | | Corrected Visual Acuity | | Deviation (PD) | |
|---|---|---|---|---|---|---|---|
| | | RE | LE | RE | LE | Near | Distance |
| Average | 23.1 ± 11.9 | −2.1 ± 3.1 | −2.0 ± 3.1 | 1.0 ± 0.2 | 1.0 ± 0.2 | 41.0 ± 13.5 | 40.7 ± 14.0 |
| Range | 5.0 to 59.0 | +1.75 to −11.0 | +1.75 to −10.0 | 0.5 to 1.5 | 0.6 to 1.5 | 25.0 to 70.0 | 20.0 to 70.0 |

LE = left eye, PD = prism diopter, RE = right eye.

According to their findings, AACE can be classified into 3 types: (1) the Swan type, which results from temporary or permanent monocular occlusion or visual loss, (2) the Franceschetti type, which is associated with low hyperopia, a minimal accommodative element and relatively large angle of deviation, and (3) the Bielschowsky type, also be classified as divergence paralysis, which occurs in patients with myopia (≤5 diopters) following physical or psychic shock or exhaustion and exhibits a diplopia for distance but fusion for near vision. Bielschowsky claimed that uncorrected myopia played a role in the etiology of this form of strabismus. In our study, none of the cases experienced monocular patching or visual loss, thus the criteria for a Swan type was not achieved in any of these cases. As the suspension of normal fusion was the underlying cause of sensory strabismus, we propose that the Swan type of AACE should be integrated into a category of sensory esotropia. In the present study, of the 18 cases with deviations ≤ 20 PD, 16 experienced diplopia for distance and fusion for near vision at onset, which encompasses some features of the Bielschowsky type. Of these 18 cases, 17 were myopic and most wore glasses at presentation and only one developed a deviation following physical exhaustion, leading us to conclude that uncorrected myopia or physical or psychic exhaustion could not be considered the features or etiology of the Bielschowsky type. Moreover, of these 18 cases the difference between distance and near deviation was < 8 PD and the divergence motor fusion was normal in synoptophore, suggesting that the diagnosis of divergence paralysis may be excluded. Among the 29 cases with > 20 PD deviation, that showed some characteristics of the Franceschetti type, 5 cases involved mild hypermetropic with age at onset ranging from 5 to 19 years; 8 cases were emmetropic and 16 cases were myopic with age of onset > 12 years. Similarly, Spierer A reported that 9/10 patients with AACE in adulthood were myopic.[6] Accordingly, low hyperopia should not be considered a feature of the Franceschetti type and the condition of the patients' refraction may be associated with the age at onset. It seems likely that no significant differences exist between the Bielschowsky and the Franceschetti types of AACE, with the exception of deviation size as observed in this study. Therefore, we suggest that AACE can be divided into 2 subgroups consisting of relatively small versus large angle deviations. The significance of such classifications include the potential to: (1) distinguish some of the clinical characteristics and therapeutic approaches that could be utilized within each of the 2 groups and (2) the possibility of isolating those patients with relatively small angle deviations, which should enable for more attention to be directed toward this type of deviation which tends to be ignored or misdiagnosed in the clinic.

The etiology of AACE is elusive. In our study, most of the cases had normal corrected visual acuity, binocular vision potential and presented no other pathologic signs other than the esotropia. Therefore, we do not deem uncorrected myopia, accommodative element, physical or psychic exhaustion, decompensated monofixation syndrome or neurologic disorders as the genesis of AACE. However, coexisting or underlying neurological pathologies were present in 6.4% of the AACE cases in this study. Several reports have described patients with intracranial diseases who present with, or as, acute concomitant esotropia.[10–13] In the report of Liu GT, 40% of children with acquired esodeviation associated with an identifiable neurologic insult showed concomitant esodeviation.[15] Such findings support the conclusion that neurologic disease may cause acquired concomitant esotropia, though for most cases with concomitant esotropia its cause is benign. In additional, in our study all 3 cases with neurological pathologies were associated with cerebellar diseases and 2 presented with nystagmus. These results suggest that the cerebellum, as a part of extrapyramidal system, may play an important role in maintaining normal ocular alignment. Alhtough the genesis of AACE remains unclear, it is important to emphasize the infrequent, but possible, presence of an underlying or coexisting neurological condition in patients with AACE. This would be a particular concern for those who present with other neurologic signs or accompanying nystagmus. Consistent with previous studies,[10,12] we suggest that a neurological and /or neuroradiological investigation are warranted for AACE under conditions where neurological findings (such as headache, papilloedema, clumsiness, poor motor coordination, etc), or nystagmus are present.

## REFERENCES


1. Burian HM, Miller JE. Comitant convergent strabismus with acute onset. *Am J Ophthalmol.* 1958;45:55–64.
2. Legmann Simon A, Borchert M. Etiology and prognosis of acute, late-onset esotropia. *Ophthalmology.* 1997;104:1348–1352.
3. Clark AC, Nelson LB, Simon JW, et al. Acute acquired comitant esotropia. *Br J Ophthalmol.* 1989;73:636–638.
4. Dawson EL, Marshman WE, Adams GG. The role of botulinum toxin A in acute-onset esotropia. *Ophthalmology.* 1999;106:1727–1730.
5. Mohney BG. Common forms of childhood strabismus in an incidence cohort. *Am J Ophthalmol.* 2007;144:465–467.
6. Spierer A. Acute concomitant esotropia of adulthood. *Ophthalmology.* 2003;110:1053–1056.
7. Savino G, Colucci D, Rebecchi MT, et al. Acute onset concomitant esotropia: sensorial evaluation, prism adaptation test, and surgery planning. *J Pediatr Ophthalmol Strabismus.* 2005;42:342–348.

8. Sturm V, Menke MN, Knecht PB, et al. Long-term follow-up of children with acute acquired concomitant esotropia. *J AAPOS*. 2011;15:317–320.
9. Lyons CJ, Tiffin PA, Oystreck D. Acute acquired comitant esotropia: a prospective study. *Eye (Lond)*. 1999;13:617–620.
10. Williams AS, Hoyt CS. Acute comitant esotropia in children with brain tumors. *Arch Ophthalmol*. 1989;107:376–378.
11. Lee JM, Kim SH, Lee JI, et al. Acute comitant esotropia in a child with a cerebellar tumor. *Korean J Ophthalmol*. 2009;23: 228–231.
12. Hoyt CS, Good WV. Acute onset concomitant esotropia: when is it a sign of serious neurological disease? *Br J Ophthalmol*. 1995;79:498–501.
13. Simon JW, Waldman JB, Couture KC. Cerebellar astrocytoma manifesting as isolated, comitant esotropia in childhood. *Am J Ophthalmol*. 1996;121:584–586.
14. Mohney BG. Acquired nonaccommodative esotropia in childhood. *J AAPOS*. 2001;5:85–89.
15. Liu GT, Hertle RW, Quinn GE, et al. Comitant esodeviation resulting from neurologic insult in children. *J AAPOS*. 1997;1:143–146.