Esotropia Outcomes and the Influence of Delay to Wearing Full Hypermetropic Correction

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ABSTRACT

Purpose: To assess whether delay to full hypermetropic correction wear in children might influence the outcome of a diagnosis of full versus partially accommodative esotropia.

Methods: All children younger than 7 years who were referred with possible strabismus over a 1-year period were assessed. A standard set of details were documented: age at which esotropia was first noticed, age at which esotropia was confirmed by an orthoptist, age at which glasses were prescribed, and age at which full refractive error was constantly worn. When full-time hypermetropic correction was worn, the type of esotropia was determined.

Results: There were 430 children referred. Of these, 117 had a concomitant esotropia (62 males and 55 females). Esotropia was confirmed at 35.47 ± 16.67 months of age (range: 4 to 78 months). There were 51 children (43.6%) with full accommodative esotropia, 57 (48.7%) with partially accommodative esotropia, and 9 (7.7%) with nonaccommodative esotropia. Longer delays between the time at which esotropia was identified and the time at which glasses were prescribed were associated with a reduced likelihood of an outcome of full versus partially accommodative esotropia (odds ratio [OR] = 0.73, 95% confidence interval [CI] = 0.58 to 0.93). Delay to glasses wear for full and partially accommodative esotropia was 1.94 ± 6.4 and 6.24 ± 8.36 months, respectively. Higher average spherical correction scores were associated with a higher likelihood of being in the full accommodative esotropia group (OR = 1.35, 95% CI = 1.07 to 1.69).

Conclusions: A child with recent onset concomitant esotropia is more likely to achieve full versus partially accommodative esotropia if the delay to full hypermetropic corrective glasses wear is minimized.

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INTRODUCTION

Partially accommodative esotropia continues to make up a significant proportion of a pediatric strabismus surgical workload. These children often do not demonstrate stereopsis following surgery.[1] Full accommodative esotropia is a diagnosis of an esotropia that is fully controlled with demonstration of stereopsis of 800 seconds of arc or more on Lang stereo test, Frisby test, or Wirt test when hypermetropic correction is worn. Although the numbers of children needing surgery have decreased due to recognition that full hypermetropic correction must be prescribed,[2] it is not clear whether the timing of full refractive correction wear relative to the onset of an esotropia influences an outcome of full versus partially accommodative esotropia.

We sought to determine the incidence and characteristics of esotropia in our population of children younger than 7 years over a 1-year period.

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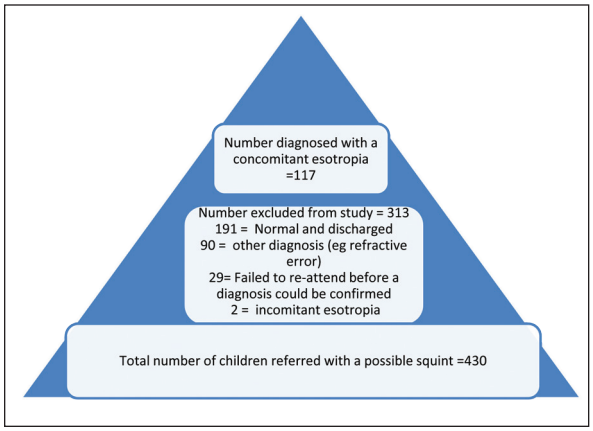

Figure 1. Patient disposition in the study cohort (number of patients).

PATIENTS AND METHODS

In 2013, as a service evaluation of our caseload and management, we prospectively looked at all children younger than 7 years who were referred with suspected strabismus. The study and data collection conformed to local trust rules and were compliant with the principles of the Declaration of Helsinki. In our catchment area, all children are screened at birth by a pediatrician for a red reflex and at 8 weeks by a general practitioner for a red reflex, and have a targeted surveillance at 2 years by a health visitor (specialist community public health nurse) (using a questionnaire to determine if there is parental/professional concern regarding the child's vision or the presence of a strabismus). At this surveillance stage, the health visitor, in accordance with Health for All guidance,[3] automatically refers children with any of the following: dysmorphic syndrome, neurodevelopmental disorder, learning disability, sensory neural hearing impairment, cerebral palsy, Down syndrome, prematurity (less than 32 weeks' gestation), and/or low birth weight (1,500 grams or less). A formal vision screen of children occurs at 4 to 5 years and is performed by a school nurse who assesses visual acuity using a logarithm of the minimum angle of resolution (logMAR) test and refers to the orthoptist those who fail to achieve 0.20 logMAR visual acuity. Children with suspected strabismus can be referred outside of these staged contacts due to parental or health care professional concerns.

All children referred were assessed by an orthoptist and a standard set of details was documented: age at which esotropia was first noticed, age at which esotropia was confirmed by an orthoptist, age at which glasses were prescribed, and age at which full refractive error was constantly worn. When full-time hypermetropic correction was worn, orthoptic tests were used to determine the type of strabismus and the level of binocular function.

All children with an esotropia had a cycloplegic refraction and the full hypermetropic correction prescribed if they had a refractive error of +1.50 diopters (D) or greater (following removal of the working distance only). Children prescribed glasses were followed up 2 months later by an orthoptist. Esotropia subtypes included were non-accommodative esotropia, partially accommodative esotropia, and full accommodative esotropia. The accommodative convergence/accommodation ratio was not routinely checked.

Non-accommodative esotropia was defined as a concomitant esotropia, either associated with a refractive error of less than +1.50 D or an esotropia that did not alter in size by 10 prism diopters (PD) or more following full-time hypermetropic correction wear. A partially accommodative esotropia was defined as a manifest esotropia with no binocular single vision when wearing full hypermetropic correction and the deviation was at least 10 PD smaller with glasses compared to the unaided measurement. A full accommodative esotropia was defined as an esotropia that became a phoria when full hypermetropic correction was worn and binocular single vision was measurable using either a Lang stereo test, Frisby test, or Wirt test. Children were deemed "normal" and discharged when age-appropriate normal uniocular vision had been recorded, a cover test showed no manifest strabismus, binocular single vision and fusional control were demonstrable, and ocular movements were full.

RESULTS

In 2013, our catchment area had 29,365 children younger than 7 years.[4] Over a 1-year period from January 1, 2013, to December 31, 2013, 430 children were referred with suspected strabismus. Esotropia was confirmed in 117 and 313 were excluded (**Figure 1**).

Of the 117 included cases, 62 (53%) were males and 55 (47%) were females. Esotropia was confirmed by an orthoptist in patients with ages ranging from 4 to 78 months (35.47 ± 16.67 months). There were 51 children (43.6%) who had full accommodative esotropia, 57 (48.7%) who had partially accommodative esotropia, and 9 (7.7%) who

TABLE 1

Timing of Glasses Wear and Esotropia Subtype Outcomes[a]

Time	Partially Accommodative (n = 57)	Full Accommodative (n = 51)	Non-accommodative (n = 9)
Mean ± SD time elapsed in months from age esotropia first noticed to age glasses worn full time	6.24 ± 8.36	1.94 ± 6.40	1.80 ± 1.92
Mean ± SD time elapsed in months from age esotropia confirmed by orthoptist to age glasses prescribed	0.30 ± 2.35	-1.14 ± 2.67	0.57 ± 1.27

SD = standard deviation
[a]A negative value is present because some children had glasses prescribed by a community optometrist prior to seeing an orthoptist.

TABLE 2

Variables Associated With Achieving Full Accommodative Esotropia[a]

	Single Predictor Model		Multiple Prediction Model	
Variable	OR	95% CI	OR	95% CI
Average spherical correction	1.35[b]	1.07 to 1.69	1.30[c]	1.02 to 1.66
Age (months) esotropia confirmed by orthoptist until glasses were prescribed	0.73[b]	0.58 to 0.93	0.81	0.64 to 1.03
Age (months) esotropia first noticed until glasses were worn	0.91[c]	0.84 to 0.98	0.94	0.87 to 1.01

OR = odds ratio; CI = confidence interval
[a]OR > 1.00 favors full accommodative esotropia.
[b]$P < .01$.
[c]$P < .05$.

had non-accommodative esotropia. Stereopsis in the full accommodative esotropia group ranged from 55 to 600 seconds of arc for near. Three children who had non-accommodative esotropia were not prescribed glasses because they had no hypermetropia of +1.50 D or greater; 6 of them were prescribed their full hypermetropic correction. No child was phoric for distance and esotropic for near either with or without glasses. No child had a trial of bifocals. Six children were diagnosed as having essential infantile esotropia when younger than 12 months. Of these, 2 had non-accommodative esotropia, 3 had partially accommodative esotropia, and 1 had full accommodative esotropia. Of note, our population had 3,956 infants younger than 1 year in 2013,[4] giving an incidence for essential infantile esotropia of 1 in 659 live births or 0.15%.

In our cohort, children in the full accommodative esotropia group had a shorter delay between age at which esotropia was first noticed to age at which glasses were worn full time (1.94 ± 6.40 months), compared with children in the partially accommodative esotropia group (6.24 ± 8.36 months). The same is also observed between the age when esotropia was first confirmed by an orthoptist and the age when glasses were prescribed. The full accommodative esotropia group had a mean of -1.14 ± 2.67 months, whereas the partially accommodative esotropia group had a mean of 0.30 ± 2.35 months (**Table 1**).

Binary logistic regression models were used to examine the predictors of full versus partially accommodative esotropia using average spherical correction and two time delay variables. The approach involved estimating models in which each of the predictors was specified separately and comparing the results to a model in which all three predictor models were specified simultaneously.

Results of the separate and combined regression models are summarized in **Table 2**. The average spherical correction was calculated by adding the spherical equivalents for each eye and dividing by two. When predictors were specified in single predictor models, higher average spherical correction scores were associated with a higher likelihood of being in the full accommodative esotropia group

(odds ratio [OR] = 1.35, 95% confidence interval [CI] = 1.07 to 1.69). Similarly, longer delays between age at which esotropia was first confirmed by an orthoptist until glasses were prescribed were associated with a reduced likelihood of achieving a full accommodative esotropia outcome (OR = 0.73, 95% CI = 0.58 to 0.93). In addition, longer delays between the age at which esotropia was first noticed until glasses were worn were also associated with a reduced likelihood of a full accommodative esotropia outcome (OR = 0.91, 95% CI = 0.84 to 0.98). When all three predictors were entered simultaneously as predictors, only the average spherical correction scores were uniquely predictive of an accommodative esotropia outcome ($P < .05$).

DISCUSSION

Treating strabismus can help improve psychosocial effects, aid in visual development by preventing amblyopia, and, if stereoacuity is achieved, help in developing good hand–eye coordination.[5] Studies in children with esotropia conducted by Fawcett et al.[6] and Uretmen et al.[7] have shown that shorter duration of constant or intermittent misalignment is associated strongly with stereoacuity preservation. Therefore, it is advocated that children with refractive accommodative esotropia should be prescribed their corrections promptly. Our study supports this view. In our 117 cases with concomitant esotropia, partially accommodative esotropia was the most frequent strabismus subtype, with an incidence of 48.7%. This is higher than previously reported in larger population-based studies. In a Danish cohort[5] of 645 patients with esotropia, 39% had partially accommodative esotropia. In an American cohort[8] of 385 patients with esotropia, 10% were partially accommodative. We identified modifiable factors associated with increasing the likelihood of a child with an esotropia achieving a full accommodative esotropia status: minimizing delay to prescribing and successful full-time wear of the full hypermetropic correction.

A range of non-modifiable factors that might favor an outcome of full versus partially accommodative esotropia have been reported. Lai et al.[9] found the angle of deviation was significantly smaller in their fully accommodative group (n = 28) versus their partially accommodative group (n = 17) ($P = .004$). In that study, refractive error was also higher in the fully accommodative esotropia group ($P = .062$), but age of esotropia onset, age at first visit, and presence of inferior oblique overaction were similar. Reddy et al.[10] and our study also found refractive error to be higher in the fully accommodative group compared to the partially accommodative group. Torp-Pedersen et al.[5] found age of onset was older for full accommodative esotropia.

The strengths of our study include that a standard set of data was prospectively collected on all patients. We had a large number of confirmed esotropias (117 patients) for a 1-year study, with likely good catchment due to the nature of the National Health Service, with children having scheduled contacts with a health care professional at various ages and equal and free access to the National Health Service. One weakness of our study was that a verbal history from the parents regarding full-time glasses wear was used. This was combined with a good acuity documented at the next examination when looking through glasses, suggesting that the children had relaxed their accommodation due to habitual glasses wear. Of the 117 children included in the study, only 6 failed to attend their first follow-up appointment. All 6 of these children were in the partially accommodative group.

A long-term study[11] has shown that good compliance to glasses wear is important in achieving good stereopsis and satisfactory eye alignment in children with pure refractive accommodative esotropia. However, this can be difficult to achieve. Children can refuse to wear their glasses or can overlook the frames.

Children with fully accommodative esotropia may become emmetropic and abandon glasses as they get older.[12] However, undercorrecting hypermetropia in those established as having full accommodative esotropia can cause control to be lost; a study of 30 children found 20% decompensated with a 1.00 D reduction of hypermetropic correction.[13]

Our study suggests that children presenting with recent onset concomitant esotropia should have an immediate cycloplegic refraction and the full hypermetropic correction prescribed if the refractive error measures more than +1.50 D. These glasses should be worn full time to increase the likelihood of gaining a full accommodative esotropia status.

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