

## Ocular Features and Autism Spectrum Disorder: A 10-Year Retrospective Review

We reviewed the medical records of our pediatric ophthalmology and strabismus clinic of our hospitals for the period 1 January, 2009 to 31 December, 2018, to identify children with autism spectrum disorder (ASD). We found that refractive errors (62%) and strabismus (63%) were the most common ocular manifestations in children with ASD. With timely management, amblyopia and strabismus could have favorable outcome. As amblyopia was significantly associated with intellectual disability ( $P=0.02$ ), early ophthalmic monitoring via multidisciplinary approach is warranted.

**Keywords:** *Amblyopia, Intellectual disability, Refractive errors, Strabismus.*

Autism spectrum disorder (ASD) is a spectrum of neurodevelopment disorders with impairment of social communication and social interaction with restricted repetitive pattern of behavior, interest, or activities [1,2]. The incidence of ophthalmic disorders in ASD has been reported up to 71% [3,4].

Ophthalmic examination of children with ASD could be challenging due to their suboptimal cooperation for examination and any impairment of vision may affect eye contact training in ASD children. We conducted this study to explore the demographics, ocular manifestations, and treatment outcomes of pediatric patients with ASD. This is because identifying and treating the underlying eye conditions timely and appropriately can facilitate training of children with ASD.

This retrospective study was approved by the local institutional review board and was conducted in accordance with the Declaration of Helsinki. Medical records of all consecutive cases attending pediatric ophthalmology and strabismus clinic of Kowloon East Cluster of Hong Kong over 10 years, from 1 January, 2009 to 31 December, 2018, with the following diagnoses, were reviewed (International Classification of Diseases and Related Health Problems, 9th and 10th revision): "Autism", "Asperger's disorder" and "Pervasive Developmental disorder" [5]. Our study included ASD patients with or without intellectual disability (ID) who were referred for ophthalmological assessment. ID was diagnosed with a score below 70 on Wechsler Intelligence Scale for Children- Fourth Edition (WISC-IV).

The Record showed that all patients had undergone complete ophthalmic examination by pediatric ophthalmologists and optometrists. The best corrected visual acuity (BCVA) was measured with Snellen or Sheridan-Gardiner visual acuity test for verbal patients, and preferential looking (Cardiff Acuity card) for non-verbal patients. Amblyopia was diagnosed only in verbal patients, with BCVA of 20/40 or worse in at least one eye or at least 2 lines of difference between two eyes. Successful

treatment of amblyopia was defined as BCVA difference in less than 2 lines between eyes or BCVA better than 20/40 after treatment. Cycloplegic refraction was performed in accommodative esotropia or those with poor cooperation [6].

A total of 100 patients aged 1 month to 11 years [80 boys, median (IQR) age 1 (1,4) year] were identified. The mean follow up period was 4.94 years (3 months to 16 years). Ten patients were born prematurely (at 36 weeks of earlier) and 13 were preverbal. Coexisting developmental delay ( $n=32$ ), ID ( $n=24$ ) and attention deficit and hyperactivity disorder ( $n=31$ ) was present. The most common reasons for ophthalmic referral were ocular misalignment (58%), followed by refractive errors (15%) and poor vision (8%). The most common eye problems reported were strabismus (63%) and refractive errors (62%) (Table I).

Amblyopia was identified in 26 patients, with a mean (SD) presenting age of 2.69 (1.85) years. Strabismus (34.6%) and anisometropia (30.8%) were the leading causes. All cases were treated with spectacles and part-time patching, except for three cases who declined treatment. Eighty seven percent of children were successfully treated with patching. Three cases had failed treatment, including 2 cases with poor compliance and 1 case with underlying optic atrophy.

A total of 63 cases presented with strabismus, out of which 46 (73%) had exotropia. The average angle of deviation at near was 29.6 +/-15.7 Prism Dioptre (PD) and 33.3 +/- 11.7 PD at distance. Esotropia was found in 23.8% patients with strabismus, with an average angle of deviation at near and distance of 27.4 +/- 14.1 PD and 24.4 +/- 15.3 PD, respectively. For esotropia, fully or partially accommodative esotropia was the most common (80%). Success rates for strabismus surgery were 75% for exotropia and 80% for esotropia. We reported higher frequency of exotropia than esotropia in all ASD patients with strabismus in our series, which is consistent with the findings from the Multi-Ethnic Pediatric Disease Study (MEPEDS) for Asian children [7].

Most cases ( $n=83$ ) in this study were reported by psychiatrists to have poor eye contact, including 4 without any eye contact during psychiatry consultations. However, only 4 cases had structural abnormalities (chronic retinal detachment, congenital nystagmus, bilateral optic atrophy and Leber Congenital Amaurosis) while the other 79 were structurally normal and without any history of epilepsy. Poor eye contact in ASD could be attributed to an abnormality in the orbitofrontal-striatum-amygdala circuit in response to social stimuli [8].

The rate of amblyopia (26%) in the present study is comparable to other studies (10-19%) [4,9], but much higher than the general pediatric population (1.81%) [7]. The most common causes of amblyopia were strabismus (34.6%) and anisometropia (30.8%) which is similar to a recent study [4]. Amblyopia was significantly associated with ID or developmental delay when compared with normal ASD patients (37% vs 16.7%,  $P=0.02$ ,

**Table 1 Ophthalmic Diagnosis of Patients With Autism Spectrum Disorder (N=100)**

<i>Ophthalmic diagnosis</i>	<i>No.</i>
<b>Squint</b>	
Exotropia	46
Intermittent exotropia	45
Sensory exotropia	1
Esotropia	15
Fully accommodative esotropia	7
Partially accommodative esotropia	5
Abducens nerve palsy	1
Non-accommodative esotropia	2
Superior oblique palsy	2
<b>Refractive errors</b>	
Myopia	36
Hyperopia	14
Astigmatism <sup>a</sup>	46
Anisometropia	16
<b>Amblyopia</b>	
Strabismic	9
Anisometropic	8
Deprivational	4
Bilateral ametropic	4
Unknown	1
<b>Others<sup>b</sup></b>	
Retinopathy of prematurity	2
Ptoxis	3
Nasal lacrimal duct obstruction	3
Epiblepharon	8
Nystagmus	2
Chalazion	2
Iris abnormality	2

<sup>a</sup>34 patients with coexisting myopia/hyperopia. <sup>b</sup>One each had congenital cataract, Leber congenital amaurosis, vernal keratoconjunctivitis, retinal detachment, optic atrophy, and suspected glaucoma.

Chi-Square test). This higher prevalence of amblyopia in ID or developmental delay has also been reported and may have been contributed by the higher incidence of refractive errors and strabismus in this population [10].

Our study is limited by its retrospective nature which may be subject to missing data and we did not include healthy control in our study. We encountered the incidental finding of unilateral chronic rhegmatogenous retinal detachment of a preverbal moderate ID case. This highlights that presentation of severe but potentially treatable conditions could be delayed in ASD, due to communication and language problems. This together with our findings of significant association of amblyopia with ID or developmental delay in ASD have brought out a strong message that general practitioners, psychiatrists and pediatri-

cians should have a low threshold for ophthalmology referral, especially if there is any concern of the vision of ASD patients. We propose that visual screening should be offered to all ASD patients with ID or limited language ability around age of four years old, using a multidisciplinary approach with pediatricians, psychiatrists, optometrists, nursing specialists, and play therapists. This would allow early detection and treatment of any potentially treatable condition.

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