

## SCIENTIFIC CORRESPONDENCE

# Changing patterns of strabismus: a decade of experience in Hong Kong

C B O Yu, D S P Fan, V W Y Wong, C Y Wong, D S C Lam

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**Background/aims:** Racial variation in the pattern of strabismus is known, but few large scale studies on non-white populations are available. Furthermore, longitudinal change in this pattern within a local setting has not been well documented in the past. This study aims to support the clinical impression that exotropia is more common in Chinese patients, and that the proportion of patients with exotropia has been increasing in the past decade.

**Methods:** A total of 2704 consecutive patients with the diagnosis of primary horizontal strabismus, seen in the strabismus clinic of the Hong Kong Eye Hospital, were retrospectively analysed to determine the relative prevalence of esotropia and exotropia. Characteristics recorded include patient demographics, type of strabismus, and whether the nature of the squint was constant or intermittent.

**Results:** 742 (27.4%) patients were found to have esotropia, 548 (20.3%) had constant exotropia, 1213 (44.9%) had intermittent exotropia, and 201 (7.4%) had microtropia. The proportion of exotropic to esotropic patients was shown to increase steadily throughout the past decade ( $p < 0.0001$ ). This was mainly accounted for by an increase in the number of patients with intermittent exotropia, and a corresponding decrease in the number of patients with esotropia.

**Conclusion:** Exotropia was shown to be more prevalent than esotropia in a Hong Kong Chinese population. Furthermore, the proportion of patients with intermittent exotropia appears to be increasing, in contrast with esotropic patients. The exact nature of this trend, and possible aetiological factors will require further study.

Conventional textbooks<sup>1</sup> and prevalence studies on strabismus,<sup>2–6</sup> based mainly on white populations, have stated that esotropia is more common than exotropia. However, geographical variations in this pattern are known.<sup>7</sup> Of the few non-white studies available, Eustace<sup>8</sup> found divergent squint to be more prevalent in West Indian children, likewise in children living in Cameroon.<sup>9</sup> Ing and Pang<sup>10</sup> showed that in their Hawaiian based practice, exotropia was more common than esotropia in patients of Oriental descent but the reverse was true in their white counterparts. An additional finding was that exotropia and esotropia were observed to be of equal distribution in the racially mixed group of patients.<sup>10</sup>

A study was therefore conducted on all patients who presented with primary horizontal strabismus to our institution over the past decade, to lend support to the clinical impression that exotropia is more common in the Chinese, and also to show how the pattern of strabismus has changed over time.

## METHODS

All patients with primary, horizontal, and concomitant strabismus, evaluated for the first time in the strabismus clinic

of the Hong Kong Eye Hospital, from 1 January 1990 to the 31 July 2001 inclusive, were studied retrospectively. Patients with previous squint surgery were excluded. The geographical region of the study is urban, and the local population is almost exclusively of Chinese descent. The Hong Kong Eye Hospital is the sole, secondary and tertiary referral centre for all eye diseases in the central region of Kowloon, and all patients suspected of a squint are seen in the strabismus clinic. Referral to this hospital is via general practitioners, general outpatient departments of district hospitals, and maternal and child health clinics. In addition, some referrals are made from private ophthalmic practitioners. This referral pattern has not changed for the past 10 years.

The diagnosis recorded in the strabismus clinic for the entire study period was made by attending orthoptists, and verified by ophthalmologists. Additional data recorded include patient's name, unique Hong Kong identity number, age at first visit, sex, type of strabismus, and whether the strabismus was constant or intermittent. The latter was defined by observing at least some degree of control of the deviation during prism cover tests at 33 cm for near, and 6 metres for distance, with the patients wearing their full refractive correction. Patients with suspected neurogenic, myogenic, and restrictive causes, as well as latent squints, were excluded. Microtropia was recorded for those patients with a deviation of less than 10 prism dioptres, regardless of whether the patient was esotropic or exotropic.

## RESULTS

A total of 2704 patients fulfilled the inclusion criteria for the study. Among them, 1439 (53.2%) were female, and 1265 (46.8%) were male. The mean age at presentation was 14.1 years (range 3 months to 91 years); 742 (27.4%) were found to have esotropia, 548 (20.3%) had constant exotropia, 1213 (44.9%) had intermittent exotropia, and 201 (7.4%) had microtropia. Table 1 lists data extracted from other studies on strabismus, in relation to esotropic and exotropic cases alone. To facilitate a more meaningful comparison between the Hong Kong patients and those reported in Western countries, only those study patients presenting age 7 years or less were tabulated.

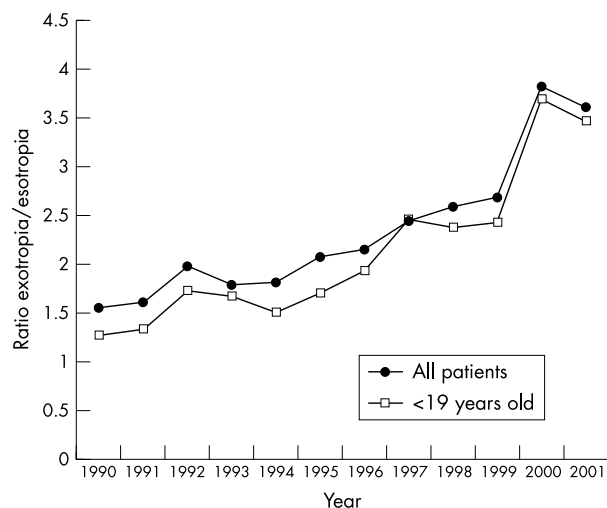
In an attempt to refine the diagnostic accuracy, we elected to analyse only those patients who presented before the age of 19 years. This cut-off point was chosen to try to exclude patients who develop strabismus as a result of other pathologies leading to poor vision, such as cataract and retinal detachment, etc, which tend to occur later in adulthood. However, this choice should not exclude those patients with intermittent exotropia, who may have become symptomatic for the first time in the teenage years. Figure 1 shows the calculated ratio of exotropia to esotropia cases for each year of the study. The rising trend is similar for all the study patients as well as those under 19 years of age.

To facilitate further analysis of the changing pattern of strabismus, patients who were under 19 years of age at first

**Table 1** Comparison of selected prevalence studies on strabismus

Study	Country	Study base	Total cases	Esotropes	Exotropes	Ratio eso/exo
Rantanen <i>et al</i> <sup>2</sup> (1971)	Finland	Community (7 year olds)	97	54	43	1.26
Graham <sup>3</sup> (1974)	UK	Community (5–6 year olds)	210	173	37	4.68
Kornder <i>et al</i> <sup>4</sup> (1974)	Canada	Community (6 year olds)	116	71	45	1.58
Chew <i>et al</i> <sup>5</sup> (1994)	USA	Community (7 year olds)	1677	1187	490	2.42
Friedman <i>et al</i> <sup>6</sup> (1980)	Israel	Community (1–2½ year olds)	475	361	114	3.17
Schlossman <i>et al</i> <sup>11</sup> (1955)	USA	Institution (all age groups)	1431	1107	324	3.42
Mvogo <i>et al</i> <sup>7</sup> (1996)	Cameroon	Institution (all age groups)	137	51	86	0.59
Ing <i>et al</i> <sup>8</sup> (1974)	Hawaii	Institution (all age groups)	202*	66	136	0.49
Yu <i>et al</i> (2001)	Hong Kong	Institution (age ≤7 years)	1391	491	900	0.54

\*Oriental patients only.

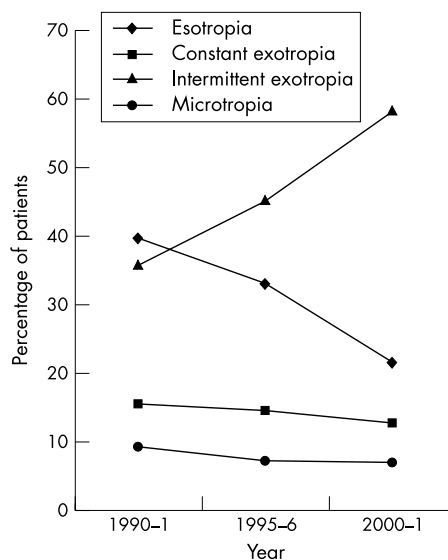
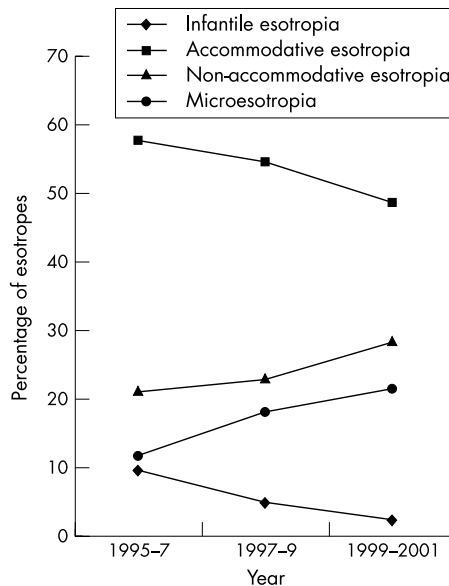
**Figure 1** Change in ratio of exotropic to esotropic cases over time.

visit were selected from three 2 year periods—namely, those who presented between January 1990 to December 1991, January 1995 to December 1996, and August 1999 to July 2001, respectively. The total number of patients were 389, 405, and 359, respectively for the three groups. ANOVA testing showed that the age distributions for these three periods were not significantly different from each other ( $p=0.09$ ). The  $\chi^2$  test showed that there was no significant sex difference either ( $p=0.79$ ). Figure 2 shows how the pattern of strabismus encountered at our centre has varied over the years. This change was assessed using the  $\chi^2$  test for independence and was found to be statistically significant ( $p<0.0001$ ).

Figure 3 divides the esotropic patients into those with infantile, accommodative, non-accommodative, and microesotropia, and shows how this pattern has changed over time. True infantile esotropia was defined as constant esotropia with onset before 6 months of age, and deviation measured at greater than 45 prism dioptres at presentation.

## DISCUSSION

We have shown that exotropia is more common than esotropia by about a factor of 2 in this study of Chinese patients. A comparison indicates that this pattern is only evident in studies based on non-white populations.<sup>7–10</sup> It must be emphasised however that the quoted studies vary in their population bases, and age groups, and these may have a significant bearing on the observed data. Intermittent exotropia is the most common type encountered, and this is similarly reported by others.<sup>2,11</sup> There was a slight female preponderance in the study patients. The ratio of the number of cases of exotropia to the number of cases of esotropia has gradually increased in the past 10 years. Further analysis showed that this is due to a rise in the number of patients with intermittent exotropia,

**Figure 2** Changing pattern of strabismus with time (<19 years old at presentation).**Figure 3** Changing pattern of esotropia with time.

and a decrease in the number of patients with esotropia. In contrast, the number of patients with constant exotropia and microtropia has remained relatively constant.

The age at presentation was recorded for analysis instead of age at perceived onset of symptoms, as we believe that patients

and parents often have difficulty accurately dating the onset of disease, especially exotropia. Although the presenting age may be affected by illness behaviour, it facilitates comparison as it applies to all types of squint, and averages out between patients over time. There are other limitations of this study owing to its retrospective nature. Firstly, it reflects the experience of a single centre and therefore cannot be extrapolated to the general population. Lack of detailed charts from the early years of the study precluded confirmation of diagnoses and subsequent progress. It also did not allow clarification of cases of microtropia, which could either be convergent or divergent. In addition, lack of data on health status, such as any neurological abnormalities, and visual status may represent sources of bias.

Although extrapolation to reflect the true disease experience of the population is not possible, the merits of this study we believe lie in the large number of patients involved and greater diagnostic accuracy. For example, in the population based study by Chew,<sup>5</sup> strabismus screening of 39 227 children was performed by paediatricians with the Hirschberg test at ages 1 and 7 years. Exotropia cases were only confirmed by an ophthalmologist if strabismus was found at the initial screening. The Hirschberg test, while useful in detecting manifest strabismus, is a corneal light reflex test performed at near. Therefore, cases of intermittent exotropia, especially of the divergence excess type, would be missed. Similarly, in another comprehensive screening of 38 000 children<sup>6</sup> in Israel, mainly conducted by orthoptists and ophthalmologists, the age group screened was between 1–2½ years old. Cases of intermittent exotropia, which may present later in childhood, again would be underestimated.

The Hong Kong Eye Hospital is a government funded hospital which sees about 90% of the local population, with the other 10% seen by private ophthalmologists. The catchment area comprises approximately one quarter of the population of Hong Kong. As mentioned before, this system and referral pattern has remained unchanged in the past decade. The strabismus clinic is jointly run by three full time orthoptists and attended by paediatric ophthalmologists. There has only been one addition and one change in personnel during the entire study period. Over 99% of the local population is of Chinese ancestry, and for the purposes of this analysis, it is assumed that all the subjects were. Finally, by statistical analysis, the age and sex distributions of the patients who presented in 1990 were not different from those presented in 2001. Having considered that all these demographic factors have remained relatively constant, we believe that the trends seen reflect a true change in the disease experience of our local population.

The next question is therefore why the observed change in the number of patients with esotropia and intermittent exotropia? A change in patient education and awareness may have increased the number of consultations for exotropia, but cannot explain the decrease in convergent squint cases. Further analysis of the esotropic patients showed that the proportion with true infantile esotropia and accommodative esotropia is decreasing, while those patients with non-accommodative or microesotropia are increasing. One factor that we feel may be important is myopia. There is evidence that the prevalence of myopia is increasing,<sup>12</sup> much more so in the Far East<sup>13</sup> than in Western countries.<sup>14</sup> This may partially explain why there is an apparent drop in the number of accommodative esotropic patients in the past 10 years. We also believe that myopia may be important in the development of intermittent exotropia. Our own unpublished data show that our exotropic patients are significantly more myopic than our esotropic patients. However, whether they are more myopic than a control group without strabismus is the subject of an ongoing study. A relation between myopia and exotropia was first proposed by Donders<sup>15</sup>; however, we agree with other investigators that it is far less inflexibly linked as is the case with hypermetropia and esotropia.<sup>16</sup> Other factors which may

account for the racial differences observed might include variations in orbital shape, muscle insertion, and possibly interpupillary distance. However, it is difficult to see how these could vary with time to explain the trends seen.

In summary, we have found that exotropia is more prevalent than esotropia among strabismus cases seen in our institution in Hong Kong. We have also observed that the number of patients with convergent squint has decreased, while the number of patients with intermittent divergent squint has increased in the past 10 years. Although there are flaws in this study, we believe this change in pattern is real. Today, more than half of the world's population lives in Asia. Ninety eight per cent of the increase in human numbers during the next quarter of a century will take place in Africa, Asia, and Latin America.<sup>17</sup> With voluntary, economically motivated international migration on the increase, the ethnic mix of the more developed countries will continue to change in the future. Improved understanding of racial variations in disease characteristics will better equip us to serve our community in the future.

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