CAN RETINOSCOPY BE USED TO SCREEN INFANTS FOR AMBLYOPIA? A LONGITUDINAL STUDY OF REFRACTION IN THE FIRST YEAR OF LIFE

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SUMMARY

One hundred normal babies were refracted by two observers in a double-masked study within 24 hours of delivery and 30 minutes after instillation of 1% cyclopentolate. The procedure was repeated at 6 weeks, 3 months, 6 months and 1 year. At birth agreement between the two refractionists to within 1 dioptre spherical equivalent was 82%, rising to 94% at 1 year. Astigmatism of greater than 1 dioptre increased from 10% at birth to 42% at 6 months but decreased to 15% at 1 year. Myopia was uncommon (4%) but 80% of eyes were hypermetropic more than +2 dioptres and 25% more than +4 dioptres at birth, although these percentages decreased to 5% and 3% at 1 year. Anisometropia of more than 1 dioptre between the two eyes was uncommon but in the two cases where it persisted in the presence of high hypermetropia, reversible amblyopia was encountered in both cases.

The risk of developing amblyopia is greatly increased in infants with hypermetropia and anisometropia.[1,2] Bilateral refractive errors may lead to bilateral amblyopia[3] and meridional amblyopia may ensue when astigmatism is uncorrected in childhood.[4]

Approximately 6% of young infants have a significant refractive error and most are hypermetropic.[5,6] Astigmatism is common in normal infants[7–10] but the degree of astigmatism decreases[8,9,11] and the axis of the astigmatism changes with age.[10,12] Astigmatism rarely develops after the age of 1 year.[12]

Various techniques have been used to assess the refractive error in infants including retinoscopy (static and dynamic),[13] photorefraction,[6,7] autorefraction,[14,15] and visual evoked responses.[16]

In Northampton, orthoptists have been performing retinoscopy as a static procedure with accommodation relaxed under cyclopentolate cycloplegia for some years.[17] It was decided to investigate retinoscopy at birth and during the first year of life to see whether amblyopia could be identified and treated earlier than ever before.[18] The objectives were therefore threefold:

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1. To demonstrate the reliability of orthoptists' refractions on a very difficult group of children, the newborn and the very young.
2. To ascertain the normal refractive range of infants in the first year of life.
3. To determine the youngest age at which it would prove practical to screen by refraction.

PATIENTS AND METHODS

A sample of 100 newborn babies, as consecutive as possible, was obtained from the two maternity wards at Northampton District General Hospital beginning on 30 October 1989, all babies being examined within 24 hours of delivery on Monday to Friday mornings at 0800 hours. All the babies were full-term, normal deliveries of birth weight no less than 2.3 kg.

Once consent had been obtained, 1% cyclopentolate drops were instilled into the baby's eyes and all the babies

Fig. 1. *Retinoscopy within 24 hours of birth.*

Table I. Summary of results

Age	Attendance	Agreement of two refractionists (%)	Astigmatism (%)	Anisometropia (%)
Birth	100	82	10	9
6 weeks	56	86	11	3.5
3 months	67	77	17	4.5
6 months	55	94	42	1.8
1 year	53	94	15	3.8

were refracted 30 minutes later (Fig. 1). Fourteen mothers declined our offer of examination of their babies and 100 had been examined by 28 November 1989.

Retinoscopy was recorded by the first refractionist (BH) unseen by the second refractionist (PA or BB), an orthoptist, who repeated the process and made a separate record of her retinoscopy. All retinoscopy was performed at ⅔ metre using individual lenses held by the refractionist who attempted to attract the baby's attention to the retinoscopy light. All refractions were deduced by subtracting 1.5 dioptres from retinoscopy readings for working distance only; nothing was subtracted for cycloplegia. The process was repeated at 6 weeks, 3 months, 6 months and 1 year.

RESULTS

One hundred babies were refracted at birth (Table I), 56 attended at 6 weeks, 67 at 3 months, 55 at 6 months, and 53 at 1 year. Forty-four attended all examinations. The largest drop-out was from birth to 6 weeks, after which the numbers remained fairly constant. Agreement between the two refractionists to within 1 dioptre spherical equivalent was good. At birth it was 82%, increasing to 94% at 6 months and 1 year. Astigmatism, defined as a difference between the two meridia of 1 dioptre or more, was found in 10% at birth but this rose to a maximum of 42% at 6 months, falling back again to 15% at 1 year. It was found that astigmatism with a plus cylinder at 90° was twice as common as combined oblique and horizontal astigmatism at 6 months. Anisometropia of more than 1 dioptre between the two eyes was fairly uncommon, being 9% at birth but only 3.5% at 6 weeks, 4.5% at 3 months, 1.8% at 6 months and 3.8% at a year.

In order to consider the actual values of the refractions at the various stages during the first year of life, the spherical equivalents were calculated having deducted 1.5 dioptres from the retinoscopy readings for the working distance only (Table II).

Myopia was uncommon; at birth only 1% of the eyes was considered to be myopic, at 6 weeks 10% and thereafter 4%. The consistent 4% were actually two infants, each with two myopic eyes of −1 sphere. Emmetropia, plano to +2.25, increased from 18% at birth, through 43% at 6 weeks, 57% at 3 months and 75% at 6 months, to 88% at 1 year. Mild hypermetropia, +2.50 to +4.0, decreased from 56% at birth to only 5% at a year. High hypermetropia, greater than +4.0 refraction, decreased from 25% of eyes at birth to 3% at 1 year.

Regardless of whether the high hypermetropia is studied as a percentage of eyes or a percentage of patients, the results are very similar (Table III). In terms of percentage of patients with refraction greater than +4 in any meridian, there were 40% at birth falling to 6% at a year. The percentage of patients with retinoscopy greater than +4 spherical equivalent was 35% at birth, again falling to 6% at 1 year. As a percentage of eyes, there are 25%, reducing to 3% at a year. High hypermetropia decreases markedly from birth to 1 year, whichever calculation is used.

DISCUSSION

It is difficult to draw absolute conclusions from such a necessarily small study. It is clear, however, that orthoptists are able consistently to refract this difficult group of children, especially after the child reaches 6 months of age. It is also clear that, at birth, 80% of eyes are long sighted greater than +2.0 and 25% of eyes (35–40% of patients) are hypermetropic greater than +4.0 dioptres. We feel confident that the vast majority of these hypermetropic eyes become more emmetropic by the age of 1 year, when 92% of eyes have refractions between −1.0 and +2.0 dioptres.

High hypermetropia combined with anisometropia causes concern and can lead to amblyopia. In our series the only two children with this combination were found to be amblyopic on Vernier strip testing,[19] one at 12 months of age and the other at 22 months of age. The amblyopia was treated with appropriate spectacle correction and after 2 months of spectacle wear with no occlusion the amblyopia disappeared.

Astigmatism in infants is common: 42% of the children were astigmatic more than 1 dioptre at 6 months but only 15% remained so at 1 year. Of the infants astigmatic at

Table II. Refractions in spherical equivalents (percentage of eyes)

Age	Myopia >−0.25 (%)	Emmetropia plano to +2.25 (%)	Mild hypermetropia +2.5 to +4.0 (%)	High hypermetropia > + 4.0 (%)
Births	1	18	56	25
6 weeks	10	43	36	11
3 months	4	57	30	9
6 months	4	75	15	6
1 year	4	88	5	3

Table III. Refraction greater than +4 dioptres

Age	% patients				% eyes	
	in any meridian		in spherical equivalents		in spherical equivalents	
Birth	40	[38/94]	35	[33/94]	25	[46/188]
6 weeks	12.5	[7/56]	11	[6/56]	11	[12/112]
3 months	12	[8/67]	12	[8/67]	9	[12/134]
6 months	7	[4/55]	6	[3/55]	6	[6/110]
1 year	6	[3/53]	6	[3/53]	3	[3/106]

6 months, two thirds had astigmatism with the rule (plus cylinder at 90°) while the other third had astigmatism against the rule (plus cylinder at 180°) or obliquely in equal numbers. The astigmatism that remained at 1 year was against the rule in two thirds and with the rule in one third, the 180° plus cylinders persisting from 180° or oblique astigmatism at 6 months. The with-the-rule astigmatism at 6 months had largely disappeared by 1 year.

Several explanations of the suspiciously frequent occurrence of infant astigmatism have been suggested including poor fixation of the infant's eyes and non-coincidence of the optical and visual axis with infants' large angle alpha.[20] In our series, holding open the eyelids was not a significant factor in the aetiology of the astigmatism as the highest incidence (42%) occurred at 6 months of age when as little forced lid opening was required as at 1 year (15%); the most force required to open the lids was exerted in the examination at birth when the incidence of the astigmatism was at its lowest (10%). It seems that large numbers of infants are temporarily astigmatic but do not become amblyopic. In our study we saw no amblyopia in any of the astigmats nor in the anisometropes who had no concomitant high hypermetropia. We did, however, put one child, who was under paediatric care for developmental delay, into vertical astigmatic plus 2.5 cylinders at the age of 20 months because her vision did not seem to be developing adequately.

Since high hypermetropia is extremely common in the newborn, astigmatism is equally common at 6 months of age, and since both conditions are reduced markedly at 1 year, we feel that screening by refraction before 1 year of age might be counterproductive in that it could lead to the wearing of unnecessary spectacles by large numbers of temporarily hypermetropic infants. If amblyopia is discovered at 1 year and a refractive error is then found the refractive error may then be corrected and the amblyopia may well disappear with no occlusion.

Retinoscopy can be performed by orthoptists, but it is time-consuming and all infants require cycloplegia. We feel that progress will be made when orthoptists are able to screen 1-year-olds with a reliable, quick test that can detect a difference of vision between the two eyes. Amblyopia itself will then be identifiable rather than merely its risk factors.

Key words: Amblyopia, Refraction, Retinoscopy, Screening.

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