Ophthalmic Screening of 38,000 Children, Age 1 to 2 1/2 Years, in Child Welfare Clinics

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Over 90% of children born in Israel attend child welfare clinics, and it was found that these clinics could also accommodate an ophthalmic screening program. In a previous preliminary publication, results of screening 6,000 children were reported. The first part of this paper deals with the organization, methods of examination, and the overall results of screening 38,000 children, age 1 to 2 1/2 years with particular reference to strabismus and strabismic amblyopia. The second part deals with a new method of screening—"rapid retinoscopy"—introduced in an attempt to detect refractive amblyopia without strabismus.

Part I: General Results, Strabismus, and Strabismic Amblyopia

ORGANIZATION AND METHODS

Child welfare clinics in Israel provide free health care, including periodic examination, immunization, and audiometric screening. The attendance rate of children up to the age of 30 months in the 42 child welfare clinics of the Haifa area is 98%. With the cooperation of the Regional Health Service, our department has been conducting ophthalmic screening services in all of these clinics since October 1968. All children age 1 to 2 1/2 years are invited for an eye examination that is conducted by two orthoptists, occasionally assisted by one of the residents. The examination includes history-taking from the mother with particular reference to strabismus and/or amblyopia in the family, external inspection of the eyes, the corneal reflex test, and the cover test.

RESULTS

From October 1968 until February 1976, 38,000 infants were examined representing 98% of the population born in the area during that period. Of these, 2,009 were referred to the eye clinic for further examination.

Overall Findings

Table I shows the number of children in whom pathological findings were diagnosed. Strabismus was found in 498 children (1.3%); nearly half of these had constant unilateral strabismus and, therefore, presumably had strabismic amblyopia also. Organic pathology
TABLE I
OVERALL SCREENING RESULTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strabismus</td>
<td>498/38000</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>2. Strabismic amblyopia</td>
<td>206/38000</td>
<td>(0.5%)</td>
</tr>
<tr>
<td>3. Other significant organic findings</td>
<td>78/38000</td>
<td>(0.2%)</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Ptosis</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Congenital cataract</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Luxation of lens</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Uveal coloboma</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Mongolism</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Albinism</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Retinoblastoma</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tay-Sachs disease</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Coats' disease</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tapeto-retinal degeneration</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

TABLE II
CLINICAL FORMS OF STRABISMUS IN 498 INFANTS

<table>
<thead>
<tr>
<th>Form</th>
<th>Esotropia</th>
<th>Exotropia</th>
<th>Vertical Strabismus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>189</td>
<td>10</td>
<td>7</td>
<td>206</td>
</tr>
<tr>
<td>unilateral</td>
<td>100</td>
<td>93</td>
<td>16</td>
<td>212</td>
</tr>
<tr>
<td>alternating</td>
<td>68</td>
<td>12</td>
<td>7</td>
<td>80</td>
</tr>
<tr>
<td>intermittent</td>
<td>100</td>
<td>10</td>
<td>15</td>
<td>115</td>
</tr>
<tr>
<td>total</td>
<td>360 (72.2%)</td>
<td>115 (23%)</td>
<td>23 (4.6%)</td>
<td>498</td>
</tr>
</tbody>
</table>

was found in 78 cases, 0.2% of the series, and the diagnoses are listed in Table I.

Strabismus

A summary of the clinical forms of strabismus diagnosed in the 498 cases appears in Table II. Esotropia was three times more common than exotropia. Amblyopia was found in 189 (52%) of the 360 cases with esotropia and in 10 (8.7%) of the 115 cases with exotropia. There was no sex predilection in either esotropia or exotropia.

The refraction in 475 children with horizontal strabismus is shown in Table III. Forty-three percent of the 360 children with esotropia were emmetropic (0 to +2.0 diopters), 47% had hypermetropia, and 10% were myopic. The majority of the 115 children with exotropia were emmetropic, 22% were myopic, and there was one case of high hypermetropia exceeding +5.0 diopters. Of the total of 41 children with anisometropia of at least 1.5 diopters, 31 had constant unilateral esotropia.

Accommodative strabismus was diagnosed in 25 of the 360 cases of esotropia, and the outstanding features in this group of young patients were: Age of onset—6-24 months; fully accommodative—12 cases; convergence excess—10 cases; hypermetropia of 5D or more—17 cases; and amblyopia—9 cases (one of whom was bilateral).

A or V patterns were found in 75 of the 498 cases with strabismus, including 41 of the 360 cases with esotropia (12%) and 34 of the 115 cases with exotropia (29%). Table IV lists the most important clinical features in this group.

A paralytic element was diagnosed in 46 of the 498 cases with strabismus. Table V lists the muscles affected in the 24 patients with paralytic vertical strabismus and in the 22 patients with paralytic horizontal strabismus. The most frequently affected muscle was the external rectus—22 cases, including ten with Duane’s retraction syndrome.

None of the patients with Duane’s retraction syndrome had amblyopia. In four of the cases with paralytic horizontal strabismus and in four of the cases with paralytic vertical strabismus, the eye with the affected muscle was amblyopic. In six of the seven amblyopic cases with
### TABLE III

<table>
<thead>
<tr>
<th>Spherical Equivalent of the More Ametropic Eye</th>
<th>Astigmatism</th>
<th>Anisometropia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=-3.0</td>
<td>-0.25--3.0</td>
<td>0+2.0</td>
</tr>
<tr>
<td>Esotropia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant unilateral</td>
<td>189</td>
<td>5</td>
</tr>
<tr>
<td>Alternating</td>
<td>68</td>
<td>2</td>
</tr>
<tr>
<td>Intermittent</td>
<td>103</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>360</td>
<td>10</td>
</tr>
<tr>
<td>Exotropia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant unilateral</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Alternating</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Intermittent</td>
<td>93</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
<td>5</td>
</tr>
</tbody>
</table>

### TABLE IV

SEX DISTRIBUTION, INCIDENCE, AND CLINICAL FEATURES OF 75 CASES WITH A AND V PATTERNS AMONG 360 CASES WITH ESOTROPIA AND 115 CASES WITH EXOTROPIA

<table>
<thead>
<tr>
<th>Refraction</th>
<th>M</th>
<th>F</th>
<th>-0.5 to -3.0</th>
<th>0 to +2.0</th>
<th>+2.25 to +5.0</th>
<th>&gt;=+5.0</th>
<th>Amblyopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>V esotropia</td>
<td>27</td>
<td>(7.5% of 360)</td>
<td>8</td>
<td>19</td>
<td>4</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>A esotropia</td>
<td>14</td>
<td>(4% of 360)</td>
<td>9</td>
<td>5</td>
<td>-</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>V exotropia</td>
<td>33</td>
<td>(29% of 115)</td>
<td>14</td>
<td>19</td>
<td>5</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>A exotropia</td>
<td>1</td>
<td>(1% of 115)</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>(15.8% of 475)</td>
<td>31</td>
<td>44</td>
<td>9</td>
<td>46</td>
<td>19</td>
</tr>
</tbody>
</table>
vertical muscle paralysis the hypotropic eye was amblyopic. In ten other cases with esotropia or exotropia, some vertical element was also present: in the absence of A or V patterns or of a demonstrable paretic muscle, three of these patients had amblyopia.

DISCUSSION

The present paper deals with one of the largest ophthalmic screening projects in infants ever reported. Among 38,000 children age 1 to 2 1/2 years, the overall prevalence of strabismus was 1.3% and 41% of the strabismic patients (0.5% of the entire population screened) had amblyopia. In 78 cases, 0.2% of the series, other organic pathology was diagnosed. While the figures given here represent the actual incidence of strabismus and strabismic amblyopia, the actual incidence of other organic diseases is probably higher than indicated since in all probability some of these cases had been diagnosed and treated elsewhere before the age of 1 year.

The prevalence of strabismus in childhood, according to most authors, is higher than that reported here, varying between 2.8% and 5.3%. However, most of the reports dealt with older children and series dealing with infants were relatively small. Frandsen found strabismus in 3.7% of 1,927 children, age 0.5-6 years; 2.8% of 571 children, age 1-2 years, had strabismus; and 0.7% had strabismus amblyopia. Nordlow found strabismus in 3.86% of 6,004 children examined up to the age of 7. Graham examined 4,784 children, age 5-6 years, and found strabismus in 5.3% of them. Kornder et al found strabismus in 4.5% of 2,619 children, age 6 years. Oliver and Nawratzki found strabismic amblyopia in 0.6% of 1,910 children, age 1 1/2-3 years.

Esotropia was more than three times as common as exotropia; this is in accord with most reports. The vast majority of our cases with esotropia (94 out of 115), but less than one-third of the cases of esotropia, were intermittent; similar findings have been reported by others. This is consistent with the fact that the incidence of amblyopia in esotropia was six times higher than in exotropia.

Ametropia is a major contributing factor in strabismus. It was present in 250 of 475 cases with horizontal strabismus in our series (52.6%). Myopia was found in 20% of infants with exotropia and in 10% of infants with esotropia. This prevalence is higher than that found in children of the same age group in the general population. Hypermetropia was the most common refraction in esotropia (47%, including 12% with hypermetropia of more than 5.0 diopters). Costenbader reported similar refraction findings concerning hypermetropia in infantile esotropia, but found only 3.8% of myopia in young children with esotropia and 6.8% in children with esotropia over the age of 2 years. Anisometria was particularly common in esotropia and contributed to the development of amblyopia. It was found in 34 (9.4%) of the 360 esotropes, including 31 (16.4%) of the 189 unilateral esotropes.

Accommodative strabismus is said to be rare before the age of 2 1/2 years. Graham stated that the mean age of onset of accommodative strabismus was 40 months and that only 15% of such cases appeared before the age of 2 years. Pollard reported two cases of accommodative strabismus that were diagnosed at
the age of 6 months. In our series, accommoda-
tive strabismus was diagnosed in 25 of the
children with esotropia (7%); 12 of them were
fully accommodative and high hypermetropia
was the most frequent refractive error.

A and V patterns were found in 15.8% of our
series, which is similar to the findings reported
by Harley and by Campion. These patterns
were almost three times more frequent in
exotropia than in esotropia (29% and 12%,
respectively), mainly because of the relatively
high frequency of V-exotropia.

Some vertical component was found in 25% of
our cases with horizontal strabismus and in
an additional 5% there was manifest paralytic
vertical strabismus. This overall incidence was
somewhat lower than that reported by Sco-
bee—35% out of 558 cases, and by White and
Brown—36.6% out of 1,955 cases.

The relatively high frequency of strabismus
amblyopia (41% of all strabismus cases) shows
the importance of ophthalmic screening in
childhood. The subject of early detection of
amblyopia without strabismus is dealt with in
Part II of this report.

### Part II:
Rapid Retinoscopy as a Screening Method for
Ametropia and Nonstrabismic Amblyopia

Refractive amblyopia without strabismus is
relatively frequent and accounts for 33% - 75% of all cases of amblyopia. Because such
cases cannot be diagnosed during mass
screening by the use of the cover test, an
attempt was made to detect them by “rapid
retinoscopy” without cycloplegia.

#### MATERIALS AND METHODS

From January 1, 1974 through December 31, 1976, 15,084 children, age 1 to 2 1/2 years,
underwent ophthalmic screening in child welfare clinics of the Haifa area. In these,
immmediately following the cover test, “rapid retinoscopy” was performed without cycloplegia
and without the use of the trial lenses. The child was seated on his mother’s lap in a semi-
darkened room at a distance of 2/3 meter from the examiner, a trained orthoptist or one of the
residents. Spot retinoscopy was performed by moving the light quickly several times across
the pupil, both horizontally and vertically. In all cases of emmetropia or with small errors of
refraction, a clear reflexion of light spot was seen to move rapidly across the pupil with the
direction of the movement of the retinoscope. In cases of low myopia or marked accommoda-
tion, the light was clearly seen to move rapidly against the movement of the instrument. In
cases with ametropia of ± 3 diopters or more, the light reflex was of reduced intensity and the
movement, if seen at all, was slow. Likewise, cases with significant astigmatism could easily
be detected, as well as cases with anisometropia. Opacities in the media anywhere on the
optical axis altered the light reflex and were easily spotted.

All cases with suspicion of ametropia or
opacities in the media were referred to the eye
clinic, where in addition to the routine examination by an ophthalmologist, customary reti-
unoscopy was performed 45 minutes following
three instillations of 1% cyclopentolate, at ten-
minute intervals. Glasses were prescribed and
additional treatment for amblyopia was started
as necessary. All cases were kept under
observation until no further treatment was
deemed necessary.

RESULTS

Table I-a summarizes the results of screening
15,084 children by “rapid retinoscopy.” Cases
with strabismus or other findings detected by
external inspection with a torch or by the cover
test were excluded (these were dealt with in
Part I). Following “rapid retinoscopy,” there
was suspicion of ametropia in 173 infants, who
were referred to the eye clinic. Of these,
significant refractive errors were confirmed in
84. There were 27 cases of hypermetropia—8
of them unilateral; 34 cases of myopia—19
unilateral; and astigmatism of all types, usually
combined with myopia or hypermetropia, was
found in 43 cases—25 of them unilateral. In all,
significant anisometropia of 2 diopters or more
was found in 16 children.

Opacities in the media were discovered
through “rapid retinoscopy” and later con-
formed and diagnosed in the clinic in eight eyes
of five children. In two there was bilateral
incipient congenital cataract and in one there
was bilateral subluxation of the lens. Of the two
unilateral remaining cases, one had an incipi-
ent congenital cataract and the other had
retinoblastoma. The tumor practically filled the
vitreous cavity and no red reflex could be seen.
There was no strabismus in any of these five
cases.

DISCUSSION

To our knowledge, this is the first attempt of
mass screening for refractive errors in infants.
There is no claim to the diagnosis of all cases of
ametropia by “rapid retinoscopy” since no
cycloplegia was used. However, the method
was practical in the solution of the problem of
eye diagnosis of amblyopia without strabismus,
on a massive scale and at relatively low
cost. The findings show that at least 13 infants
with bilateral hypermetropia of more than 5D
and four other children with bilateral astigma-
tism of 3.5D or more, were all likely to suffer
from bilateral amblyopia. Sixteen other child-
ren with unilateral high refractive errors and
significant anisometropia were likely candi-
dates for unilateral amblyopia. The prescription
of glasses and the complementary treatment by
occlusion or penalization whenever necessary
probably avoided, or at least minimized, the
amblyopia. The actual visual acuity eventually
attained by these ametropic eyes will be
reported when the children are old enough to
cooperate.

“Rapid retinoscopy” has also proved to be
valuable in the detection of opacities in the
media that were discovered in eight eyes of five
infants. These cases were easily picked up by
the orthoptist. Obviously, ophthalmoscopy is
more difficult and time-consuming and, there-
fore, not practical as a mass screening method.

Since the performance of “rapid retino-
scopy” in child welfare clinics did not exceed one
minute per child, the results presented justify
the adoption of this method of examination as a
supplement to the cover test in programs of
pediatric ophthalmic screening.

SUMMARY

Screening of 38,000 infants, age 1 to 2 1/2
years, showed a prevalence of 1.3% of strabis-
mus and 0.5% of strabismic amblyopia. Esotro-
pia was more than three times as frequent as
exotropia. Approximately half of the cases with
esotropia were amblyopic. Eighty-one percent
of the cases with exotropia were intermittent,
and in 29% the V-pattern was found.

Significant ametropia was found in over 50% of
the cases with strabismus. Although hyper-
metropia was the most frequent refraction in
children with esotropia, myopia was a frequent
finding in both esotropia and exotropia. Aniso-
metropia was particularly frequent in constant
unilateral esotropia. Accommodative strabis-
um was found in 7% of cases with infantile
esotropia. In cases with paralytic strabismus,
the most frequent muscle involved was the
lateral rectus. Significant organic pathology,
other than strabismus or amblyopia, was
revealed in 0.2% of the series.

“Rapid retinoscopy” through undilated pu-
pils is an efficient method in detecting high
refractive errors and candidates for nonstra-
bismic amblyopia in childhood. Since this
method of examination is easy to perform, its
adoption as a part of screening projects in
childhood is recommended. “Rapid retinos-
copy” performed by a trained orthoptist is also
a useful method for detecting opacities in the
ocular media.

REFERENCES


