Early surgery for infantile esotropia

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Abstract
Aim—To investigate the postoperative eye alignment and binocular visual function after early surgery for infantile esotropia.

Methods—Both the postoperative eye position and stereopsis were reviewed using the Titmus stereo test in nine patients who received uniolcular medial rectus recession and lateral rectus resection under general anaesthesia before 8 months of age and were followed up for a minimum of 4 years.

Results—Orthophoria was attained in three cases, whereas esotropia was found in four patients. Dissociated vertical deviation was noted in two other cases at the final examination. Static stereoacuity was achieved in five cases. These results also showed that most infants in whom strabismus was attained had satisfactory eye alignment during the follow up period and at the final examination. Infants who did not achieve stereopsis still had deviation throughout the follow up period.

Conclusions—It was concluded that early surgery in infantile esotropia is beneficial to achieve binocular visual function, but it is necessary to confirm a stable angle of deviation with accurate preoperative evaluation, and to maintain good postoperative eye alignment throughout the follow up period.

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Conflicting hypotheses exist regarding early surgery for infantile esotropia. Some believe that very early surgery of infantile esotropia before the age of 6 months, during the period of visual susceptibility, is useful for achieving good eye alignment and stereopsis.1–3 Others report that binocular function can rarely be demonstrated in cases of infantile esotropia despite very early surgical correction.4–6 They also point out that difficulties in accurately evaluating the eye position and a high incidence of attaining spontaneous remission at an extremely early age are the major drawbacks of very early surgery. It was our belief that both the timing of surgery and desirable ocular alignment during the critical period have a considerable effect on the development of binocular visual function. Therefore, we retrospectively studied the course of eye position and stereopsis 4–8 years after surgery and reviewed the outcome of early surgery in infantile esotropia.

Methods
We studied nine children with infantile esotropia (six boys and three girls) without any systemic or neurological abnormalities who received surgery before 8 months of age. We examined their preoperative eye movement and eye position using the Krimsky test several times before surgery which was scheduled if the angle of deviation was stable and if the eye movement did not show any paralytic component. Uniolcular medial rectus recession and lateral rectus resection under general anaesthesia were performed. Inferior oblique myotomy was carried out when inferior oblique muscle overaction was diagnosed.

We evaluated the postoperative eye position by alternate prism cover test. Static stereopsis was carried out by the Titmus stereo tests (TST) during which the patients were provided with Polaroid spectacles and asked to look at the vectograph at 40 cm. Infants who demonstrated no suppression with the fly test and responded correctly with animal and circle tests were accepted to have stereopsis. We also examined static stereopsis with random dot stereogram (SRDS) and motion stereopsis with dynamic random dot stereogram (DRDS), employing the Multivision tester (MV-200R).7 The Multivision tester is a recently developed stereo test with an image splitter system. It provides three dimensional images to be seen without glasses, which allows achievement of binocular vision as close as possible to natural conditions of seeing. Other binocular visual functions such as simultaneous perception and fusion were estimated with a synoptophore. All the test procedures were performed and evaluated by the same examiner (HS). We also assessed the ocular alignment and binocular visual function of all patients for a minimum of 4 years.

Results
All children initially had been recognised to have esotropia before 2 months of age by their parents, with confirmation of the diagnosis before 6 months of age by an ophthalmologist. The refractive error (spherical equivalent) under cycloplegic retinoscopy ranged between 0 and +4.0D. The range of age at initial surgery was between 4 months and 8 months. Unilateral recession and resection were performed in all patients initially. Two patients received a secondary operation. Recession of medial rectus for consecutive esotropia was performed in one patient at 4 years of age. The other patient received surgery for subsequent exotropia with overaction of bilateral inferior oblique muscles at 3 years 9 months of age. The range of initial angle of deviation was documented to be 30–50 prism dioptries (average 40 prism dioptres). Postoperative outcome of eye alignment and binocular visual
function were determined between 4 and 8 years of age. All patients had good visual acuity in both eyes. Orthophoria was attained in three patients, while esotropia was diagnosed in five. Dissociated vertical deviation was noted in two other cases. We achieved static stereopsis using TST in five patients (100–400 seconds of arc). Other binocular visual functions using SDRS, DRDS, and synoptophore were shown in four patients who attained simultaneous perception. The outcome of eye alignment and binocular visual function in the nine participants is shown in Table 1. We also looked for a relation between age at surgery and stereoacuity. We could not observe any particular trend between age at surgery and stereopsis in this series.

The course of postoperative eye alignment of the patients with or without static stereopsis are shown in Figure 1. We observed that most infants in whom stereopsis was attained had satisfactory eye alignment during the follow up period and at the final examination. Infants who did not achieve stereopsis still had deviation throughout the follow up period.

### Discussion

Current studies on early surgery of infantile esotropia have conflicting views on whether early surgery before the age of 6 months during the period of visual susceptibility can result in good eye alignment with stereopsis.²,³ We investigated how postoperative ocular alignment and binocular visual function of patients with infantile esotropia is influenced by early surgery and also estimated the course of eye alignment and stereopsis and reviewed the benefits of early surgery. Our results showed that five of nine patients (55.6%) achieved static stereopsis with TST (100–400 seconds of arc) and no patient attained refined stereopsis at final examination. However, van Selm reported the necessity of a longer follow up of the postoperative binocular visual function.⁸ We intended to observe the long term changes of visual function in our patients.

Wright et al suggested the concept of “the time window of binocular development” as the period before irreversible damage occurs on visual function.⁵ They also suggested that optimum timing of surgery might be 2½–3 months of age to obtain a good binocular function. Animal studies revealed that anatomical and functional development of binocular vision occurs rapidly and early after birth, and is susceptible to abnormal visual experiences.⁶,⁷ Chino recommends early surgery (before 4 months of ages) in congenital strabismus.¹¹

The range of age at surgery in our patients (before age 8 months) was older compared with the other reports. The average timing of

### Table 1 Summary and results in subjects undergoing surgery

<table>
<thead>
<tr>
<th>Subject No</th>
<th>Age at first documentation</th>
<th>Surgery and age at 1st surgery</th>
<th>Surgery and age at 2nd surgery</th>
<th>Initial eye position (PD)</th>
<th>Final eye position (PD)</th>
<th>Refractive error (SE)</th>
<th>Visual acuity</th>
<th>Static stereopsis TST (s)</th>
<th>SDRS (s)</th>
<th>DRDS (s)</th>
<th>Major amblyoscope</th>
<th>Follow up (years)</th>
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<tbody>
<tr>
<td>1</td>
<td>0 month</td>
<td>(LE) Resec 5.5 mm Reces 5.0 mm 4 months</td>
<td>(RE) Resec 5.0 mm Reces 5.0 mm 4 months</td>
<td>30 ET (LE) +1.0</td>
<td>12 ET (RE) +1.0</td>
<td>(RE) +0.5 (LE) +1.0</td>
<td>20/25 (LE) 20/20 (RE)</td>
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<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 month</td>
<td>(RE) Resec 5.0 mm Reces 5.0 mm 4 months</td>
<td>(LE) Resec 5.0 mm Reces 5.0 mm 4 months</td>
<td>40 ET (LE) +1.0</td>
<td>8 ET 6 DVD (RE) +1.0</td>
<td>(RE) +1.0 (LE) +1.0</td>
<td>20/20 (RE) 20/20 (LE)</td>
<td>none (—) (—) SP(+)</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0 month</td>
<td>(LE) Resec 5.0 mm Reces 4.5 mm 8 months</td>
<td>(RE) Resec 4.5 mm Reces 4.5 mm 8 months</td>
<td>50 ET (RE) +4.0</td>
<td>4 EP 4 DVD (LE) +1.5</td>
<td>(RE) +1.5 (LE) +1.5</td>
<td>20/20 (RE) 20/20 (LE)</td>
<td>none (—) (—) (—)</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 months</td>
<td>(LE) Resec 4.5 mm Reces 4.5 mm 5 months</td>
<td>(RE) Resec 4.5 mm Reces 4.5 mm 5 months</td>
<td>50 ET (RE) +4.0</td>
<td>6 ET (LE) +3.0</td>
<td>(RE) +3.0 (LE) +3.0</td>
<td>20/20 (RE) 20/20 (LE)</td>
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<td>4</td>
<td></td>
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<tr>
<td>5</td>
<td>0 month</td>
<td>(LE) Resec 6.0 mm Reces 6.0 mm 5 months</td>
<td>(RE) Resec 6.0 mm Reces 6.0 mm 5 months</td>
<td>35 ET (LE) +1.5</td>
<td>8 ET (RE) +1.5</td>
<td>(RE) +1.5 (LE) +1.5</td>
<td>20/20 (RE) 20/20 (LE)</td>
<td>140 unknown (—)</td>
<td>SP(+)</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0 month</td>
<td>(RE) Resec 4.5 mm Reces 4.5 mm 5 months</td>
<td>(LE) Resec 4.5 mm Reces 4.5 mm 5 months</td>
<td>30 ET ortho</td>
<td>(RE) +1.0 (LE) +1.0</td>
<td>(RE) +1.0 (LE) +1.0</td>
<td>20/20 (RE) 20/20 (LE)</td>
<td>200 (—) (—)</td>
<td>SP(+)</td>
<td>5</td>
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<td></td>
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<tr>
<td>7</td>
<td>0 month</td>
<td>(LE) Resec 4.5 mm Reces 6.0 mm 7 months</td>
<td>(RE) Resec 5.0 mm Reces 5.0 mm 7 months</td>
<td>45 ET ortho</td>
<td>(LE) 0 (RE) +0.5</td>
<td>(RE) 0 (LE) +0.5</td>
<td>20/20 (LE) 20/20 (RE)</td>
<td>100 (—) (—)</td>
<td>SP(+)</td>
<td>4</td>
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<tr>
<td>8</td>
<td>2 months</td>
<td>(RE) Resec 6.0 mm Reces 5.5 mm 5 months</td>
<td>(LE) Resec 6.0 mm Reces 5.5 mm 5 months</td>
<td>40 ET 10 DVD (LE)</td>
<td>(RE) +1.0 (LE) +1.0</td>
<td>(RE) +1.0 (LE) +1.0</td>
<td>20/20 (RE) 20/20 (LE)</td>
<td>100 (—) (—)</td>
<td>SP(+)</td>
<td>5</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>1 month</td>
<td>(RE) Resec 6.5 mm Reces 6.0 mm 5 months</td>
<td>(LE) Resec 6.5 mm Reces 6.0 mm 5 months</td>
<td>40 ET ortho</td>
<td>(RE) +2.5 (LE) +2.0</td>
<td>(RE) +2.5 (LE) +2.0</td>
<td>20/20 (LE) 20/20 (RE)</td>
<td>400 unknown unknown unknown unknown unknown</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PD = prism dioptre; SE = spherical equivalent; TST = Titmus stereo tests; SDRS = static random dot stereogram; DRDS = dynamic random dot stereogram; SP = simultaneous perception.
surgery in patients with or without stereopsis was almost identical. We thus could not find a relation between the outcome of stereopsis and the timing of surgery similar to other reports. We examined the eye position and movement many times before surgery to rule out an unstable angle of deviation and a paralytic component. We believe this is of utmost importance to obtain a successful surgical outcome.

Most infants in whom stereopsis was attained in this study had satisfactory eye alignment during the follow up after surgery and at final examination. Infants who did not achieve stereopsis still had deviation throughout the follow up period. We think that it is important to observe the status of visual and ocular motor functions during the entire critical period in order to estimate the development of binocular vision. It is also our strong belief that patients with early onset strabismus should receive surgery as soon as possible. Maintenance of proper eye alignment should be checked regularly afterwards to achieve a desirable binocular visual function.

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6 Von Noorden GK. (Discussion of Ing MR, Surgical alignment prior to six months of age for congenital esotropia.) Trans Am Ophthalmol Soc 1995;93:144.
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