EARLY SURGICAL ALIGNMENT FOR CONGENITAL ESOTROPIA

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INTRODUCTION

THE OPTIMUM TIME FOR SURGICAL ALIGNMENT IN CONGENITAL ESOTROPIA HAS been a subject of controversy in ophthalmology for many years. In fact, it was not too long ago that congenital esotropia was considered incurable and that there were no successful results of treatment other than cosmetic. Gradually, within the past two decades, the concept has evolved that a degree or grade of binocularity, or "cure," was indeed possible in a certain percentage of the patients who received surgical alignment.

Among the difficulties facing the investigator who attempts to evaluate the results of treatment has been the controversy as to what group of strabismic infants have "congenital" esotropia and what criteria denote a cure of the condition. Different tests used by different researchers have been given different relative importance in the previous evaluations, leading to further confusion about the results. Furthermore, the results of treatment have been reported on relatively small numbers of patients so that even the statistical evaluations have been subject to question.

Somewhat belatedly, findings in neurophysiologic research on the development of immature binocular pathways in mammals offered some rationale for the clinicians who favored early surgical alignment. These experiments will also be discussed in detail.

Although the critical age for surgical alignment in congenital esotropia has been heretofore undefined, it has been generally agreed that *adequate* surgical alignment is a necessary precursor of any binocularity. It has been acknowledged that no prospective studies are available.[1] However, since the age at initial surgical treatment does not necessarily correlate with the age for adequate surgical alignment (as alignment in many patients is achieved only after the second or third surgical procedure), any prospective studies based on age at initial surgery would be of lesser value if alignment is of maximum importance. Therefore, a retrospective cohort study of adequately aligned cases would still be the best available data base from which to derive conclusions.

Any meaningful study would probably have to include patients from more than one strabismologist's practice to provide adequate numbers for statistical comparison. It is reasonable to consider that prejudicial bias could be minimized by having all the evaluations performed by the same examiner without him or her having any knowledge of the patient's history until after the evaluation is completed. In addition, the same criteria for both the diagnosis of congenital esotropia and binocularity results could be applied throughout the study to help make the conclusions more acceptable.

The purpose of this paper is to report a study designed with the previously described guidelines that correlates the motor and sensory results with the age of adequate surgical alignment.

REVIEW OF THE LITERATURE

Although the classification of congenital esotropia was perhaps more nebulous in past literature than will be defined in this paper, it is, nevertheless, important to review the previous papers and concepts concerning this type of strabismus.

Worth[2] cast a gloomy prognosis for any functional result in the treatment of congenital squint in 1905 when he proclaimed there was probably a deficient fusion faculty or absence of a "fusion center" in these patients, and therefore binocularity, theoretically, would not be possible despite surgical alignment.

Chavasse[3] challenged the pessimism toward the surgical treatment of congenital esotropia when he theorized, contrary to Worth's opinion, that there was, indeed, an innate fusion faculty in the congenital esotropic patient. He argued that after any barriers to satisfactory vision are removed and the deviation is surgically eliminated at a sufficiently young age, binocularity could develop. However, Chavasse offered no cases in support of his beliefs, and, in general, negative views toward functional results persisted. For example, Doggart[4] recommended that parents of congenital esotropic infants be warned that, despite the possibility of cosmetic improvement resulting from surgery, no functional binocularity should be expected. Houlton[5] found no binocularity in 14 surgically treated congenital esotropic patients, and Kennedy and McCarthy[6] reported simultaneous macular perception (or first-degree fusion) in only 1 of 85 cases.

In defining congenital esotropia, Costenbader[7] described it as that type of strabismus that was present by 6 months of age, characterized by a large deviation unresponsive to spectacle treatment of the existing hyperopia. He emphasized that early alignment of the eyes was a necessity if any functional results were to be expected. This view was not shared by Berke,[8] who reported that the congenitally strabismic child would have little or no fusion ability despite early alignment.

Costenbader[9] described a case of congenital esotropia that he had surgically aligned by the time the patient was 16 months of age and whom he examined five years later. This patient demonstrated phoria responses on cover testing and the ability to fuse Worth 4 lights at 13 in, and Costenbader concluded that this patient had a form of binocularity or cure. In his review of Berke's[8] paper, Costenbader introduced several concepts that have influenced the subsequent studies in this area. He declared that although achievement of perfect stereopsis would be the ideal binocularity level, lesser grades of binocularity were also highly desirable and were, indeed, possible provided one surgically aligned strabismic eyes early enough in life. Lyle and Bridgeman[10] claimed that surgeons must therefore be prepared to operate on extremely young children and infants for the reflexes of normal correspondence to be developed.

Costenbader[11] published findings on infantile esotropia, which he defined as esotropia present by the first year of life; some of these cases, obviously, included congenital esotropia. It was primarily this latter group for whom he advised early surgery, at 6 to 18 months of age. It was also in this paper that Costenbader declared that there seemed to be some merit in performing early surgery even though alignment was not attained at the first operation. He also observed that gross stereopsis (worse than 100 seconds of arc) and visualization of the Worth 4 lights was apparently possible with small residual angles of deviation in some cases. He admitted, however, that in this study there were far too few esotropic infants who had been aligned by the age of 1 year to obtain findings of statistical significance. However, Leahey[12] denied that there was ever a possibility of obtaining stereoscopic vision in an aligned congenital esotropic child.

Taylor[13] must be given credit for the first published series of binocular results when, in 1963, he described 12 of 24 children with manifest congenital esotropia who attained phoria following surgical management. Taylor also emphasized that the alignment should be obtained early, preferably before the age of 2 years, and that residual deviations over 10 PD precluded a functional result. This author advised selective operations on more than two recti muscles, and on the oblique muscles if necessary.

The advice to operate on infants as young as 6 to 12 months of age in congenital esotropia was challenged by von Noorden[14] in the first of a group of spirited letters to the editor following publication of Taylor's paper. It was von Noorden's contention that an operation on infants as young as 6 to 12 months of age would be based on inadequate information on the character of the deviation and lead to a high number of overcorrections and undercorrections, thereby detracting from the original purpose. Costenbader,[15] in his letter published simultaneously, entered the controversy at this time in support of Taylor's position. Costenbader reaffirmed his earlier stance that, like Taylor, he believed very early surgery gave a higher incidence of functional results. He reminded others that, in his opinion, there was some merit in early surgery even though perfect alignment was not attained in the first operation. Costenbader also stated in this letter that although the preoperative measurements of the deviation were often less than exact, the response to surgical management of strabismus was not exact at any age; therefore, the failure to obtain perfect measurements should not be a deterrent to early surgery.

Meanwhile, certain European ophthalmologists, such as Arruga and Downey,[16] remained reluctant to advocate early surgery and stated that most cases would be merely reduced to small angles of anomaly. The question arose as to whether or not small angles of residual deviation could co-exist with binocularity in some cases. Jampolsky et al[17] discussed the fact that, within certain physiologic limits, exact and steady bifixation did not take place and that everyone had a minute amount of normal fixation disparity. Ogle et al[18] had shown that this disparity could be fused if it fell within the so-called Panum's fusional areas, and that these areas were 6 to 10 minutes of arc near the macula in normal binocularity but increased with the peripheral angles. Therefore, Ogle and Jampolsky declared that fixation disparity was a normal occurrence.

Jampolsky[19] went on the explore small-degree esodeviations in 1962 and concluded that much larger deviations could still show some binocularity. He believed that a mixture of phoria and tropia could co-exist in some patients, and that it was not necessarily an all-or-none (fusion or tropia) situation. Jampolsky emphasized that vergence movements in response to prisms and amblyoscope targets could, somewhat surprisingly, occur in the presence of frank tropias. In his concept of "fusion disparity," Jampolsky pointed out that the cover test was not an infallible criterion by which to differentiate heterophoria from heterotropia, and he suggested that a comparison of the simultaneous prism and cover test with the alternating cover test would reveal the mixture of phoria and tropia. According to this author, measuring the manifest portion of the deviation could be accomplished by simultaneously covering the fixing eye while introducing the appropriate base-out prism over the deviating eye then comparing this invariably lower figure with the quantity of prism needed to neutralize the deviation on the alternating cover test.

Contemporarily, in 1961, Parks and Eustis[20] described a clinical condition that also showed features of both a phoria and a tropia and was characterized by a quantity of deviation much larger than the 6 to 10 minutes of arc of normal disparity described by Ogle; indeed, it appeared to be many times that figure (up to 6 PD). These monofixational esophoric patients, as they were called, in addition to showing a difference between the simultaneous prism cover test and alternating cover test, were able to fuse Worth 4 lights in most instances and had gross stereopsis (up to 67 seconds of arc). Although it was not until 1969 that Parks[21] further delineated this clinical condition and named it the monofixational syndrome, it was becoming apparent that this was the type of binocular result so prevalent in the presumably cured congenital esotropic patient. Six out of 100 cases Parks presented in his extensive clinical study of patients with monofixation were indeed surgically aligned congenital strabismus cases. As early as 1961, Parks and Eustis[20] described patients they termed "secondary" monofixational phoria cases that demonstrated peripheral fusion of Worth 4 lights but only gross stereopsis. Prior to his full description of the monofixation syndrome, Parks,[22] in 1968, had also recommended tests for stereoacuity as indicators of bifixation since he believed both orthophoria and heterophoria could be maintained by peripheral fusion alone. He reported that a stereoacuity of 40 seconds of arc or better was an indicator of bifixation and that any steroacuity less than that level was an indication of monofixation. He also believed that monofixation was perhaps the best binocularity that congenital esotropic patients, when aligned, could demonstrate. Nevertheless, Parks[23] like Taylor and Costenbader, was a staunch advocate of early surgical alignment in patients as young as 6 months of age.

Ing et al[24] presented the results of a long-term study (average: 9½ years) of congenital esotropic patients who received their first surgical treatment by 18 months of age. These authors studied a group of patients who had esotropia by 6 months of age, who had no neurologic lesions, and who were considered to have, at least initially, no accommodative component of their strabismus. This clinical investigation, which became known as the "Washington study," had been underway in 1963 and was mentioned by Costenbader in his 1964 letter to the editor in support of Taylor's recommendation of early surgery. It was reported in this study that 22 out of 50 patients had a demonstrable type of binocularity. Most of the 22 patients fused Worth 4 lights at 13 in and, if they did achieve that level of binocularity, they also demonstrated fusional amplitudes with the amblyoscope. Twenty-one of the 22 patients showed some degrees of gross stereopsis. These investigators concluded that this type of binocularity, which they termed peripheral, could be attained by early surgical intervention, and that surgical treatment before the age of 1 year yielded the highest percentage of patients exhibiting this binocularity. They also concluded that foveal fusion (bifixation) was not attainable in congenital esotropia.

Fisher et al[25] contested one of the conclusions of the Washington study. After reanalyzing the data of this study, they reported that surgery for congenital esotropia performed on infants between the ages of 6 to 12 months did not lead to statistically significant better results than surgery performed on infants between the ages of 12 to 24 months.

The controversy continued when von Noorden et al[26] disagreed with the conclusion reached by the Washington group that it was important to operate by the age of 18 months. These investigators reported a comparable success rate in children whose first surgical treatment occurred between the ages of 18 months and 5 years. This group also called attention to the often neglected fact that most previous studies had provided correlations with the age of initial surgery, which did not necessarily coincide with the age of alignment. They reasoned that it was vitally important to define the time by which alignment should be completed because, if Chavasse was correct, any significant residual deviation would probably prevent the development of normal binocular reflexes. Parks,[27] in 1971, pointed out that it was important to differentiate between acquired esotropia and congenital esotropia because children with acquired esotropia would have a better prognosis for satisfactory alignment and fusional result following surgery since the neurophysiologic basis of fusion would have been established before the onset of the strabismus.

It was in the discussion of Parks'[27] 1971 paper that Jampolsky said he would prefer to have a demarcation line set at 12 months for describing the surgical treatment of congenital esotropia as "very, very early" (under 12 months) or merely "very early" (12 to 24 months).

By the early 1970's, the concept of attempting early surgical alignment for congenital esotropia was finally becoming accepted by investigators practicing outside of the United States. Stumpf,[28] of Germany, reported a series of cases in 1971 that showed a higher percentage of binocularity correlated with surgery for alignment in infants under the age of 2 years. In 1972 Gale,[29] of Australia, reported on a small series of patients who were treated surgically even before the age of 6 months. Uemura,[30] of

Japan, reported in 1973 that in his series of cases binocularity had been established in 4 out of 9 patients aligned by the age of 2 years, while a lesser percentage was found in those treated surgically after the age of 2; no binocular results were found where the age at surgery was 3 years or older.

Also in contrast with von Noorden's study, Taylor,[31] in 1972, declared no binocularity was demonstrable in his 102 patients who were aligned after the age of 2 years and challenged the concept that only peripheral fusion and gross stereopsis are attainable by the aligned congenital esotropic patient. Taylor found evidence of binocularity in 30 of 50 patients treated surgically by the age of 2 and, in four of these patients, he found a stereoacuity of 40 seconds of arc. Taylor did conclude, however, that "the vast majority of congenital esotropes who are converted from a manifest tropia to a phoria through early effective surgery do, indeed, function with a slight deficit and, with slight exception, fall within the confines of a clinical entity described by Parks as the monofixation syndrome." In this paper, Taylor advocated selective surgery that might include more than two recti muscles in the initial surgical procedure to more effectively eliminate the strabismus. This plan differed from the previous surgical plans reported by the Washington study and by von Noorden, where only two recti muscles were surgically treated in the initial attempt at alignment.

In 1976, Foster et al,[32] preferring the term infantile esotropia, described the treatment results of 34 cases and, like Taylor, advocated full initial surgical alignment even if that effort involved more than two recti muscles. This group of investigators preferred the cover-uncover test to demonstrate "bifoveal motor fusion," and it was obvious that they preferred a different standard of cure than the Washington group. They did report, however, that the percentage of binocularity was higher if initial surgical treatment was performed by the age of 2 years. In addition, they emphasized that postoperative nurturing of the result with postoperative spectacle orthoptics (minus lenses or prisms or both) enhanced the results.

Reinecke,[33] in 1979, joined the advocates of early surgery as he agreed that the prognosis for a functional result was better when surgical treatment was performed by 2 years of age.

Most recently, Hiles et al,[34] in 1980, reported a series of 54 infantile esotropic patients who had been followed up for at least five years. These investigators believed that their study underscored the instability of the findings in these patients. They reported that 37 (69%) of their patients had one or more forms of nystagmus (rotary being the most common, 42

(78%) had overaction of one or both inferior oblique muscles, and 41 (76%) manifested dissociated vertical divergence (DVD). Although a fusion response to Worth 4 lights at 13 in was present in 34 (63%) of their patients at some time during the period of observation, it apparently fluctuated as did the stereoacuity. Fifty-two of the 54 patients in the Hiles study required "medical" therapy in the form of miotics or glasses or both at some time during the period of observation. These authors concluded that only approximately 22 (40%) of the patients remained stable after the initial surgical treatment and that although final angle of alignment to 10 PD was achieved in 44 (81%), many required secondary surgical procedures.

It was obvious, from the preceding discussion, that since 1950 there had been an evolution of thought among clinicians with regard to the surgical treatment of congenital esotropia. Although there was not yet full agreement on what type of cure was possible, and there was the recognition that any binocularity established might fluctuate during the period of observation, it was acknowledged by most investigators that adequate surgical alignment was a prerequisite for any binocularity. The optimum time to achieve this surgical goal was yet to be determined to the satisfaction of the majority of investigators of this type of strabismus.

NEUROPHYSIOLOGIC RESEARCH

While the controversy about the early surgical treatment for congenital esotropia continued among the clinicians, two neurobiologists at Harvard, Hubel and Wiesel,[35-39] began a series of reports that were believed to be laboratory rationale for the concept of early surgical management by at least one of the clinical investigators.[31] The Harvard researchers first showed, in 1962, that 80% of the cortical neurones in the cat were binocularly driven, 10% driven by the ipsilateral eye and 10% driven by the contralateral eye. The receptive fields of binocularly driven neurones lay on corresponding points, and their simultaneous stimulation resulted in a summation of response. They artificially disrupted the development of vision in cats during the first three months of life by suturing the lids together or by applying an occluder contact lens over one eye. These researchers found, in 1965, that there was a loss of cortical cells that could be driven binocularly and a substantial decline in the number of cells that could be influenced by the deprived eye. Significantly, they also reported that similar, but less severe, physiologic and anatomic consequences occurred when normal binocularity was disrupted by their artificially creating strabismus in these cats by section of one of the rectus muscles.

The period of susceptibility of these deprivations was early life (up to three months); in addition to the lack of function of cortical cells, morphologic hypoplastic changes in the lateral geniculate body of the ipsilaterally deprived eye were found. Hubel and Wiesel discovered too that the results of closing one eye depended somewhat upon whether or not the other eye was closed also, so that the resultant damage might not have been simply disuse but perhaps dependence upon the interaction of the two pathways.

Guillery and Stelzner,[40] in 1970, contributed to the knowledge of deprivation effects when they found that unilateral closure affects the cells of the *binocular* segment of the lateral geniculate nucleus in the cat. Guillery,[41] 1972, also showed that geniculate cells compete for development for available synaptic surfaces upon cortical cells and that success in this competition depends upon the nature of the visual input. More recently, in 1978, Guillery[42(p9)] stated:

The visual loss, the response properties of cortical cells, and the growth of geniculate cells are all affected much more severely within the binocular segment of the nucleus than in the monocular segment, and the difference between the effects seen in the two segments provides a good measure of the extent to which each of the changes is produced by a competitive interaction.

The above conclusions were also reached by Sherman[43] who, in addition, pointed out that all of the previously described abnormalities in the cat were brought about only if the visual deprivaton occurred in the first few postnatal months.

In 1974, Blakemore and Van Sluyters[44] examined the extent to which the physiologic effects of monocular deprivation could be reversed in kittens within the sensitive period. These authors not only defined the postnatal time during which the reverse suture was effective but also showed that the development of binocular neurones required a binocular visual environment.

That year Baker et al[45] found that yet another animal, the monkey, shared the effects of visual deprivation, and they reported that these animals had smaller cells in the lateral geniculate nuclei of the deprived eyes. Von Noorden and Middleditch,[46] in 1975, also found, in the monkey, that less severe visual deprivation, such as artificially created strabismus, affected primarily binocularly driven cortical cells and that the histologic changes occurred only in the dorsal parvicellular layers of the deprived lateral geniculate body.

Van Sluyters[47] pointed out in 1978 that cortical binocular neurones are thought to be the substrate for binocular fusion and stereopsis. He reported that stereopsis had been shown to be deficient in cats lacking binocular cortical cells. Of obvious importance, he believed, was the fact that although reverse eye closure could restore visual acuity to an amblyopic eye up to a certain age, the prognosis for achieving fusion and stereopsis by this procedure would be poor. In summary, Van Sluyters reports

Animal studies on recovery from monocular deprivation suggest the following guidelines for treatment of human amblyopia: (1) therapy should be instituted as early in life as possible, (2) while procedures which utilize imbalanced visual stimulation can improve performance through the amblyopic eye, they may do so at the expense of binocular vision, and (3) when binocular stimulation techniques are employed, proper eye alignment must be maintained at all times.

This author believed that a therapeutic regimen based on the above guidelines should be effective in improving visual acuity in cases of amblyopia and offered the best chance of restoring binocular vision; he reported, however, that it was conceivable that the cortical connections subserving binocularity were more fragile and, once broken, irreparable. In his opinion, the likelihood of this last possibility might be shown in future, more sophisticated animal experiments, but he acknowledged that the final answer could only come from carefully controlled clinical studies.

Van Noorden[48] reminded clinicians in 1978 that they could not automatically conclude that early surgical alignment of the eyes in children with congenital esotropia was sufficient to restore or maintain normal binocular functions, and at that time there was still no useful primate model available for the study of congenital esotropia.

However, bridging the gap between animal experiments in the laboratory and clinical studies by ophthalmologists, there appears to be a group of psychophysical investigations of the interocular transfer of the tilt after-effect in human beings. Briefly, this investigation is conducted by exposing one eye of the person to a high-contrast grating tilted slightly away from the vertical, and then presenting to the other eye a vertical test grating. This latter test grating appears rotated in the opposite direction to the first for a short time in persons with normal binocularity. If the adapting grating is viewed with one eye and the test grating with the other, the interocular transfer is defined as the quantity of transfer of the after-effect from the adapted eye to the unadapted eye. Since it was believed that this test should reflect the proportion of binocular, as opposed to monocular, neurones, Movshon et al,[49] in 1972, tested three groups of persons: (1) those who had normal binocularity, (2) those who had no history of strabismus but had no stereopsis, and (3) those who were both strabismic and lacked stereopsis. The normal persons were found to have a mean transfer (70%), nonstrabismic persons without stereopsis had moderate transfer (40%), and those with strabismus showed grossly reduced mean transfer (12%).

In a similar experiment in 1974, Mitchell and Ware[50] showed that an absence of the interocular transfer of the tilt after-effect occurred in four stereoblind persons whereas, in normal persons, there was a correlation between percentage transfer and degree of stereoacuity. In their opinion, both stereoacuity and the extent of interocular transfer depended upon the proportion of cortical cells that were binocular as opposed to monocular.

Banks et al,[51] in the following year, described a sophisticated experiment in which 24 persons with abnormal binocular experience caused by esotropia that was initially seen at different periods of their lives were tested for the interocular transfer of the tilt after-effect. These authors selected their subjects according to the following criteria: (1) concomitant esotropia during some period of life, (2) preoperative deviation greater than 20 PD (10°), (3) postoperative deviation less than 10 PD and corrected visual acuity better than 20/60 in the less affected eye, and (4) a reasonably well-defined age at which the strabismus appeared and a well-defined age at which it was surgically corrected. The data presented by these investigators showed that congenital esotropic patients who had received early corrective surgery tended to develop greater cortical binocularity than those who had later surgery. These authors believed that the data contradicted any theory that congenital esotropia was uncorrectable—at least in terms of the development of cortical binocularity. In addition, they reported: "Our primary conclusion is that the sensitive period for the development of binocularity begins several months after birth and peaks between one and three years of age. In cases of congenital esotropia, early corrective surgery appears to be indicated for the development of cortical binocularity."

Therefore, it appeared that, in contrast to the previous circumstances in which the laboratory experiments were found to offer a rationale for preceding clinical impressions, there now remained a need for a more acceptable clinical study to match what had been found in the neurophysiologic laboratory.

PATIENT SELECTION AND METHODS OF STUDY

I conducted a multicenter study of patients with congenital esotropia. Patients were selected according to the following criteria: (1) a history of esotropia from the age of six months or younger, (2) confirmation of this diagnosis by an ophthalmologist by the time the patient was 1 year of age or by an examination by 18 months of age if other features accompanying congenital esotropia, such as DVD and low hyperopia, were present,[52] (3) surgical alignment was achieved within 10 PD of orthophoria for a minimum of six months, and (4) sufficient maturity to reliably respond to sensory testing.

Patients with neurologic abnormalities were excluded.

I personally examined all patients except those I had previously treated. The tests were uniformly performed on all patients, using the same testing instruments. The corrected Snellen visual acuity was obtained. The cover testing was performed with strict accommodation control techniques that included wearing full refractive correction and fixating 20/30 letter targets at distance and near. The various cover tests included the cover-uncover test, the simultaneous prism and cover test, and the alternate cover test. Versions were tested, including a search for A- or V-patterns. The sensory tests were as follows: (1) Bagolini striated glasses with fixation target at 0.333 m, (2) Worth 4 lights at 0.333 m with the large, conventional lights and small ("micro") lights, and (3) stereoacuity measured with the Polaroid Titmus vectographic stereotest.

At the end of the motor and sensory tests, the patient's clinical record was examined and abstracted, with particular emphasis on obtaining the following information: (1) age at onset of the esotropia, (2) first confirmation of the esotropia by an ophthalmologist, (3) initial cycloplegic retinoscopy, (4) initial measurements of the strabismus, (5) the age at which initial alignment to within 10 PD of orthophoria had been achieved for a minimum of six months, (6) additional surgery and course of the strabismus, (7) adjunctive measures such as patching, glasses, miotics, and prisms, and (8) the impression of the patient's ophthalmologist regarding the status of binocularity.

After examining the compiled histories, further refinement was attempted to exclude patients with acquired or accommodative esotropia from the study.

All patients were eliminated from this study if, by 12 months of age, they did not have a confirming examination by an ophthalmologist, even though it is acknowledged that acquired accommodative esotropia has been found as early as 4½ months of age.[53] Also eliminated were patients whose history was unreliable or conflicting, who had high hyperopia and whose history suggested acquired esotropia, or who had a history of never having been adequately aligned. One patient was excluded who had less than one year of follow-up from the last surgical procedure, another because the history revealed that adequate alignment was never attained.

Two patients were eliminated because of unreliable sensory examination answers.

Following is a summary of patient selection for this study:

1.	Total centers participating in study	8
2.	Total countries in which centers are located	3
3.	Total number of patients examined for the study (Eight of the author's patients were included in the study and report but were examined by one of the participating strabismologists under the same condition of no previous knowledge of patient history.)	162
4.	Patients excluded and reason	
	(a) Delayed confirmation of strabismus	40
	(b) Unreliable or conflicting history	10
	(c) High hyperopia and history suggesting acquired esotropia	2
	(d) History of never having been adequately aligned	1
	(e) Less than one year follow-up from last surgical procedure	1
	(f) Unreliable answers on sensory examination	2
5.	Total patients retained for study (Male 54, female 52)	106

See the Appendix for complete data on all 106 cases, presented individually.

RESULTS

For the purposes of comparison in the various parameters included in the study, the patients were divided into four subgroups according to the age of initial adequate surgical alignment (Table I through XIII).

The subgroups included patients (1) aligned by age 6 months (cases 1 through 20); (2) aligned by age 7 to 12 months (cases 21 through 66); (3) aligned by age 13 to 24 months (cases 67 through 90); and (4) aligned by age 25 to 79 months (cases 91 through 106).

All patients, by at least 12 months of age, had their initial confirmation of the esotropia by an ophthalmologist but it was believed important to calculate the average age of confirmation for the various subgroups. The ages at which the diagnosis for congenital esotropia was confirmed through direct observation by an ophthalmologist are compared in Table I, which shows that the average age of confirmation was 4 months in the earliest-aligned group, but was similar for the other subgroups and averaged 7 months overall.

Since the length of follow-up from the initial adequate surgical alignment was believed to be important, these figures are shown in Table II. It is apparent that the average length of follow-up for all the subgroups was similar, and the average was eight years, four months for the group as a whole.

A comparison of the length of follow-up from the last surgical procedure is shown in Table III. The average length of follow-up time was also similar for the four subgroups.

To rule out any significant difference in the initial refractive error for the four subgroups, a comparison of these data is shown in Table IV (excluding the few initially myopic cases: 22, 29, 53, 55, and 105). There was an average of low hyperopia for all subgroups, and the range and average was similar for all subgroups.

The initial deviations using the largest measurement (for either near or distance) are compared in Table V. The average initial deviation was also similar for the four subgroups.

The number of horizontal muscle procedures performed to achieve alignment, at the time of this study, was determined for each subgroup. Table VI shows these data along with a comparison of the percentage of cases in that subgroup that had required that particular number of surgical procedures. The numbers of procedures performed for each of the subgroups were remarkably similar. The data also show that approximately one half of the patients overall had achieved their motor alignment from a single horizontal muscle procedure, and that at least one third received a second horizontal muscle procedure.

Vertical muscle procedures, which included surgery for the oblique and vertical recti muscles, are shown in Table VII, as well as the percentage of cases within that particular subgroup that had received vertical muscle surgery. Approximately one third of all cases received vertical muscle surgery.

Several investigators[32,34,54] have claimed that once alignment is achieved, glasses or miotics or both are needed to nurture the result in a

TABLE I: AGE DIAGNOSIS CONFIRMED BY OPHTHALMOLOGIST'S EXAMINATION

ALIGNMENT AGE (MO)	MINIMUM-MAXIMUM (YR:MO)	AVERAGE (YR:MO)
0 - 6	0:3-0:6	0:4
7-12	0:3-1:0	0:6
13-24	0:5-1:0	0:8
25-79	0:5-1:0	0:8
Total	0:3-1:0	0:7

TABLE II: LENGTH OF FOLLOW-UP FROM INITIAL ADEQUATE SURGICAL ALIGNMENT

ALIGNMENT AGE (MO)	MINIMUM-MAXIMUM (YR:MO)	AVERAGE (YR:MO)
0 - 6	4:2-16:7	8:7
7-12	4:1-17:5	8:8
13-24	2:9-23:0	8:4
25-79	2:3-21:8	7:9
Total	2:3-23:0	8:4

TABLE III: LENGTH OF FOLLOW-UP FROM LAST SURGICAL PROCEDURE

ALIGNMENT AGE (MO)	MINIMUM-MAXIMUM (YR:MO)	AVERAGE (YR:MO)
0-6	1:1-12:6	6:6
7-12	1:3-17:6	7:0
13-24	1:5-23:1	7:1
25-79	1:1-21:10	7:4
Total	1:1-23:1	7:0

TABLE IV: INITIAL REFRACTION (SPHERICAL EQUIVALENT)

ALIGNMENT AGE (MO)	MINIMUM-MAXIMUM (D)	AVERAGE
0-6	+0.50- +4.50	+1.42
7-12	+0.50- +5.25	+2.04
13-24	+0.25- +4.25	+1.78
25-79	Plano- +3.75	+1.26
Total	Plano +5.25	+1.60

TABLE V: INITIAL DEVIATION (PRISM DIOPTERS)

ALIGNMENT AGE (MO)	MINIMUM-MAXIMUM	AVERAGE
0-6	40-85	62
7-12	20-70	54
13-24	20-70	54
25-79	20-90	52
Total	20-90	55

high percentage of cases. In general, this condition was found to be true for the patients in this study. The number of patients and percentage of patients within the four subgroups who received spectacle or miotic treatment or both is shown in Table VIII. At least one half to two thirds of all patients in all subgroups required this type of therapy.

By defining residual amblyopia as a corrected visual acuity difference of one line or more, the incidence of amblyopia varied insignificantly in the various subgroups, as shown in Table IX. Only two of the amblyopic patients showed a difference in visual acuity between the two eyes by more than two lines, and one of these patients (case 46) demonstrated peripheral fusion and gross stereopsis.

Some investigators[32,55] claim that motor alignment data are the criteria for any conclusions about results in strabismus surgery. Using this definition of "cure," the results for the four subgroups are shown in Table X, in which phoria or intermittent tropia, small-angle tropia (10 PD or less) and large-angle tropia (more than 10 PD) are compared. Approximately the same percentage of cases in the first three subgroups achieved phoria or intermittent tropia, and only slightly fewer achieved this goal in the latest-aligned subgroup. Also, three patients who did achieve the goal of phoria or intermittent tropia in the last subgroup achieved adequate alignment by the age of 3 years (cases 91, 92, and 97). Overall, there is no statistically significant difference in the motor alignment results of the four subgroups. (Chi square = 7.4, 6° of freedom, not significant.)

The incidence of dissociated vertical divergence is known to be as high as 76% in some series.[34,56] This motor anomaly was found to be highly prevalent in the patients in this study also, and the number of percentage for each subgroup is shown in Table XI.

The four-prism base-out test was clearly reproducible or observable in only 46 patients in the study in which it was used. Of these, 11 patients appeared to have a fusional vergence response to the introduction of the base-out prism. In the other 35 patients, monofixation or a scotoma was found. However, in general, the test was not found to be helpful in distinguishing binocularity in the patients.

In the Bagolini striated glasses test, the patient was asked to fixate a small light held at 0.333 m while looking through plano glass with fine striations 45° in one eye and 135° in the other. In this test, the striations give rise to a streak that emanates from the light at 90° to the striations.

TABLE VI: NUMBER OF HORIZONTAL MUSCLE PROCEDURES

ALIGNMENT AGE (MO)	1 (%)	2 (%)	3 OR 4 (%)	NO. OF CASES
0-6	11 (55)	7 (35)	2 (10)	20
7-12	26 (57)	16 (34)	4 (9)	46
13-24	13 (54)	8 (33)	3 (13)	24
25-79	8 (50)	5 (31)	3 (19)	16
Total	58 (55)	36 (34)	12 (11)	106

TABLE VII: NUMBER OF PATIENTS WHO RECEIVED VERTICAL MUSCLE SURGERY

ALIGNMENT AGE (MO)	PATIENTS (%)	NO. OF CASES
0-6	8 (40)	20
7-12	14 (30)	46
13-24	10 (41)	24
25-79	3 (18)	16
Total	35 (33)	106

TABLE VIII: NUMBER OF PATIENTS WHO RECEIVED SPECTACLES OR MIOTICS

ALIGNMENT AGE (MO)	PATIENTS (%)	NO. OF CASES
0-6	11 (55)	20
7-12	31 (67)	46
13-24	17 (71)	24
25-79	13 (81)	16
Total	72 (68)	106

TABLE IX: INCIDENCE OF AMBLYOPIA

ALIGNMENT AGE (MO)	PATIENTS (%)	NO. OF CASES
0-6	10 (50)	20
7-12	17 (37)	46
13-24	12 (50)	24
25-79	5 (31)	16
Total	44 (41)	106

The patient could theoretically report seeing (1) a cross with or without a central scotoma, or break, in the striations over one eye (indicating binocularity), or (2) rarely, two lights with their respective streaks, or (3) visualization of one of the streaks, but never both at once (no bin-

TABLE X: PRESENT ALIGNMENT				
ALIGNMENT AGE (MO)	PHORIA OR INTERMITTENT TROPIA (%)	SMALL-ANGLE TROPIA (%)	LARGE-ANGLE TROPIA (%)	NO. OF CASES
0-6	6 (30)	14 (70)	0 (0)	20
7-12	17 (37)	26 (56)	3 (7)	46
13-24	11 (46)	13 (54)	0 (0)	24
25-79	3 (18)	11 (69)	2 (13)	16
Total	37 (35)	64 (60)	5 (5)	106

TABLE XI: NUMBER OF PATIENTS WITH DISSOCIATED VERTICAL DIVERGENCE		
ALIGNMENT AGE (MO)	PATIENTS (%)	NO. OF CASES
0-6	16 (80)	20
7-12	26 (57)	46
13-24	15 (62)	24
25-79	10 (62)	16
Total	67 (63)	106

TABLE XII: RESULTS OF BAGOLINI STRIATED GLASSES TESTING			
ALIGNMENT AGE (MO)	BINOCULARITY (%)	NO BINOCULARITY (%)	NO. OF CASES
0-6	20 (100)	0 (0)	20
7-12	46 (100)	0 (0)	46
13-24	23 (96)	1 (4)	24
25-79	7 (44)	9 (56)	16
Total	96 (91)	10 (9)	106

TABLE XIII: RESULTS OF WORTH 4 LIGHT AND STEREOPSIS TESTING				
ALIGNMENT AGE (MO)	FUSION AND STEREOPSIS	FUSION OR STEREOPSIS	NEITHER	NO. OF CASES
0-6	15	5	0	20
7-12	38	4	4	46
13-24	15	7	2	24
25-79	2	3	11	16
Total	70	19	17	106

ocularity).[57,58] The patients with binocularity were encouraged to switch fixation if manifest deviations were present and to observe if the scotoma was transferred to the other eye.

Bagolini striated glasses minimally disturb the view of the natural environment. The results of testing with these striated glasses are shown in Table XII. It is significant that, in contrast to the patients aligned by 6, 12, or 24 months of age—in which nearly all showed a binocular response—less than one half of those aligned after the age of 24 months showed a binocular response. Most of the latest-aligned subgroup alternatingly saw only one of the light streaks at a time. These patients clearly manifested no binocularity with this test.

The Worth 4 light tests with conventionally sized lights and smaller ("micro") lights were performed at 0.333 m. As previously described by Parks[21] and Taylor,[31] the size of the scotoma in monofixation patients, or those with small-angle deviations and fusion, can be obtained by moving the larger, standard-size Worth 4 near lights away from the patient and doing geometric calculations. This scotoma has been shown to average 3° by Parks in his monofixation syndrome patients and 1° 37 seconds in 60% of the congenital esotropic cases considered cured by Taylor. In the present study, a different method of comparison was used since the smaller lights subtend an angle of only 1.25°,[59] whereas 6° is subtended by the conventional near lights. The patient who fused the smaller light, was presumed to have a smaller scotoma than one who could only fuse the larger lights.

The stereoacuity measurements, made by the Polaroid Titmus vectograph overlay, were recorded in seconds of arc. The stereopsis test reproducibility was continually checked throughout the examination. As mentioned by Reinecke,[60] the validity of the stereopsis test is checked by simple reversal of the target; in this case, the proper response is that the circle with disparity now appears to be recessed rather than standing out toward the patient. Whenever stereopsis was found in this study, the validity was checked using the above method.

The results of the crucial sensory examination with Worth 4 lights and stereopsis testing are seen in Table XIII. Because it was believed patients with both fusion *and* stereopsis probably had a more secure form of binocularity than those showing only one of these two qualities, the table displays the number, with these functions noted separately. Table XIII also shows the number from each subgroup who responded negatively to either sensory test. These results are also displayed in percentages in the Figure. Alignment achieved by any age through 24 months results in a high percentage of patients with evidence for binocularity, but a much smaller percentage of those aligned after the age of 24 months shows these functions. The differences between the first three subgroups compared with the latest-aligned subgroup reach a high level of statistical significance (chi square = 46.9, probability of error less than .001, 6° of freedom), while the difference in results between each of three earlier aligned subgroups did not (chi square = 7.03, 4° of freedom, not significant).

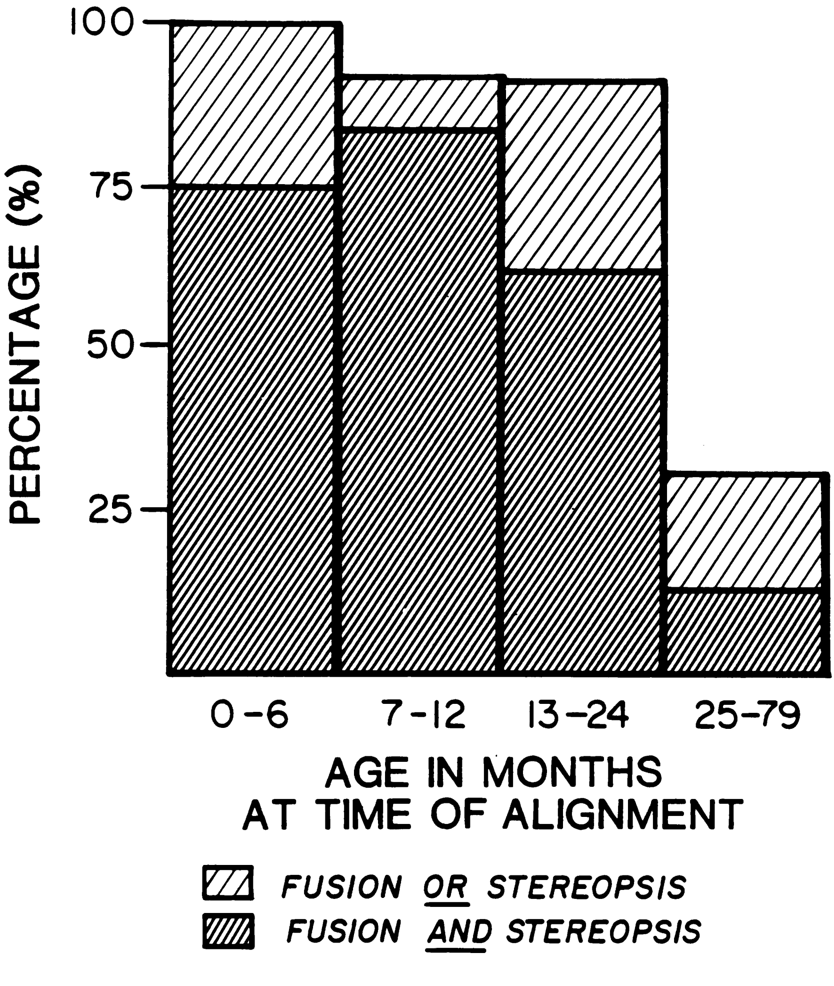

FIGURE
Binocularity results of patients adequately aligned.

The size of the scotoma varied in the patients who demonstrated fusion with Worth 4 lights. Only 48 out of a total number of 86 patients who fused the larger lights at 0.333 m could also fuse the smaller lights at the same distance as well; these patients, therefore, demonstrated smaller scotomas. Forty-four patients who fused the smaller lights as well as the larger lights also demonstrated stereopsis, but 28 of the patients who failed to fuse the smaller lights did demonstrate some stereopsis. In addition, there were two patients who did not fuse either large or small lights but who, nevertheless, demonstrated some stereopsis. Conversely, there were 16 patients who fused either large or small Worth 4 lights or both who had no stereopsis.

DISCUSSION

It has been pointed out by Taylor[31] that it is indeed unusual for an ophthalmologist to have the opportunity to make the diagnosis of "congenital" esotropia at birth. However, it has been generally accepted by most investigators that, despite the risk of some cases being extremely early "acquired esotropia," the diagnosis can be reasonably made if the onset of the esotropia is apparent before 6 months of age.[7,24,52,61-64]

As noted in the historical review, previous studies have sought to determine the optimum age of alignment for the congenital esotropic patient. Although these studies have reached some preliminary conclusions, they have usually been based on the age at initial surgery rather than on the age of initial adequate alignment, and they have often lacked adequate controls. A truly prospective, randomized, blind study is not possible because the age of initial adequate alignment does not always correspond to the age of initial surgery, and there is no way to prospectively determine the former.

A retrospective study, therefore, is mandatory, but to provide more reliable data the methods of examination and diagnosis were standardized for this study.

Examiner bias was also minimized by having all the tests performed prior to any knowledge of the patient's clinical history by the examiner. The tests were standardized by using the same method of examination, and the same instruments throughout the study.

For the purposes of comparison, the patients were divided into four subgroups according to the age of initial adequate surgical alignment. All the subgroups were similar in (1) length of follow-up time from the initial adequate alignment, (2) length of follow-up time from the last surgical procedure, (3) initial refractive error, (4) initial deviation, (5) number of horizontal muscle procedures, (6) number of vertical muscle procedures,

(7) incidence of amblyopia, (8) postoperative nurturing of the results by spectacles or miotics, (9) incidence of DVD, and (10) motor alignment at the time of the study.

The study clearly showed that the one major parameter in which there was a statistically significant difference was the evidence for binocularity. Binocularity results in patients aligned after the age of 24 months were substantially less than in those aligned before that age ($P < .001$).

Of the 20 patients aligned by the age of 6 months, 100% showed evidence of binocularity, and those patients aligned by the age of 12 months and by 24 months also had a high percentage of binocularity. There was not a statistically significant difference in binocularity among the earlier-aligned subgroups. The results of the present study, therefore, concur with a smaller, less controlled series previously reported.[32]

Fusion of the Worth 4 lights can be demonstrated in patients with up to 8 PD of heterotropia. Some investigators[21,24,56] have concluded with Costenbader[11(p408)] that the "visualizing of four lights in the presence of bifoveal fixation, or even in the presence of a small manifest esotropia, suggests a more stable binocular relationship than if no fusion could be demonstrated." Parks believed that these patients obtained peripheral fusion despite a foveal esodeviation by virtue of the ability of Panum's visual space for peripheral binocular vision to encompass a retinal image disparity up to 5° of esodeviation. Parks also pointed out that fusional vergence amplitudes in monofixation are comparable to those in bifoveal fixation. Since all patients who attained fusion of Worth 4 lights were also shown to have fusional ability with the major amblyoscope in two previous studies,[21,24] the latter test was not used in this investigation.

As reported in the previous section of this study, there was not an exact correlation between fusion of either larger or smaller Worth 4 lights and the finding of stereopsis. Some patients with one function did not demonstrate the other. These findings support the concept that they are different facets of binocular function.

Of the few patients who did demonstrate any evidence for binocularity in the group aligned after 24 months of age, only two showed both fusion and stereopsis, and both of these were aligned before the age of 3 years. One patient in the latest-aligned group (case 103) did, however, show evidence of gross stereopsis with a small residual angle of deviation, even though he was not adequately aligned until after 4½ years of age. Therefore, it is possible to establish some (although weaker) evidence for binocularity even at that later age.

As found in another study,[31] it was possible to establish refined (40 seconds of arc) stereopsis for the aligned congenital esotropic patient, but it was extremely rare to achieve this degree of excellence in stereoacuity. Most of the patients with stereopsis ability achieved only what has been designated as "gross" (200 to 3,000 seconds of arc) stereoacuity. In general, the vast majority of patients who showed a functional cure with stereopsis fell within the confines of the monofixation syndrome.

Lang has found that 40% of convergent strabismus cases have microtropia.[65] It is interesting to note that 64 of 106 patients (60%) in this series had manifest deviations of 10 PD or less, but there were significant differences in the binocular function of the patients with microtropia that were correlated with the age of alignment. The majority of those aligned before the age of 24 months evidenced binocularity; only a small percentage of those aligned after the age of 24 months with a resulting manifest deviation did so.

Parks[21] further elucidated the concept that patients with small manifest deviations could, nevertheless, demonstrate binocularity. He has concluded that Lang's microtropia cases are, in fact, the syndrome he earlier described as "monofixational phoria." These cases were earlier described by Lang as having unilateral strabismus of less than 10 PD, harmonious anomalous corrrespondence with partial stereopsis, and usually slight amblyopia in the nonfixating eye. Parks, however, disagreed with the conclusion that abnormal retinal correspondence (ARC) existed in these patients although the findings of several sensory tests such as the bifoveal correspondence test of Cuppers were interpreted as such by Lang. Parks concluded that the ARC finding in these patients was spurious since he believed that there was still a good possibility that Jampolsky's original concept of normal retinal correspondence (NRC) peripheral fusion was being obtained with a stretched-out Panum's fusional space.

Jampolsky[55] has called the cover test the "supreme court test" of binocularity, and this test was routinely performed in the present study. However, he had earlier concluded that there was a surprising mixture of tropia and phoria in his "fusional disparity" cases,[19] and it is apparent that up to at least 8 PD of heterotropia can co-exist with peripheral binocularity in the monofixation cases discussed by Parks.[21]

Furthermore, as pointed out by Parks,[21] an absence of a manifest deviation may or may not indicate bifixation, and a more reliable indicator of bifixation appears to be refined stereoacuity. Many strabismologists have seen a case of presumably well-aligned congenital esotropia slip into an exotropic position, and it is reasonable to conclude that at one time these same previously esotropic cases were close to or definitely "orthophoric" on their way to exotropia. It was obvious from this clinical study that binocularity could be clearly demonstrated only by relying on sensory tests to augment a clinical impression derived from motor tests alone.

The inadequacy of trying to rely solely on motor alignment to evaluate treatment is demonstrated by the results of tests in case 105. This patient was aligned by 6½ years of age and was thought to be binocular and "bifoveal" by his own ophthalmologist (he had not been subjected to any sensory test). The patient apparently had no previously detectable squint, but he definitely showed a small-angle tropia on the examination for this study. He did not demonstrate any binocularity with Worth 4 lights or stereopsis testing or even with Bagolini striated glasses. Apparently, it is just a fact of life that some patients may have eyes that appear straight but have no measurable binocularity. Perhaps squint, like beauty, is in the eye of the beholder, but a study of this particular case also emphasizes the principle that a fair comparison of the results in treatment of congenital esotropia can only be made by using the same testing devices and standards of examination.

Testing with Bagolini striated glasses resulted in visualization of a cross with or without a break in one of the streaks by the patients with binocularity. However, the break, or scotoma, was not consistently found or reported, despite a manifest deviation being occasionally present on the cover-uncover test. The cover-uncover test has been used with striated glasses in an attempt to classify patients with NRC or ARC. According to the originator of the test,[57] if a deviation is seen on the cover-uncover test, the case was automatically classified as ARC, but Parks[21] challenged this concept in his discussion of the monofixation syndrome. According to Parks, the presence of the monofixation syndrome, with the invariable central scotoma in one eye during binocular viewing, would permit a much larger deviation before ARC must be developed to replace NRC in achieving peripheral fusion. Parks explained that despite the inexactness of the intersection of the visual axes at the light, Panum's fusional space, being sufficiently large peripherally to the scotoma, would permit the peripheral simultaneous perception with NRC. This is a similar reasoning he had applied to the previous discussion of Lang's conclusion that ARC existed in the latter's microtropia cases.

Perhaps it suffices to say that whatever the retinal correspondence, a binocular response to the Bagolini striated glasses was found much less frequently in patients aligned after the age of 2 years. Although the binocular responses did not always indicate fusion or stereopsis or both, it was invariably found if either of these other qualities of binocularity were found.

SUMMARY AND CONCLUSIONS

1. Controversy concerning the optimum age of surgical alignment for congenital esotropia has been prolonged in the literature by the inability of authors to agree on criteria for both diagnosis and cure.
2. Neurophysiologic research has provided evidence that suggests that earlier, rather than later, surgical alignment should provide a better developed neurophysiologic matrix for binocular result.
3. To provide adequate numbers of patients who varied in age of initial adequate alignment, over 150 patients treated by seven different strabismologists were personally examined by me for a clinical study.
4. To minimize bias, the examination was performed without the examiner having any knowledge of the clinical history of the patient, and the tests were standardized in both method of examination and testing devices.
5. From the patient population group, 106 patients were selected for this clinical report by having a definite history of esotropia established by 6 months of age and a confirming examination by an ophthalmologist by at least 12 months of age (average age of confirmation overall was 7 months).
6. The patients reported in this study were divided into four subgroups, depending upon the age of initial adequate surgical alignment, for the purposes of comparison. The various subgroups were followed for an average of eight years, four months overall and showed similarity in all parameters except in the evidence for binocularity.
7. Although the motor alignment was essentially as good for all patients, the results of sensory testing showed that patients aligned after 24 months of age demonstrated a significantly lower percentage with evidence of binocularity ($P < .001$).
8. Most of the patients who appreciated stereopsis obtained that perception only from relatively large degrees of horizontal image disparity (140 to 3,000 seconds of arc) so that, while more refined stereopsis was demonstrated, it was extremely rare to find this degree of excellence in stereoacuity.
9. The results of sensory testing in those adequately aligned by the age of 6 months vs 12 months vs 24 months were not statistically different, and all three of these subgroups showed a high percentage of patients with evidence of binocularity.
10. The results of the present clinical study demonstrate that the initial adequate surgical alignment in the congenital esotropic patient should be accomplished by 2 years of age to attain the highest yield of binocular function.

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Appendix

Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth.
1) TB (Dr E)	11:1	0:4	0:4	+1.50 OU	ET'70	Recess MROU (0:4) Recess IOOU (7:5)	- / -	20/25 20/20	E 2 E'4	fusion	binoc.	+ / +	800	++	+
2) SH (Dr E)	8:1	0:4	0:4	+1.00 OU	ET'70	Recess MROU (0:4) Recess LROU (1:8)	+ / -	20/30 20/30	ET 8, DVD OU ET'8 - 10, DVD'OU	--	binoc.	+ / -	3000	++	+
3) JH (Dr E)	14:6	0:5	0:5	+0.50 OU	ET'70	Recess MROU (0:5) Resect LROU (1:7) Recess IOOU (7:8) Recess LROU (11:1)	+ / +	20/20 20/20	XT 18, DVD OU LHT'6	--	binoc.	+ / +	800	++	+
4) CM (Dr F)	6:0	0:4	0:5	+1.50 OU	ET 70	Recess MROU (0:5) Resect RLR (0:5)	- / -	20/40 20/30	ET 4, DVD OU ET'4, DVD'OU	scotoma OD	binoc.	+ / -	none	++	?
5) RA (Dr A)	8:0	0:3	0:6	+4.50 OU	ET 45	Recess MROU (0:6)	+ / +	20/20 20/25	ET 6 - 12, DVD OS ET'15 - 20, ET'bif 8	--	binoc.	+ / -	3000	++	+
6) SK (Dr A)	10:0	0:6	0:6	+1.50 OU	ET 85	Recess MROU (0:6) Recess IOOU (2:7)	- / +	20/30 20/20	DVD OD X'6	--	binoc.	+ / +	3000	++	+
7) JM (Dr A)	8:7	0:3	0:6	+2.50 OU	ET 55	Recess MROU (0:6) Resect LMR (5:7) Recess LLR (5:7) Recess LIO (5:7) Advance LMR (6:9)	+ / -	20/25 20/25	ET 4, RHT 6 ET'30, ET'bif 4	--	binoc.	+ / -	none	+	+
8) GM (Dr A)	11:6	0:4	0:6	+2.00 OU	ET 65-70	Recess MROU (0:6) Resect LROU (3:0)	+ / +	20/30 20/25	ET OD 6 - 10, DVD OU ET'OD 4	--	binoc.	+ / -	800	++	+
9) SS (Dr A)	7:3	0:6	0:6	+0.25 OU	ET 60	Recess MROU (0:6) Recess LROU (2:2) Recess IOOU (2:2)	- / -	20/30 20/30	DVD OD ET'OD 4	?fusion	binoc.	+ / -	none	+	+
10) DT (Dr B)	6:10	0:3	0:6	+0.75 OU	ET 50	Recess MROU (0:6)	- / +	20/40 20/40	ET 2 - 8, DVD OU ET'4 -20, DVD'OU	scotoma OS	binoc.	+ / -	200	++	+
11) LT (Dr B)	6:5	0:2	0:6	+0.75 OU	ET'60	Recess MROU (0:6)	- / +	20/25 20/30	EX 0, DVD OU, RH 8 XT'4, DVD'OU	--	binoc.	+ / -	3000	++	+

Appendix

Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth.
12) AA (Dr E)	17:3	0:4	0:6	+1.00 OU	ET'60	Recess MROU (0:6) Recess LROU (6:2)	+ / -	20/20 20/20	ET 4 - 10 (OS) ET'6	--	binoc.	+ / +	800	++	+
13) JF (Dr E)	13:0	0:4	0:6	+0.75 OU	ET 40 ET'60	Recess MROU (0:6)	+ / -	20/20 20/20	XT 6 - 12, DVD OD E'2, RH'2	fusion	binoc.	+ / +	800	++	+
14) MG (Dr E)	7:3	0:6	0:6	+1.25 OU	ET'50	Recess MROU (0:6) Resect LROU (3:9) Recess IOOU (3:9)	- / -	20/30 20/20	ET 4 - 6 ET'6	scotoma OD	binoc.	+ / +	3000	++	?
15) MM (Dr E)	10:6	0:6	0:6	+1.50 OU	ET 70	Recess MROU (0:6) Recess LROU (2:6) Recess IOOU (2:6)	- / -	20/25 20/30	ET 4, DVD OU ET'4, DVD'OU	scotoma OS	binoc.	+ / +	200	++	+
16) SS (Dr E)	12:9	0:3	0:6	+0.75 OU	ET 40	Recess MROU (0:6) Recess RIO (3:0) Resect RIR (3:0)	- / -	20/20 20/20	X 6, DVD OU XT'20, DVD'OU	?fusion OU	binoc.	- / -	400	+	-
17) DV (Dr F)	5:0	0:5	0:6	+0.75 OU	ET 60	Recess MROU (0:6) Resect LLR (0:6)	- / -	20/20 20/30	?DVD (OD) DVD'(OD)	fusion	binoc.	+ / -	3000	++	+
18) SD (Dr F)	4:9	0:4	0:6	+1.50 OU	ET 40	Recess MROU (0:6)	- / -	20/25 20/30	XT (OS) 10, DVD (OS) X(T)'6	--	binoc.	+ / +	3000	++	-
19) KD (Dr F)	10:2	0:4	0:6	+1.00 OU	ET 60	Recess MROU (0:6)	- / -	20/20 20/20	XT 10, LHT 6, DVD OS X(T)'4, LHT'6	--	binoc.	+ / -	140	++	-
20) KV (Dr F)	7:6	0:6	0:6	+3.50 OD +3.00 OS	ET 50-60	Recess MROU (0:6) Resect LLR (0:6)	+ / -	20/30 20/40	XT 10, DVD OU ET'6, DVD'OU	--	binoc.	+ / +	none	+	-
21) MM (Dr A)	6:2	0:6	0:7	+0.50 OU	ET 45	Recess MROU (0:7) Displace down (0:7)	+ / +	20/30 20/30	ET 10 - 15 ET'30, ET'bif 4	--	binoc.	+ / +	800	++	+
22) SB (Dr A)	11:5	0:4	0:7	+4.25 OD +3.50 OS	ET 45	Recess MROU (0:7)	- / -	20/30 20/30	RH(T) 2 RH(T)'2	scotoma OD	binoc.	+ / +	400	++	+
23) MG (Dr E)	11:10	0:7	0:7	-1.00 OD plano OS	ET'70	Recess MROU (0:7)	+ / +	20/20 20/25	ET 4, DVD OU ET'15 - 20, Lat. nystagmus	--	binoc.	+ / -	3000	++	+

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity This exam	Own ophth.
24) BC (Dr E)	0:6	0:6	0:7	+5.00 OD +2.25 OS	ET'70	Recess MROU (0:7) Recess IOOU (3:5) Recess LROU (3:5)	+ / -	20/30 20/25	ET 4, DVD OU ET'4, DVD'OU	scotoma OD	binoc.	+ / +	400	++	+
25) DR (Dr E)	8:0	0:5	0:7	+3.50 OU	ET 40	Recess LMR (0:7) Resect LLR (0:7) Recess RMR (2:0) Resect RLR (2:0)	+ / -	20/20 20/20	XT 8, DVD OU DVD'OU	scotoma OS	binoc.	+ / -	none	+	+
26) RL (Dr E)	10:6	0:6	0:7	+0.50 OU	ET 45	Recess MROU (0:7) Resect LROU (1:2) Recess IOOU (2:6) Extirpate RIO (5:6)	- / -	20/20 20/20	XT 17, RHT 8 X(T)'8, RHT'4	--	binoc.	+ / +	3000	++	+
27) LT (Dr E)	6:5	0:3	0:7	+1.25 OU	ET'70	Recess MROU (0:7)	- / -	20/25 20/30	XT 10, DVD OU E(T)'6, DVD'OU	fusion	binoc.	+ / +	800	++	?
28) BM (Dr F)	8:3	0:6	0:7	+1.00 OU	ET 60	Recess MROU (0:7) Resect LLR (0:7)	- / -	20/30 20/30	ET 6, RHT 4 ET'4, DVD'(OD)	--	binoc.	+ / +	400	++	+
29) JM (Dr F)	5:2	0:4	0:7	plano OD -5.25 OS	ET 65-70	Recess MROU (0:5) Resect LLR (0:7)	+ / +	20/30 20/40	EX 0 ET'4	scotoma OS	binoc.	+ / +	3000	++	?
30) LD (Dr A)	9:5	0:6	0:8	+2.00 OU	ET 40	Recess MROU (0:8) Recess RIO (2:2)	- / +	20/20 20/20	DVD OU (slight) ET'OS 8 - 10, DVD'OU	fusion	binoc.	+ / +	3000	++	+
31) JI (Dr A)	7:2	0:6	0:8	+3.00 OU	ET 40	Recess MROU (0:8)	+ / -	20/25 20/25	ET 20 - 35, DVD OU ET'40, EX'bif 0, DVD'OU	--	binoc.	+ / -	800	++	-
32) CD (Dr B)	9:7	0:2	0:8	+2.25 OU	ET 35	Recess MROU (0:8)	+ / +	20/20 20/20	X 4, DVD OU XT'6 - 8, DVD'OU	--	binoc.	- / -	none	-	-
33) JM (Dr B)	7:7	0:3	0:8	plano OU	ET 50	Recess MROU (0:8)	- / +	20/30 20/30	EX 0, DVD OU EX'0, DVD'OU	scotoma OD	binoc.	+ / -	400	++	+
34) AB (Dr E)	17:0	0:4	0:8	+1.37 OD +1.50 OS	ET'30-70	Recess MROU (0:8) Resect RIR (15:7) Resect LIR (15:8)	- / -	20/20 20/20	DVD OU DVD'OU	?fusion	binoc.	+ / +	400	++	+

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth
35) DC (Dr E)	18:2	0:8	0:8	+1.75 OU	ET 20 ET'40	Recess MROU (0:8)	- / -	20/20 20/20	DVD OU DVD'OU	fusion	binoc.	+ / +	200	++	+
36) JH (Dr E)	12:3	0:4	0:8	+3.00 OU	ET 65 ET'70	Recess MROU (0:8)	+ / +	20/25 20/25	XT 12, DVD OU, RHT 2 XT'12, DVD'OU, LHT'2	--	binoc.	+ / +	800	++	+
37) CK (Dr E)	8:3	0:5	0:8	+1.75 OU	ET'60	Recess MROU (0:8)	+ / +	20/20 20/20	E 4, DVD OS LH'4, DVD'OS	scotoma OS	binoc.	+ / +	800	++	?
38) GM (Dr E)	10:2	0:7	0:8	+0.50 OU	ET'60	Recess MROU (0:8) Recess IOOU (5:7) Recess LSR (8:1) Recess RSR (8:3)	- / -	20/25 20/20	ET (OD) 4, DVD OU ET'OD 4, DVD'OU, LH'3	scotoma OD	binoc.	+ / +	3000	++	?
39) DW (Dr E)	11:1	0:3	0:8	+0.75 OU	ET 40	Recess MROU (0:8) Recess LROU (8:0) Tenot. SOOU (8:4) Recess IOOU (9:9)	- / -	20/25 20/20	LHT 10+, DVD OS LHT'6	--	binoc.	+ / -	none	+	+
40) EM (Dr F)	6:11	0:5	0:8	+3.00 OU	ET 35-55	Recess MROU (0:8)	+ / -	20/25 20/25	E 4 EX'0	--	binoc.	+ / +	3000	++	?
41) CZ (Dr F)	6:3	0:4	0:8	+4.50 OU	ET 45	Recess MROU (0:6) Recess LROU (0:8)	+ / -	20/30 20/30	ET 8 - 16 ET'10- 12	--	binoc.	+ / -	3000	++	?
42) PR (Dr A)	9:3	0:6	0:9	+3.50 OD +2.25 OS	ET 60	Recess MROU (0:9) Recess LIO (3:2)	+ / -	20/30 20/20	ET 8 - 12 ET'6 - 12	--	binoc.	+ / -	800	++	+
43) JL (Dr E)	12:0	0:6	0:9	+4.50 OD +4.25 OS	ET'70	Recess MROU (0:6) Resect LROU (0:9) Recess LIO (1:5) Myotomy RIO (1:5)	- / -	20/25 20/20	RHT 4 - 6, DVD OU ET'4, RHT'4, DVD'OU	--	binoc.	+ / -	400	++	+
44) GJ (Dr E)	16:0	0:7	0:9	+1.25 OD +2.75 OS	ET'70	Recess MROU (0:9) Recess LROU (3:9) Recess LSR (3:9)	- / -	20/25 20/25	RHT 15, XT 3, DVD OU RHT'10 - 15, XT'6, DVD'OU	--	binoc.	- / -	none	-	+

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth.
45) KW (Dr F)	9:2	0:8	0:9	+3.25 OD +3.50 OS	ET 15-20	Recess LMR (0:9) Resect LLR (0:9) Recess RMR (2:6) Resect RLR (2:6)	+ / -	20/30 20/30	ET 20 DVD OS ET'10 - 12, DVD'OS	--	binoc.	+ / +	3000	++	-
46) SS (Dr A)	7:8	0:9	0:10	+1.25 OD +1.00 OS	ET 65	Recess MROU (0:10) Resect LROU (3:8) Recess IOOU (3:8)	+ / +	20/40 20/80	ET 4, DVD OU DVD'OU, Add. nystagmus	--	binoc.	+ / +	3000	++	+
47) GH (Dr A)	12:4	0:4	0:10	+5.25 OU	ET 45	Recess MROU (0:10) Myotomy LMR (8:8) Resect LLR (8:8) Recess IOOU (8:8)	+ / +	20/20 20/20	ET 30 ET'10 - 25	--	binoc.	+ / -	800	++	+
48) KT (Dr A)	8:10	0:7	0:10	+1.25 OU	ET 60-70	Recess MROU (0:10) Resect LROU (1:9)	+ / -	20/20 20/30	ET OS 4 - 12 ET'6 - 15	--	binoc.	+ / -	3000	++	+
49) MS (Dr E)	6:10	0:9	0:10	+0.75 OU	ET 30	Recess MROU (0:10)	- / -	20/20 20/20	monofixation OS ET'4, LHT'4	scotoma OD	binoc.	+ / +	none	+	?
50) DM (Dr F)	6:4	0:3	0:10	+2.25 OU	ET 75	Recess MROU (0:10) Resect RLR (0:10) Recess LROU (2:2)	- / -	20/30 20/30	LHT 8 - 10, DVD OS LHT'8	scotoma OD	binoc.	+ / +	3000	++	?
51) SS (Dr A)	9:2	0:4	0:11	+1.75 OU	ET 60	Recess MROU (0:5) Resect LROU (0:11)	- / +	20/20 20/30	ET OS 10 - 12, DVD OS ET'OS 4	--	binoc.	+ / +	800	++	+
52) HM (Dr A)	8:3	0:10	0:11	+1.75 OU	ET 45	Recess MROU (0:11) Resect LROU (4:2) Recess IOOU (4:2)	+ / +	20/40 20/30	ET (OD) 35, DVD OU ET'(OD) 35 - 40 Latent nystagmus	--	binoc.	- / -	none	-	-
53) PH (Dr A)	10:11	0:9	0:11	-1.75 OU	ET 55	Recess MROU (0:11) Recess LROU (5:7)	+ / -	20/30 20/40	ET OS 8 - 10 ET'OS 8 - 12	--	binoc.	+ / -	none	+	+
54) DW (Dr A)	11:10	0:10	0:11	+0.75 OD +0.50 OS	ET 75	Recess MROU (0:11)	+ / +	20/50 20/50	ET 4 X'4 Lat. nystagmus	scotoma OD	binoc.	+ / +	3000	++	+

Appendix

Case	Age (years:months) At exam	First dx'd by ophth.	Init. ade-quate align.	Init. ref. (sph. equiv.)	Init. devia-tion	Surgery/Age	Spec. and/or miotics	Pre-sent VA	Present alignment distance and near	4 pd B-O test	Stri-ated glasses	Worth 4 dot macro/ micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Own ophth.
55) ML (Dr B)	8:6	0:6	0:11	-0.50 OU	ET 50	Recess MROU (0:9) Resect LROU (0:11)	+ / -	20/20 20/25	ET 2, DVD OU ET'1, DVD'OU	scotoma OS	binoc.	+ / -	800	++	+
56) TB (Dr E)	5:3	0:7	0:11	+0.75 OU	ET 70	Recess MROU (0:8) Resect LROU (0:11) Recess LROU (1:9) Recess IOOU (1:9) Resect IROU (1:9) Advance LLR (2:7) Recess LSR (2:7)	+ / -	20/30 20/30	X 8, DVD OU X'6, DVD'OU	--	binoc.	+ / -	3000	++	?
57) DB (Dr F)	7:0	0:3	0:11	+2.75 OU	ET 60	Recess MROU (0:11) Resect LROU (0:11)	+ / -	20/30 20/30	ET 6 - 15 ET'6 - 15	--	binoc.	- / -	none	-	-
58) LA (Dr A)	7:1	1:0	1:0	+2.00 OU	ET'70	Recess MROU (1:0)	- / -	20/30 20/30	ET OD 4, lat. nystagmus ET'(OD) 6 - 8	--	binoc.	+ / +	none	++	+
59) MH (Dr A)	13:3	0:10	1:0	+1.75 OD +2.25 OS	ET 80	Recess MROU (1:0)	- / -	20/40 20/40	DVD OU X(T)'10, DVD'OU	--	binoc.	+ / -	800	++	+
60) LW (Dr A)	8:11	0:11	1:0	+2.50 OU	ET 45	Recess MROU (1:0)	+ / +	20/30 20/20	ET OD 12 - 18 ET'OD 6	--	binoc.	+ / +	400	++	+
61) KM (Dr B)	5:2	0:3	1:0	+0.75 OU	ET 25 ET'30	Recess MROU (1:0)	+ / -	20/30 20/30	X 2 X'6	--	binoc.	+ / -	140	++	+
62) RB (Dr B)	10:8	0:8	1:0	+2.50 OD +3.50 OS	ET 20 ET'35	Recess RMR (1:0) Resect RLR (1:0)	+ / +	20/20 20/40	XT 4 XT'6	scotoma OS	binoc.	+ / -	800	++	+
63) KD (Dr E)	7:9	0:6	1:0	+0.50 OU	ET'80	Recess MROU (0:6) Resect LROU (0:8) Resect LROU (1:0) Recess IOOU (1:0)	+ / -	20/40 20/30	XT 20, RHT 6 X'4	--	binoc.	+ / +	800	++	?
64) DF (Dr E)	15:11	0:11	1:0	+4.75 OD +3.00 OS	ET 40	Recess MROU (1:0)	+ / -	20/50 20/30	ET OD 4, RHT 2 RHT'4	--	binoc.	+ / +	800	++	+

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth
65) CG (Dr E)	15:11	0:11	1:0	+1.25 OU	ET'70	Recess MROU (1:0)	+ / +	20/20 20/20	ET 2 - 15, DVD OU ET'6 DVD'OU	--	binoc.	+ / +	800	++	+
66) JR (Dr E)	8:6	0:10	1:0	+0.75 OU	ET 16 ET'20	Recess MROU (1:0) Recess LROU (3:6) Recess IOOU (3:6) Recess LROU (7:3) Recess RIO (7:3)	- / -	20/20 20/20	XT (OS) 10 X'6	--	binoc.	+ / +	800	++	+
67) PB (Dr A)	8:10	0:10	1:1	+3.00 OD +3.50 OS	ET 50	Recess MROU (1:1)	- / -	20/25 20/30	ET 4, DVD OU X'6, DVD'OU	--	binoc.	+ / -	800	++	+
68) AF (Dr A)	8:3	1:0	1:1	+0.50 OD +0.25 OS	ET 40	Recess MROU (1:1) Recess LROU (3:9) Recess IOOU (3:9)	+ / -	20/20 20/25	DVD OU ET'4, DVD'OU	scotoma OS	binoc.	+ / +	800	++	+
69) JF (Dr A)	7:0	0:8	1:1	+2.75 OU	ET 30	Recess MROU (1:1) Recess IOOU (3:0)	+ / -	20/30 20/25	ET 8 - 15 (OD), LHT 2 ET'6	--	binoc.	+ / -	3000	++	+
70) FA (Dr B)	9:3	0:8	1:1	+2.00 OU	ET 17-25	Recess MROU (1:1) Tenotomy RIO(3:2)	- / -	20/20 20/20	ET 4 (OD) EX'0	scotoma OD	binoc.	+ / +	140	++	+
71) RJ (Dr E)	14:2	0:7	1:1	+1.25 OU	ET'70	Recess MROU (0:9) Resect LROU (1:1) Resect LLR (6:0) Resect LIR (6:0) Recess MROU (9:0) Recess RSR (9:0)	- / -	20/20 20/25	EX 0 DVD OU ET'4 - 8, DVD'OU	scotoma OS	binoc.	+ / +	400	++	-
72) BK (Dr A)	11:0	1:0	1:2	+2.00 OU	ET 45	Recess MROU (1:2)	+ / +	20/25 20/40	ET 8 - 20 ET'20, ET'bif 6 - 18	--	binoc.	+ / -	none	+	+
73) DW (Dr E)	7:0	0:5	1:2	+1.00 OU	ET'70	Recess MROU (0:6) Resect LROU (1:2) Recess IOOU (2:0) Extirp IOOU (5:7)	+ / +	20/30 20/40	ET 4 - 8, DVD OU ET'4 - 8, DVD'OU	scotoma OS	binoc.	+ / +	800	++	+

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth.
74) GR (Dr A)	5:9	0:9	1:3	+1.50 OU	ET 55	Recess RMR (1:1) Resect LLR (1:1) Recess LIO (1:1) Recess RMR (1:3) Resect RLR (1:3)	- / -	20/30 20/30	ET OD 4 EX'0	scotoma OD	binoc.	+ / -	3000	++	+
75) ST (Dr A)	7:7	0:5	1:3	+2.00 OD +2.25 OS	ET 65-70	Recess MROU (0:6) Resect LROU (1:3)	+ / +	20/30 20/25	XT 15, DVD OD X'4 DVD'(OD)	--	binoc.	+ / -	none	+	+
76) CS (Dr E)	17:5	1:0	1:3	plano OD +0.50 OS	ET'70	Recess MROU (1:3) Advance RMR (1:11) Recess LROU (2:2) Recess LIO (2:2) Advance LMR (2:2) Resect MROU (3:0)	- / -	20/30 20/25	ET 8, LHT 10 ET'8, LHT'6	--	binoc.	+ / -	none	+	+
77) DB (Dr H)	24:4	0:6	1:3	+2.50 OU	ET 60-70	Recess MROU (1:3) Resect LLR (1:3)	+ / -	20/20 20/20	DVD OU DVD'OU, slight X'	fusion	binoc.	+ / +	40	++	+
78) KG (Dr A)	6:5	0:5	1:4	+2.00 OU	ET 65	Recess RMR (0:10) Resect RLR (0:10) Recess LMR (1:4) Resect LLR (1:4)	+ / -	20/30 20/30	DVD OU XT 8, DVD'OU	scotoma OS	binoc.	+ / +	none	++	+
79) KN (Dr A)	8:6	0:8	1:4	+1.25 OU	ET 60	Recess MROU (0:9) Resect RLR (1:4) Recess RIO (1:4) Myotomy LMR (2:8) Resect LLR (2:8)	+ / +	20/30 20/30	DVD OU X'4	scotoma OS	binoc.	+ / +	800	++	+
80) KB (Dr E)	11:0	0:9	1:4	+2.00 OU	ET'70	Recess MROU (0:10) Resect LROU (1:4)	- / -	20/20 20/20	EX 0, DVD OU E'4, DVD'OU	scotoma OD	binoc.	+ / +	800	++	+
81) GD (Dr H)	14:9	1:0	1:4	+0.50 OD +0.67 OS	ET 20 ET'25	Recess MROU (1:4)	+ / -	20/20 20/20	EX 0 EX'0	fusion	binoc.	+ / +	40	++	+

Appendix

Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/ micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth
82) KS (Dr A)	10:2	0:5	1:5	+1.00 OU	ET 55	Recess MROU (0:8) Resect LROU (1:5)	+ / +	20/200 20/30	ET OD 10 ET'OD 10	scotoma OD	no binoc.	- / -	none	-	+
83) CK (Dr C)	7:6	0:6	1:5	+0.50 OU	ET 60-70	Recess MROU (1:5) Resect LROU (1:5)	- / -	20/30 20/30	ET (OS) 6, DVD OS ET'6, add. nystagmus	--	binoc.	+ / +	3000	++	?
84) LG (Dr G)	12:6	0:11	1:6	+2.00 OU	ET 50-60	Recess MROU (1:6) Myotomy IOOU (4:6)	- / +	20/20 20/20	XT 14, LHT 4 X'10	--	binoc.	+ / +	3000	++	+
85) GB (Dr A)	5:11	0:6	1:8	+4.00 OU	ET 75-80	Recess MROU (0:7) Recess LSR (4:5)	+ / +	20/30 20/30	ET 6, DVD OS ET'6, LHT'4	--	binoc.	+ / +	none	+	+
86) KB (Dr E)	9:8	1:0	1:8	+1.00 OU	ET 70	Recess MROU (1:8)	+ / -	20/20 20/20	ET OS 4, DVD OU E'4, DVD'OU, latent nystagmus	fusion	binoc.	+ / +	400	++	+
87) DK (Dr A)	7:10	0:11	1:8	+0.75 OU	ET 20	Recess MROU (1:8)	- / +	20/40 20/30	ET (OS) 8 - 15	--	binoc.	+ / -	3000	++	+
88) JM (Dr C)	8:1	0:5	1:10	+4.25 OU	ET 30-40	Recess MROU (1:10) Resect LROU (1:10)	+ / -	20/20 20/20	ET 6, LHT 6, DVD OU ET'4, DVD'OU	--	no binoc.	- / -	none	-	-
89) AB (Dr F)	4:10	0:8	1:11	+2.50 OD +1.25 OS	ET 20	Recess MROU (1:11)	+ / -	20/30 20/25	ET 10 - 14, DVD (OS) ET'10 - 14, DVD'(OS)	scotoma OD	binoc.	+ / +	none	+	-
90) ML (Dr A)	10:2	0:8	2:0	+2.50 OU	ET 65	Recess MROU (2:0) Recess IOOU (2:0) Tenotomy IOOU (8:5) Resect RLR (8:5) Myotomy RLR (8:5)	+ / -	20/30 20/25	ET OD 4, DVD OD ET'(OD) 4 Latent nystagmus	scotoma OD	binoc.	+ / -	3000	++	-
91) MT (Dr A)	13:3	0:6	2:4	+3.75 OU	ET 80-90	Recess MROU (2:0) Resect LROU (2:4) Recess IOOU (2:4)	+ / -	20/30 20/30	XT 8, DVD OS XT'12	--	no binoc.	- / -	none	-	+
92) LM (Dr B)	10:0	0:6	2:4	+1.00 OD +1.25 OS	ET 65	Recess MROU (0:11) Resect LROU (1:3) Myotomy MROU (2:0) Re-resect LROU (2:4)	+ / -	20/30 20/30	XT 6, DVD OU EX'0, DVD'OU	scotoma OD	no binoc.	- / -	none	-	-

Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity This exam	Evidence for binocularity Own ophth
93) LA (Dr H)	20:7	1:0	2:4	+3.00 OU	ET 50-60	Recess MROU (2:4) Recess LMR (10:8) Resect LLR (10:8)	+ / -	20/20 20/20	DVD OU DVD'OU, X'12	scotoma OS	binoc.	+ / +	none	+	-
94) RK (Dr D)	4:10	0:7	2:6	plano OU	ET 70	Recess MROU (2:6)	+ / -	20/15 20/20	ET 4 - 6, DVD (OS) ET'6, Lat. nystagmus	scotoma OS	binoc.	+ / +	none	+	+
95) CZ (Dr H)	11:2	0:7	2:8	+1.50 OD +2.00 OS	ET 55-60	Recess MROU (0:8) Resect LROU (2:8)	- / +	20/30 20/30	ET 4, DVD OS, LHT 2 LHT'2	scotoma OS	binoc.	+ / -	3000	++	+
96) EL (Dr A)	6:10	0:6	2:11	+1.50 OU	E(T)45	Recess MROU (1:7) Myotomy LMR (2:11) Resect LLR (2:11)	- / -	20/30 20/30	ET 25, DVD OU ET'15	--	no binoc.	- / -	none	-	-
97) WK (Dr A)	13:2	0:6	2:11	+1.75 OD +1.50 OS	ET 50	Recess MROU (2:11) Recess LROU (3:10) Recess IOOU (3:10) Myotomy LLR (10:6) Resect LMR (10:6)	- / -	20/20 20/20	XT OS 2 X(T)'10	scotoma OS	binoc.	+ / -	800	++	+
98) BB (Dr H)	25:0	1:0	3:2	+2.37 OU	ET 60 ET'55	Resect LROU (2:7) Recess MROU (3:2)	+ / -	20/20 20/20	XT 18, LHT 6 XT'20, LHT'6	--	no binoc.	- / -	none	-	-
99) GS (Dr D)	10:0	0:8	3:6	+1.50 OU	ET 40	Recess LMR (3:6) Resect LLR (3:6)	+ / -	20/20 20/25	ET 10, RHT 4 ET'10, RHT'2	--	no binoc.	- / -	none	-	-
100) DA (Dr D)	7:8	0:9	3:4	+1.50 OD +2.00 OS	ET 50	Recess LMR (3:4) Resect LLR (3:4) Myotomy LIO (3:4) Resect RMR (3:4) Disinsert RIO (3:4)	+ / -	20/40 20/20	ET 4, LHT DVD OU XT'4, LHT'6, DVD'OU	--	no binoc.	- / -	none	-	-
101) SB (Dr C)	13:8	1:0	3:10	plano OU	ET 40	Resect LLR (3:10) Recess LMR (3:10)	- / -	20/20 20/20	ET 14, LHT 6 ET'6 - 12, DVD'OU	--	no binoc.	- / -	none	-	?
102) DA (Dr B)	6:7	0:6	3:10	plano OU	ET 30 ET'50	Recess MROU (0:8) Resect LROU (0:11) Myotomy LMR (3:10)	+ / -	20/25 20/20	ET 25 ET'25, ET'bif 12	--	binoc.	- / -	none	-	-

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Case	Age (years:months) At exam	First dx'd by ophth.	Init. adequate align.	Init. ref. (sph. equiv.)	Init. deviation	Surgery/Age	Spec. and/or miotics	Present VA	Present alignment distance and near	4 pd B-O test	Striated glasses	Worth 4 dot macro/micro	Stereo acuity (in sec. of arc)	Evidence for binocularity: This exam	Evidence for binocularity: Own ophth.
103) SB (Dr D)	10:8	0:8	4:6	plano OU	ET 20	Recess MROU (4:6)	+ / -	20/15 20/25	ET 4 - 15 ET'4 - 20	fusion	binoc.	- / -	800	+	+
104) BC (Dr D)	9:6	0:8	6:3	+0.50 OD +0.75 OS	ET 30	Recess RMR (6:3) Resect RLR (6:3)	+ / -	20/15 20/15	XT 4, DVD OU ET'4, DVD'OU	scotoma OD	no binoc.	- / -	none	-	+
105) KD (Dr C)	17:4	0:5	6:6	-11.00 OD -9.50 OS	ET 40	Recess LMR (6:6) Resect LLR (6:6)	+ / +	20/30 20/30	ET 4, DVD OD ET'8, lat. nystagmus	scotoma OS	no binoc.	- / -	none	-	+
106) ML (Dr D)	7:8	0:7	6:7	plano OU	ET 30-60	Recess RMR (6:7) Resect RLR (6:7)	+ / -	20/40 20/40	ET 8 - 30, RHT 6, DVD OU ET'6 - 15, DVD'OU Latent nystagmus	--	binoc.	- / -	none	-	-