THE BROAD CLINICAL SPECTRUM OF EARLY INFANTILE ESOTROPIA*

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INTRODUCTION

MUCH OF THE DISCUSSION OF INFANTILE ESOTROPIA IN RECENT YEARS HAS FOCUSED on the optimal time for surgical correction.[1-10] Treatment recommendations have tended to center on this aspect of management, often in highly selected subgroups of patients. More broadly inclusive accounts of infantile esotropia have suggested a lack of uniformity of patients with the condition,[5,11-13] as well as variability in their course following surgical alignment.[14] Since it may not be clear at the time of early examination which patients will have spontaneous improvement in their misalignment,[11] which will experience temporary or permanent realignment with nonsurgical methods of treatment,[15,16] and what will be the response to efforts at surgical correction,[14] it would seem important to examine the variability in characteristics and course of an inclusive group of patients with early infantile esotropia in order to put in perspective our efforts to achieve early surgical realignment. Although retrospective analyses of groups of patients suffer from the limitations of incomplete and sometimes inaccurate data, they may help to define clinical experience and sharpen questions to be addressed in future investigations. The present review of 75 patients with early infantile esotropia, treated and followed since 1965, was undertaken with these aims in mind.

PATIENTS AND METHODS

The records of 258 patients that had been considered to have early infantile esotropia when first examined by one of the authors (RMR) between 1965 and 1980 were reviewed. Patients that had been seen in consultation or for a single visit (75 patients), those that had moved elsewhere or were otherwise lost to follow-up (28 patients), those that had

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strabismus surgery elsewhere (45 patients), and those whose initial ophthalmological examination was after 14 months of age (30 patients) were excluded from further study. Five patients with ocular abnormalities that probably influenced their strabismus (oculocutaneous albinism, infantile hemangioma of the eyelid, hypoplasia of the optic nerve, and cataracts) were also excluded from further consideration, leaving a total of 75 patients for study. All patients were seen and followed by a single ophthalmologist at The Children's Hospital in Boston. Patients were referred by personal contacts, pediatricians, and other physicians in the hospital and community. The average age at the time of first ophthalmological examination was 7.9 months. The onset of esotropia by history was before 3 months in 59 patients and between 3 and 6 months in 16 patients. The average length of follow-up was 8.7 years with a range from 2.7 years to 19 years. Sixty-five of the 75 patients were followed longer than 5 years.

Of the 75 patients reviewed 9 were born prematurely at an average gestational age at 34.3 weeks (range, 32 to 36 weeks) and average birth weight of 4.9 pounds. Two of the prematurely born patients were also in a group of 16 with neurological disease or impairment. These children had one or more of the following: mental retardation (10 patients), cerebral palsy (7 patients), hydrocephalus (3 patients), seizures (2 patients), and Down syndrome (1 patient). Fifty-two patients were born at term and appeared to have normal growth and development except for their strabismus. Nearly one third of the group had a family history of strabismus known to their parents.

RESULTS

The average initial esotropic deviation for all 75 patients was 44 ± 16.5 (mean ± standard deviation) prism diopters (Table I), a value that did not vary appreciably among those who were prematurely born (45 ± 14.9 prism diopters), those with neurological impairment (40 ± 17.3 prism diopters), or those with normal growth and development (46 ± 15.5 prism diopters). Twenty-one patients had alternating fixation patterns and required no patching. Fifty-four patients (72%) had a monocular fixation preference which prompted occlusion therapy for some period of time. Of the latter, 29 patients were patched only during the first 3 years and for periods of less than 18 months, whereas 25 patients required some patching beyond 3 years of age for periods longer than 18 months. Four patients had a reversal of fixation preference from one eye to the other while being occluded, but none was rendered permanently amblyopic in the occluded eye.

TABLE I: INITIAL AND FINAL DEVIATION IN VARIOUS GROUPS OF PATIENTS

GROUP	INITIAL DEVIATION		FINAL DEVIATION		
	NO. OF PATIENTS	ESOTROPIA IN PRISM DIOPTERS*	NO. OF PATIENTS	TYPE OF DEVIATION	AMOUNT IN PRISM DIOPTERS*
All patients	75	44 ± 16.5	66‡§	ET	11.0 ± 8.2
			7	XT	9.1 ± 6.6
Normal growth and development	42	46 ± 15.5	37	ET	10.2 ± 7.5
			5	XT	9.6 ± 7.5
Premature birth	9	45 ± 14.9	9	ET	11.2 ± 7.9
Neurological impairment	16	40 ± 17.3	13‡§	ET	12.5 ± 9.2
			1	XT	4
All surgical patients	54†§	50.5 ± 12.9	48†§	ET	10.8 ± 8.1
			6	XT	10.5 ± 7.1
One operation	36	46.4 ± 12.2	32	ET	9.8 ± 9.1
			4	XT	6.5 ± 5.8
More than one operation	18	58.9 ± 10.4	16	ET	12.7 ± 5.3
			2	XT	13.0 ± 9.9
Nonsurgical patients	18‡	27.5 ± 10	17‡	ET	12.2 ± 8.6
			1	XT	12

*Mean ± standard deviation.
†One patient excluded because surgery restricted to inferior oblique muscles.
‡One patient excluded: surgery declined because of severe mental retardation.
§One patient excluded: second operation declined because of severe mental retardation.
ET = esotropia.
XT = exotropia.

Significant refractive errors requiring glass correction were found in 56 of the 75 patients (75%) at some time during the course of their treatment. Twenty-nine patients had more than 2 diopters of hyperopia, but there were notable variations within this group: 16 patients had relatively stable hyperopia that was corrected with glasses at the time of initial refraction and continued to warrant correction throughout the period of follow-up; 11 patients had hyperopia which increased with time and 5 of these patients were given glasses after initial surgery had been performed; 2 patients had decreasing hyperopia for which glasses were initially prescribed and subsequently discontinued. Four patients had myopic anisometropia of greater than 2 diopters, all had persistent monocular fixation, and two developed deep amblyopia in the more myopic eye despite efforts at occlusion therapy. Another two patients had symmetrical high myopia which increased during the first 4 years. Approximately 40% (23) of the patients who had strabismus surgery wore glasses prior to their first surgery, while an additional 32% (18) were given glasses sometime after an initial operation had been performed. Fifteen of 19 patients (79%) for

whom surgery was not required, wore glasses at some time during the course of their management.

Strabismuc surgery was performed on 56 of the 75 patients with infantile esotropia. All but one patient had horizontal muscle surgery, and this one patient, who had only bilateral inferior oblique myectomies, was excluded from calculations of pre- and postoperative horizontal alignment. One additional patient was excluded from these calculations because the severe degree of his mental retardation became increasingly apparent after an initial operation on the horizontal rectus muscles of one eye had been done, and additional surgery was declined by the parents in spite of a residual 40 prism diopter esotropia. The remaining 54 surgical patients had an average preoperative deviation of 50.5 ± 12.9 prism diopters of esotropia. The surgery was generally performed on two horizontal rectus muscles at each operation, usually a recession of one medial rectus muscle combined with a resection of the lateral rectus muscle of the same eye (50 patients) and only occasionally recession of both medial rectus muscles (4 patients). Additional horizontal muscle surgery was carried out as a secondary procedure when a significant residual esotropia remained. Using this approach 36 patients with an average preoperative deviation of 46.4 ± 12.2 prism diopters of esotropia had one operation, and 18 patients with an average preoperative deviation of 58.9 ± 10.4 prism diopters of esotropia had more than one operation on the horizontal muscles. In 48 patients who were esotropic at the end of the follow-up period the average final deviation was 10.8 prism diopters, and in 6 patients who were exotropic the average residual deviation was 10.5 prism diopters. The final deviations were slightly larger in patients who had more than one surgical procedure than in those who had a single operation (Table I).

Nineteen of the 75 patients with infantile esotropia did not require strabismus surgery. Nine of these were from the group with neurological impairment, two were prematurely born, and nine had apparently normal growth and development. The average initial esotropia in this nonsurgical group was 27.5 ± 10.0 prism diopters. Seventeen patients had an average final esotropia of 12.2 ± 8.6 prism diopters and 1 patient had an exotropia of 12 prism diopters. One patient was excluded from these calculations of initial and final deviation because his level of retardation led his parents to decline surgery despite a 50 prism diopter deviation that would ordinarily have placed him in the surgical group. Nine of the 18 remaining patients in this group had hyperopic refractive errors, for which glass correction was given and had a beneficial effect on the deviation. On the other hand, five of the group were myopic, one had mixed astigmatism, and three had

no significant refractive error.

Seven of the 75 patients became exotropic at some time during the period they were followed. One of these diverged spontaneously from an initial esotropia of 25 prism diopters. He had had straight eyes at age 6 years with some binocular vision and gross stereopsis, but by age 9 years had developed an intermittent exotropia of 12 prism diopters, the eyes being constantly exotropic with distant fixation. The six other patients developed exotropia at varying times following strabismus surgery, two following bilateral recess-resect operations, two following a recess-resect operation on one eye, one after a bimedial recession, and one after recession of both medial recti combined with a resection of one lateral rectus muscle. Three patients required reoperation for their exodeviations, the others having only a modest exotropia of little cosmetic significance. Six of the seven patients who developed exodeviations had evidence of binocular vision at some time during the course of their strabismus, measured with Worth lights and the Titmus stereo test (Titmus Optical Company, Petersburg, VA). Four of the six had lost this evidence of binocularity at the time of their last follow-up examination. Only one patient in the group with consecutive exotropia had retarded mental development; the others were felt to have normal growth and development.

Several additional features of the ocular misalignment present in our group of 75 patients are worthy of consideration. Twenty patients (27%) had sufficient oblique muscle imbalance to warrant surgery. Seventeen bilateral and four unilateral inferior oblique myectomies were performed, either at the time of horizontal rectus muscle surgery or as a separate procedure. The superior oblique muscles were less often found to be overacting, and only one bilateral and one unilateral superior oblique tenotomy were performed. The average age at the time of oblique muscle surgery was 4.5 years, considerably later than the time of horizontal muscle surgery. Dissociated vertical deviations were recognized in 30 of 75 patients (40%), but no surgery was specifically directed to this variable vertical misalignment. Abduction deficiency was noted in the charts of 41 patients (55%), a figure that must be considered approximate since the deficiency of abduction was variable in amount and may not have been recorded in all records. Although incomplete abduction was often associated with increasing jerk nystagmus in lateral gaze, no patient was felt to have the nystagmus blockage syndrome as presently defined.[17] The deficiency of abduction improved with time. It was often less apparent after surgery on the horizontal muscles, but record review did not allow us to establish the timing of this improvement with accuracy. No patient was left with a persistent limitation of abduction. Nystagmus in the primary

position was recorded in 10% of patients, and occlusional nystagmus was present in 16% of the group.

Binocular responses on the Titmus stereo test and the Worth lights were not found in any patient in the premature group and in only three patients with neurological impairment. Of the patients with normal growth and development who had surgical alignment to less than 10 prism diopters of esotropia, four of eight (50%) who were aligned prior to 2 years of age had some binocular vision. Only 3 of 22 patients (14%) who were similarly aligned after 2 years of age had evidence of binocular vision. Five patients with final alignment greater than 10 prism diopters of esotropia had no binocular vision. In the nonsurgical group, including those with neurological impairment, three of five patients who reached an alignment of less than 10 prism diopters of esotropia by 2 years of age had evidence of binocular vision, whereas only one of eight patients who achieved this alignment after 2 years had binocularity. None of the five unoperated patients with esodeviations greater than 10 prism diopters had any evidence of binocular vision. The presence of binocular vision in six of seven patients who developed exodeviations and its loss in four of these patients has been described above. A total of five patients in the operated group and two in the unoperated group who had binocular vision at some point in their course had lost binocularity by the time of their last follow-up examination.

DISCUSSION

The composition of any group of patients with early infantile esotropia will vary with the setting in which the patients have been seen and the referral patterns for ophthalmic care in a given community. Accordingly different proportions of infants with premature birth or neurological impairment will be found in reports on infantile esotropia, and the characteristics of the esotropic deviation itself may vary in different studies. It seems probable that most of the variations in infantile esotropia are represented in the present study. There is a remarkable similarity in the breadth of the clinical picture reported here and in that described by Costenbader in a larger group of patients in 1961.[11] In the interval between these two studies much attention has been focused on the optimal time for surgical correction of infantile esotropia,[1-10] often in selected subgroups, that exclude retrospectively patients with large or asymmetrical refractive errors, amblyopia, variable deviations, mental retardation or cerebral palsy. Spontaneous divergence to an acceptable alignment has seldom been mentioned.[5,6] Recommendations for surgery have therefore been based on examination of a limited part of the population, and may

not be appropriate for all patients. It is not always apparent at the time of initial examination which patients will have important refractive errors, which will require prolonged amblyopia therapy, which will have evidence of neurological impairment, and which will experience a spontaneous change in the angle of misalignment. Repeated examinations over a period of time help to resolve these uncertainties.

It was somewhat surprising to find that 72% of the patients in this group with infantile esotropia required patching for monocular fixation and presumed amblyopia, since alternating fixation has been said to characterize the group.[18] Our patients could be divided roughly into thirds: one third with alternating fixation, one third with monocular fixation requiring limited occlusion, and one third requiring extended occlusion for persistent amblyopia. Glass correction was also necessary for 75% of the patients. Approximately 40% of those who had strabismus surgery wore glasses preoperatively, and an additional 32% were given glasses after at least one operation had been performed. In this latter group were patients who had only moderate hyperopia associated with large initial deviations. Whereas glass correction was not felt to offer a significant reduction in the larger initial esotropia, it did make a significant difference in the smaller residual esotropia following surgery, especially if the amount of hyperopia had increased somewhat with time. This circumstance has been recognized by Raab in a more general discussion of accommodative esodeviations.[19] Nearly 80% of the patients who did not require strabismus surgery wore glasses. Some but not all were hyperopic, and none was felt to have purely accommodative esotropia of early onset.[15,16]

We have not attempted to relate the exact amount of strabismus surgery performed on our patients to the initial and final deviations. It is interesting, however, to note that the average initial esotropic deviation of those patients who had one operation (46.4 ± 12.2 prism diopters) was less than that of those patients who had more than one operation (58.9 ± 10.4 prism diopters), and the average initial deviation of those who had no surgery (26.8 ± 10.2 prism diopters) was least of all. The standard deviations in all groups are large, however, and it would have been difficult to place individual patients in their proper category with accuracy at the outset. One difficulty in this categorization is the uncertainty whether the initial angle of esotropia will increase or decrease spontaneously as it is observed over the first 12 to 18 months of life. Another problem is the potential inaccuracy of prism measurements for angles of deviation over 50 prism diopters.[20,21] The final deviations in our patients were generally small and cosmetically inapparent, perhaps reflecting the observation that

the amount of correction obtained from strabismus surgery is directly related to the magnitude of the initial deviation.[22,23] The somewhat larger residual deviations in the group with neurological impairment reflect a more conservative approach to surgery in these patients and may reveal something of their underlying neuromuscular instability.[12]

Those patients who became exotropic following strabismus surgery were not characterized by any single preoperative feature or by the type or amount of strabismus surgery they underwent. Only one of them had cerebral palsy, a condition generally associated with surgical overcorrection of congenital esotropia.[24] The development of an exodeviation did not seem to be prevented by prior fusion. Most patients who became exotropic had some evidence of binocular vision during the period between their initial alignment and their subsequent exotropia. The instability of a surgical correction in at least some patients with infantile esotropia has been well documented by Hiles.[14]

Binocular vision, as measured by two commonly used sensory tests, was found in only 13% of the total group of patients at the time of last examination. Another 9% had evidence of binocular vision at one time, but had lost it by the end of the follow-up period. As might be predicted on the basis of earlier studies,[8,9] binocularity was found only in those patients who were well aligned, and it was more common in those whose alignment was achieved by 2 years of age (50%) than in those who were straightened later (14%). These results are similar to those reported by others in retrospective studies of selected patients.[2,7] The age factor in determining binocularity seemed to hold true for patients whose esotropia had lessened spontaneously as well as for patients who were straightened surgically. The fact that none of the patients in the premature group developed binocular vision might reflect their final alignment, the age at which alignment was achieved, or merely the small number of patients in this group. The tendency of a significant number of patients to lose previously documented evidence of binocularity in the course of the first decade has been noted before,[14] and raises a question about the ability of fusional responses to maintain ocular alignment once it has been achieved.

Early infantile esotropia is a disorder with a broad clinical spectrum. It requires careful diagnostic efforts and usually both surgical and nonsurgical care over most of the first decade of a patient's life. The timing of possible surgical intervention is an important consideration, but only one factor in many that are needed to provide optimal care for this condition. A better understanding of the cause of the disorder and the variations in its course should allow improvement in our current treatment.

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DISCUSSION

DR SEWART M. WOLFF. Doctor Robb and Ms Rodier have given us a paper that reflects 21 years of experience in pediatric ophthalmology in a large metropolitan children's hospital. As seen retrospectively it outlines problems encountered in the management of the most common ophthalmic affliction of children in this country. Looking at the subject another way, it considers strabismus in the context of coincidental or commonly-related problems in childhood growth and development. Under the umbrella of pediatric ophthalmology, practitioners pursue sub-subspecialties as diverse as genetics, strabismus, congenital glaucoma, and pediatric neuroophthalmology. It is important for the ophthalmologist, whatever his subspecialty, to remember that more than one subset of disorders may be found in the same patient. The authors emphasize the centrality of the patient and the need for prolonged careful repeated observation. I liked the paper.

It stresses variability in the characteristics of patients with early infantile esotropia and variability in the results of treatment. The authors point out that in any strabismic child predictions as to what direction the strabismus will take are difficult at best. Some patients (25%) will straighten spontaneously and will not require surgery.

The methods of treatment described are conventional and emphasize early surgery to achieve approximate mechanical realignment at the earliest possible, practical age. What follows is, supposedly, the restoration of rough binocularity in the presence of good bilateral visual acuity. Good visual acuity is achieved by refraction and patching, as sound practice dictates. Seventy-two percent of the patients reported here required some patching; 79% required glasses. The group described here is as homogeneous as it is possible to be. All patients were observed to have strabismus before 6 months of age and all were followed at least 2.7 years. Most were followed longer than 5 years.

Fifty-six of the 75 patients were operated upon, some more than once. Most were undercorrected a little, some were overcorrected a little. The author performs recessions and resections. I suspect the prevailing procedure in this country is the bimedial recession, but no one should be surprised to note that the results of either approach are about the same.

The data on binocularity are of great interest. It is in this area that the answers to what von Noorden calls the "riddle of infantile esotropia" must lie. In our lifetimes, several giant steps have been made in the management of infantile esotropia. These include the recognition of oblique dysfunction as a cofactor in the strabismus, the identification of the binocular cortex and the timing of its development and, as a logical sequel, the importance of early alignment as a prerequisite to functional binocularity. Now we are positioned to take the next step—the recognition and selection of those patients who have the potential for binocularity—thus, we hope, enlarging the pool of patients who may achieve it.

The authors address the subject that may provide some of the evidence necessary to take that next step—the identification of those who have had binocularity and lost it—and of those who, not having had it, have achieved it. In this case, four of eight patients who were aligned before 2 years of age developed some

binocularity. Seven patients of 75 who had binocular vision lost it. In fact, only 10 of the 75 patients finally had binocularity measurable by the standard tests, although all 75 were cosmetically straight.

It is easy to criticize the methods for measuring binocularity. Certainly they are far from satisfactory. Rough alignment is often accompanied by rough binocularity, although the patient may have no response to stereoscopic testing or be dissociated by haploscopic devices commonly used in the measurement of binocularity. We need better methods for assessing the simpler forms of binocularity.

I would like to ask two questions. First, do the authors think that motor alignment might be improved by early surgery of the obliques, here operated upon much later—at age 4½? Second, many patients demonstrated disassociated vertical divergence. Would earlier surgery for the disassociated vertical divergence have been helpful in these patients?

Finally, I would congratulate the authors on their study of the many parameters of congenital esotropia. The patient group has been carefully studied and there is that wonderful and very important fourth dimension—a long follow-up. This is a valuable addition to the literature addressing a subject of continued interest in ophthalmology. I appreciate the opportunity to have commented on it.

Dr Arthur Jampolsky. It is a priviledge to be able to discuss this paper which I also liked very much. Infantile esotropia has been a subject of much discussion. The title of this last paper, correctly terms it infantile esotropia because it is abundantly clear that it is not congenital. I have long been a champion of clarification of strabismus terminology and descriptions. To perpetuate the term congenital esotropia is simply to perpetuate a misnomer.

There are three important aspects of this paper that I think the authors bring out and are to be congratulated upon. First is the fact that 20% to 25% of these patients have neurologic disease which is not fully appreciated early in life. Secondly, three-quarters of the patients had significant refractive errors. Thirdly, a full 25% did not require surgery. Twenty percent of those had good binocularity.

Refractive errors are very, very important, even in very, very early infantile esotropia. It is now well documented by many different authors that fully accommodative esotropia can be fully corrected at 4 months of age. Think of that. Therefore, as Doctor Flynn has pointed out the correction of refractive errors (not just what drop is used or how to determine it) and the implementation process of early glasses wear is one of our major problems. Re-refractions are of inestimatable importance to further correct latent hyperopic elements and refractive error differences. Secondly, alternate occlusion is necessary in my opinion. There is no reason not to. We all know the value of occlusion on the visual acuity system in preventing the development of amblyopia, but we don't always appreciate that the binocular system is a very separate system. The way to keep that binocular slate clean until one has aligned the eyes is by some system of continual alternate occlusion. When the diagnosis of constant esotropia is made and as long as the strabismus exists and until surgery is appropriate, alternate occlusion regimens

prevent anomalous binocular vision as well as anomalous acuity. Thus before early surgery is considered I think careful refractive error correction and re-refractions with implementation of glasses and alternate occlusion regimens are essential. There is no reason not to.

The uniform practice of very early surgery may mean that one will operate on a certain number of infants with neurologic disease; that there will be a significant number with an accommodative factor that might have eliminated surgery, and that 20% might be straight without surgery. Therefore, infantile esotropia is clearly a multifaceted disease and any single treatment such as very early surgery is bound to fail in a significant number of cases.

DR EDWARD L. RAAB. I share the enthusiasm of the previous discussants of this paper and have some points, one of which I think was already introduced by Doctor Jampolsky, that is, the necessity for detecting and managing an accommodative component in infantile esotropia patients. This occurs in astonishingly high frequency and has been discussed recently by myself and others. The second point has to do with the question of neurologically impaired children. There are several reports of strabismus in these cases. I think Doctor Robb's study gives an opportunity to compare neurologically impaired versus neurologically normal individuals examined by the same physician who followed them longitudinally. There are not many reports that do this. If Doctor Robb cannot include such a breakout of neurologically impaired cases in the written version of this paper, perhaps he would attempt it as a sequel.

DR MARSHALL M. PARKS. I appreciated this paper on infantile esotropia because it reminded me of my mentor's 1963 thesis prepared for admission into this society. Doctor Costenbader was the first to use the term congenital esotropia and the first to recognize the importance of dividing the esotropias into congenital and acquired. However, his AOS thesis was a study about all esotropic patients followed since "infancy." His definition of infancy extended up to 2 years of age which since has been defined by the World Health Organization to extend to only 1 year of age. Therefore, his thesis on infantile esotropia contains a pot-pourri of esotropic patients, some having acquired esotropia.

The authors attempt to sort out one group of patients in their study and refer to them as early onset esotropia. I interpret this to be what is commonly referred to as the entity of congenital esotropia. Then, they accepted into their study patients who were examined for the first time up to 14 months of age. From the history obtained they decided whether the patient was one with early onset esotropia. My concern is that by 14 months of age the parents' memory is not sufficiently accurate to permit this technique to be a valid criteria for labeling the esotropic child as one with an early onset. For many years it has become customary to not accept patients as having congenital esotropia unless the esotropia is confirmed by an ophthalmologist by 6 months of age.

The other point of interest to me was their finding that patients who became exotropic with therapy manifested poorer binocular vision responses to sensory

testing than those who were straight or esotropic. This also is my observation, but I doubt it reflects poorly on their binocular vision potential. I would like to know what the binocular vision response was to sensory testing with the exotropic angle fully compensated with base-in prisms or after eliminating the exotropia with surgery. In my experience I find most of the exotropic patients when compensated by prisms or corrected by surgery give as good binocular vision responses to sensory testing as the patients with straight eyes or residual esotropia.

DR RICHARD ROBB. I would like to thank all the discussants for their comments, especially Doctor Wolff for his attentive review of the manuscript. In response to Doctor Wolff's specific questions, I would certainly favor earlier surgery on the oblique muscles if their overaction could be more easily recognized. The problem is that it is often difficult to recognize oblique muscle overaction, especially superior oblique overaction, in the presence of reluctant abduction, which is so often a part of early infantile esotropia. With regard to surgery for the dissociated vertical deviations, that, too, I would like to be in a position to offer. Unfortunately, my experience is that surgery for dissociated vertical deviations is still not entirely satisfactory. There are a number of approaches to the problem, but the variability of the deviation is not easily matched by any fixed surgical correction. I concur with Doctor Wolff that better tests for binocular vision would be helpful. The tests that we currently use clinically are still quite rudimentary in nature. I think the Randot stereo tests are better than the Titmus test because they offer fewer monocular clues, but, unfortunately, they were not available during the entire period of this study.

Doctor Jampolsky suggest that repeated refractions are important and I certainly agree with that. The simple fact is that refractive errors do change during infancy and sometimes the change is of real clinical significance, more often an increase in hyperopia with time, but occasionally a decrease. I am not as sure about the value of alternating occlusion preoperatively. I think, theoretically, it may have some justification. Full time alternate occlusion does, of course, preclude any binocular vision from developing, but more than that, it is quite difficult to carry out on a day to day basis.

Doctor Raab's comments about the presence of an accommodative component in infantile esotropia are well documented by his previous publications on the subject and are certainly supported by the present study. The accommodative factor may not be apparent in children who start with a very large esodeviation and only a moderate amount of hyperopia. After initial surgery is done on these children and their deviation is reduced to a smaller angle, however, the residual esotropia may be within the range of their accommodative component, especially if their hyperopia has increased in the months since the initial surgery was performed. Doctor Raab's suggestion of comparing the neurologically impaired child with children who have experienced normal growth and development is certainly an appropriate one. There is a fair amount of information looking at both groups separately. One of the difficulties is that we have been rather imprecise in defining neurological impairment. For that matter, infantile esotropia itself could

be considered a form of neurological impairment. One of the things I recognized in reviewing my patients was that there wasn't as much data in the records on neurological status as I would have liked. We probably should be more alert to this aspect of patients with infantile esotropia and more frequently arrange for neurological consultations.

Doctor Park's wish to use the term congenital esotropia for a specific group of patients with early infantile esotropia is understandable on historical and personal grounds. I think the implication that the esotropia is in fact congenital may be misleading, and it is difficult to decide which patients to put in this group in a prospective way. There is enough variation and evolution in the clinical presentation of early infantile esotropia that care needs to be taken to evaluate patients individually over a period of time to arrive at the best treatment. An initial ophthalmological evaluation at 14 months of age is later than would be optimal for management, but the average age of first examination in this study was 7.9 months. Additional surgery for those patients who developed an exotropia may well have altered their sensory status, but would not seem to guarantee any long term stability of alignment.