OUTCOME STUDY OF BILATERAL LATERAL RECTUS RECESSION FOR INTERMITTENT EXOTROPIA IN CHILDREN*

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ABSTRACT

Purpose: This paper reports an outcome study of 52 consecutive children treated by bilateral lateral rectus recession for intermittent exotropia over a 9 year period (1981-90) with a minimum follow up of 6 months.

Methods: Successful alignment was defined as the absence of any postoperative intermittent or constant tropia in any position of gaze. The study examined the variables that might be predictive of successful alignment. The charts were abstracted for age at initial surgery, quantity of initial deviation, initial refraction, motor alignment at 1 week and 6 months, final alignment, secondary surgery results and the incidence of a monofixation syndrome result.

Results: Motor tests demonstrated that 32 (62%) of the patients were successfully aligned by the initial procedure performed for a mean of 25 prism diopters of preoperative deviation while viewing distant targets at a mean age of 4 years 8 months, followed for a mean of 4 years, 4 months. The incidence of undercorrections and overcorrections were approximately equal in quantity suggesting that the current surgical dosage was adequate, but the age at initial surgery, initial deviation, initial refraction and 1 week postoperative alignment results were not predictive of success. Alignment at 6 months, however, was highly correlated with successful alignment by the end of the study ($p = 0.002$). Secondary surgery was performed for 11 patients and 5 patients were found to have a monofixation syndrome result.

Conclusion: Successful alignment was achieved in the majority of children treated for intermittent exotropia by an initial bilateral lateral rectus reces-

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sion. However, 20% of the patients received secondary surgery for a residual deviation, and the study confirmed a previously reported 10% incidence of monofixation syndrome result in children surgically treated for this type of strabismus.

INTRODUCTION

Outcome studies of common surgical treatment programs have become even more important in the era of managed care. Insurance plan administrators are requesting information for even generally accepted surgical programs to justify expenses of anesthesia, outpatient surgery suites, and surgeon fees. Despite nonsurgical treatment programs for intermittent exotropia in children such as patching, orthoptic therapy, and minus lenses, surgery has remained the cornerstone of therapy for this type of strabismus in childhood. However, previous studies of the surgical management of intermittent exotropia have not been in agreement for the following questions: (1) What criteria should be utilized to define success? (2) What is the relationship of the age at initial surgery to the outcome? Does delaying surgery until after age 4 protect against overcorrection or the development of a monofixation syndrome result? (3) Is early (1 week to 10 days) postoperative esotropia a reliable predictor of long-term success?

The purpose of this paper is to report a statistical analysis to answer the above questions and, in addition, to examine the data collected in the present series to determine answers for the following questions: (1) Are currently popular surgical dosages adequate for successful alignment? (2) Does the size of the initial deviation have any relationship to successful final alignment? (3) Does the initial refractive error predict outcome? (4) Is the 6-month postoperative measurement a reliable indicator of long-term success?

Lastly, unlike several previous studies of the surgical results for intermittent exotropia, the authors also report in the present series the incidence, timing, and results of secondary surgery when the initial procedure failed to achieve successful alignment.

MATERIALS AND METHODS

A retrospective chart review of 52 consecutive cases treated by bilateral rectus recession during a 9-year period was performed. The diagnosis of intermittent exotropia was based upon parental observation and a confirming ophthalmic examination, with cover-uncover and alternate cover testing with prisms to quantitate the deviation. All patients were measured while viewing both distant and near (14 inches) objects. All surgery was performed by one of the authors (M.R.I.). Patients selected for

surgery had to have the history of parental observation of manifest exotropia on a daily basis. In addition, all patients treated by surgery had to have a confirmation by the surgeon of spontaneously developing manifest exodeviation while viewing distance objects or targets in the office.

To be included in the study, the patients were required to have no previous eye muscle surgery, no vertical muscle dysfunction, no neurologic disorders, and approximately equal vision in each eye. The patients were required to be no older than 15 years of age at the time of surgery and were followed for a minimum of 6 months postoperatively.

The quantity of surgical dosage was that commonly used by previous investigators[1] and is reported in Table I.

Successful alignment was defined as the absence of any intermittent or manifest tropia at *both* distance and near measurements on the final examination. Data obtained from the charts were subjected to statistical analysis to determine any relationship of the following covariables to successful alignment: age at initial surgery, early (1 week to 10 days) postoperative alignment, alignment at 6 months, final alignment, initial refractive error, incidence of a monofixation result, and the incidence, timing, and result of secondary surgery. All patients had their near stereoacuity determined postoperatively and most had it done preoperatively, except for some younger patients who did not cooperate.

TABLE I. SURGICAL DOSAGE

DISTANCE DEVIATION (PRISM DIOPTERS)	BILATERAL LATERAL RECTUS RECESSION (MM)
15 - 20	4
21 - 25	5
26 - 35	6
over 35	7

RESULTS

Although any definition of success is somewhat arbitrary in the evaluation of surgery for intermittent exotropia, the authors chose to classify the result as a success if there was an absence of residual tropia, intermittent or constant, in near or distance measurements, as a result at 6 months or later postoperatively. Depending on the outcome at 6 months or longer after the initial surgery, the patients were assigned to 3 outcome groups. Group 1 comprised patients who were considered to have successful alignment; these patients had no tropia on examination and demonstrated refined stereoacuity (n = 32). Failures were classified as residual tropia and assigned to either group 2a (residual exotropia, n = 11) or group 2b (residual esotropia, n = 9), depending on their measurement at 6 months or later postoperatively.

As shown in Table II, age at initial surgery, initial deviation, and length of follow-up were similar for all 3 groups. The study group as a whole had a mean age at initial alignment of 4 years, 8 months and a mean preoperative distance deviation of 25 prism diopters; mean follow-up was 4 years, 4 months.

Correlations between success or failure at last examination, and the age of initial surgery, esotropia at 1 week postoperative measurement, quantity of initial deviation, and initial refractive error are shown in Table III. None of these correlations were statistically significant. However, successful alignment at 6 months was found to be significantly correlated with success at the last examination, which was done at a mean of 4 years, 4 months postoperatively (P=.002).

Secondary surgery had been performed on a total of 11 patients by the end of the study (Table IV). Among the patients who were successfully aligned at 6 months by the initial surgery, only 1 patient (T.T.) had received additional surgery by the end of the study. This patient received a resection of one medial rectus 3 years after the initial bilateral rectus recession for recurrence of intermittent exotropia for distant targets. Although the quantity of intermittent exotropia in this patient was reduced from 15 to 8 prism diopters by the surgery, and the patient remained phoric for near targets, his result was classified as a failure.

Seven additional patients with residual exotropia (group 2a) received a resection of one or more medial recti for residual intermittent exotropia of 15 or more prism diopters at the 6-month examination or later. Of these patients treated for residual exotropia by secondary surgery, only 2 were converted to successful alignment. Residual intermittent exotropia, although often small in quantity, remained for 5 patients, and 1 patient was overcorrected with a small-angle esotropia result and was found to have a monofixation syndrome result by the end of the study.

TABLE II. CONSIDERATION OF AGE, INTITAL DEVIATION, LENGTH OF FOLLOW-UP, IN SUCCESS AND FAILURE GROUPS

VARIABLE	GROUP 1 (SUCCESS) (n=32)	GROUP 2A (FAILURE XT) (n=11)	GROUP 2B (FAILURE ET) (n=9)	ALL (n=52)
Age at surgery	Range: 1 yr 11 mo- 8 yrs 6 mo Mean: 4 yrs 7 mo	Range: 1 yr 1 mo - 10 yrs 7 mo Mean: 5 yr 3 mo	Range: 1 yr 2 mo- 7 yr Mean: 4 yr 4 mo	Range: 1 yr 1 mo - 10 yr 7 mo Mean: 4 yr 8 mo
Initial deviation (prism diopters)	Range: XT 15 - 35 Mean: 25	Range: XT20 - 40 Mean: 26	Range: XT 20 - 28 Mean: 24	Range XT 15 - 40 Mean: 25
Length of follow-up	Range: 6 mo - 11 yr 2 mo Mean: 4 yr 9 mo	Range: 6 mo - 11 yr 6 mo Mean: 3 yr 7 mo	Range: 2 yr 10 mo- 6 yr 10 mo Mean: 4 yr	Range: 6 mo- 11 yr 6 mo Mean: 4 yr 4 mo

TABLE III. CORRELATIONS BETWEEN VARIABLES

VARIABLE	VARIABLE	*P* VALUE
Refractive error	Success by group	0.480
Initial distance deviation	Success at 6 mo	0.421
Initial distance deviation	Success at last exam	0.273
Age at surgery	Success at last exam	0.947
Age at surgery	Success at 6 mo	0.702
Age at surgery	Success by group	0.694
Esotropia at 1 wk post	Success at last exam	0.825
Success at 6 mo post	Success at last exam	0.002

All patients with residual esotropia at the 3-week examination were treated by a combination of miotics, alternate occlusion, and base-out prism glasses, if necessary. For those 9 patients with residual esotropia in near or distance gaze position at 6 months following the initial lateral rectus recession (group 2b), 3 received secondary surgery consisting of recession of one or both medial recti. Two patients with an initial esotropia result were successfully aligned by their secondary surgery, and the third patient's surgery resulted in a moderately large-angle exotropia for distance with a small-angle esotropia for near. Two additional patients with residual esotropia at near point only were prescribed bifocals instead of surgery; 1 patient was converted to orthophoria with glasses while the other remained a small-angle esotropia while viewing near targets.

Of the total of 11 secondary surgeries, only 4 patients had successful alignment resulting in the elimination of any residual tropias. Secondary surgery ranged from 9 months to 3 years, 2 months (mean, 2 years, 7 months) following initial surgery (Table V).

By the end of the study, 5 patients who were considered successfully aligned at 6 months or later had a recurrence of their intermittent exotropia for distant targets. All of these patients were considered failures in the present study, but it should be pointed out that these patients maintained fusion and refined stereoacuity for near targets. The majority of these latter patients had not received secondary surgery because the distance deviation was relatively small and was considered cosmetically acceptable by the patients.

At the conclusion of the study, there were a total of 5 patients who, although they maintained fusion and were cosmetically well aligned, were considered to have a monofixation syndrome result and were, therefore, classified as failures (Table VI).

TABLE IV. SECONDARY SURGERY

PATIENT	PREOP DEVIATION	PRIMARY SURGERY	POSTOP DEVIATION	SECONDARY SURGERY	RESULT	FINAL ASSESSMENT
TT	X(T) 20, EX'0	Recess LROU 09/23/89	XT 15, X'2	Resect RMR 10/24/92	XT 8, X'8 08/16/94	Failure
BK	X(T) 22, EX'0	Recess LROU 06/28/84	X(T) 20, EX'0	Resect MROU 04/24/85	X 6, EX'0 12/26/95	Success
LT	X(T) 20, EX'0	Recess LROU 11/24/86	XT 10, X(T)'15	Resect RMR 08/19/87	XT 12, EX'0 08/19/87	Failure
RC	XT 30, X'4	Recess LROU 01/16/87	XT 20, X'15	Resect MROU 12/09/89	X(T) 15, EX'0 12/29/92	Failure
JV	XT 40, X'2	Recess LROU 04/24/87	XT 25, X'8	Rresect MROU 01/05/90	XT 25, X'10 05/04/92	Failure
JS	X(T) 28, X(T)'5	Recess LROU 04/25/87	XT 20, X'15	Resect MROU 01/15/90	X(T) 20, EX'0 05/14/90	Failure
GT	X(T) 30, X'6	Recess LROU 01/18/89	XT 15, EX'0	Resect RMR 01/16/90 Resect LMR 06/09/93	X 8, X'4 04/08/94	Success
SH	XT 30, X'6	Recess LROU 09/22/84	XT 20, EX'0	Resect RMR 10/10/84	ET 2, ET'8 05/28/87	Failure
MH	X(T) 25, X'4	Recess LROU 06/14/86	E 4, ET'20	Recess LRM 11/12/88	EX 0, RH'2 05/03/90	Success
NY	X(T) 20, EX'0	Recess LROU 08/11/88	EX 0, ET'17	Recess RMR 06/29/91	XT 25, ET'4 07/08/96	Failure
LS	X(T) 30, X'8	Recess LROU 07/07/90	ET 20, ET'45	Recess MROU 04/03/93	EX 0, EX'0 12/31/93	Success

TABLE V. LENGTH OF TIME BETWEEN FIRST AND SECONDARY SURGERY

Group 1 (n=1)	Range:	0 mo
	Mean:	3 yr, 2 mo
Group 2a (n=7)	Range:	9 mo - 2 yr, 9 mo
	Mean:	2 yr, 1 mo
Group 2b (n=3)	Range:	2 yr, 6 mo - 2 yr, 11 mo
	Mean:	2 yr, 9 mo
All (n=11)	Range:	9 mo - 3 yr, 2 mo
	Mean:	2 yr, 7 mo

TABLE VI. MONOFIXATION SYNDROME RESULTS

AGE AT INITIAL SURGERY		FINAL ALIGNMENT	FUSION	STEREOPSIS
SS	5 yr 4 mo	ET 2, ET'2	Yes	Nil
CL	5 yr 11 mo	ET 2, ET'6	Yes	100 sec
SH	4 yr 4 mo	ET 2, ET'8	Yes	1,000 sec
SN	2 yr 8 mo	EX 0, ET'2	Yes	400 sec
CC	3 yr 11 mo	ET 2, ET'2	Yes	100 sec
	Ave 5 yr 1 mo			

DISCUSSION

Similar to a previous study by Pratt-Johnson and associates,[2] the authors chose no residual tropia to be the criterion of success in the treatment of intermittent exotropia. The criterion of no residual intermittent tropia to determine success in the present study is more restrictive than the studies by Richard and Parks[3] and, more recently, Stoller and colleagues.[4] In these 2 studies, the presence of a residual intermittent tropia of 10 or fewer prism diopters, while viewing distant targets, did not preclude the author's definition of success. A comparison of success rates for surgical treatment of intermittent exotropia by various investigators who utilized bilateral lateral rectus recession as the initial surgical treatment for intermittent exotropia is shown in Table VII.

Secondary surgery was performed for undercorrection in 9 patients. Somewhat surprisingly, only 2 of these undercorrected patients who

TABLE VII. SUCCESS RATES FOR INITIAL SURGERY FOR INTERMITTENT EXOTROPIA IN PREVIOUS STUDIES

AUTHOR	SUCCESS RATE (%)
Pratt-Johnson et at[2]	41
Richard and Parks[3]	56
Stoller et al[4]	58
Present study	62

received secondary surgery achieved a successful result, demonstrating that some intermittent exotropia patients are very resistant to surgical alignment. None of the undercorrected patients in this series were treated with base-in prisms, as advocated by Hardesty.[5] It is possible that the omission of these prisms contributed to the relatively low success rate from secondary surgery for undercorrection of intermittent exotropia in this series when compared with the relatively high rate of success in 17 of 20 initially undercorrected patients reported by Hardesty.

In contrast to a previous study,[6] esotropia was not a particularly desirable finding in the first postoperative week. In fact, it was observed that 50% of the patients with esotropia in the first postoperative week in the present study remained esotropic for near or distance or both at the 6-month examination, although they were cosmetically satisfactory. Of the 9 overcorrected patients at the 6-month measurement, 3 received secondary surgery, and 2 of these patients were converted to a successful result.

Overall, only 4 of 11 patients had successful alignment after secondary surgery, indicating that secondary surgery was helpful to establish a desirable motor status for some patients, but also might fail to achieve this goal in others.

Five patients were identified as having the monofixation syndrome by the end of the present study. Richard and Parks[3] found only 5% of their patients developed a monofixation result in their study, but the finding of 5 patients of 52 with this outcome is identical in the present study (10%) to the percent of monofixation results in the study by Pratt-Johnson and associates.[2]

The monofixation syndrome is considered a successful result in the treatment of congenital esotropia but, in contrast, is often classified as a failure when surgically treating intermittent exotropia. The monofixation syndrome was found after first surgery in patients whose age ranged from

1 year, 8 months to 5 years, 11 months. The mean age of the initial surgery in this group with a monofixation result was 5 years, 1 month, and this mean age did not vary significantly from the mean age of 4 years, 8 months for the group as a whole. Three patients of 5 with a monofixation result received their initial surgery after the age of 4. Therefore, delaying surgery until after age 4 did not prevent the development of a monofixation syndrome result in this series.

The surgical dosages, as presented in Table I, are also used by other investigators and were felt to be adequate in the present study because approximately the same number of patients with undercorrection (11) were found in comparison with overcorrection (9) when examined at a minimum of 6 months postoperatively.

The finding that the quantity of preoperative distance deviation was not predictive of successful alignment following bilateral lateral rectus recession was similar to the findings in both the studies of Richard and Parks,[3] and Stoller and colleagues.[4]

In contrast to Pratt-Johnson's study,[2] but in agreement with the studies of Richard and Parks,[3] and Stoller and colleagues,[4] the age at initial surgery was not a factor in determining success. In the present study, in contrast to previous observers,[7] the incidence of secondary surgery was not greater for patients having surgery at a younger age in contrast to older children.

In agreement with Stoller and colleagues,[4] but in contrast to Raab and Parks,[6] the authors found that esotropia during the first postoperative week was not predictive of success. However, the authors did find in the present study that successful alignment at the 6-months postoperative measurement was highly correlated with success at the last measurement ($P = 0.002$) made at the mean of 4 years, 4 months following the bilateral lateral rectus recession.

SUMMARY

The present study of 52 consecutive patients reports the outcome of bilateral lateral rectus recession in treating intermittent exotropia in children. The authors found an overall success rate of eliminating any intermittent or constant tropia in 62% of the patients from initial surgery. This initial surgery was performed for a mean of 25 prism diopters of deviation, at a mean age of 4 years, 8 months, and followed for a mean of 4 years, 4 months.

The age at initial surgery, the quantity of initial deviation, the initial refraction, and the finding of esotropia during the first-week operative measurement were not predictive of success. Alignment at 6 months, however, was highly correlated with successful alignment by the end of the

study.

The majority of patients were aligned by the initial surgical procedure, but secondary surgery performed at a mean of 2 years, 7 months following initial surgery was necessary in 20% of patients with residual deviation. The authors also confirmed a previously reported incidence of a monofixation syndrome result in 10% of children treated by bilateral lateral rectus recession for intermittent exotropia.

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DISCUSSION

MARSHALL M. PARKS, MD. I am grateful for having been selected to review this paper and to the authors for sending their manuscript so promptly. It is a concise report of their experience in surgical management of intermittent exophoria at a young age. Overall, their results are excellent, even better than their analysis discloses. Let me explain.

Success was based on two criteria, consisting of a motor and a sensory evaluation. They demanded no return of tropia (as observed by the patient or the family or proven by Dr Ing's cover-cover test), and the patient retains the preoperative refined stereoacuity.

The refined stereoacuity differentiates the ideal fixation result from the less ideal monofixation result. It was either presumed or proven that all patients had preoperative bifixation, which 5 lost as a result of surgery having converted a larger intermittent exophoria angle to a smaller constant angle esotropia of 8 prism diopters or less. Since exophoria patients possess almost nil fusional divergence, the overcorrected constant esotrope is unable to reduce the esodeviation to within 0.5 prism diopters, which bifixation demands. Extramacular binocular vision is far less demanding and tolerates up to 8 prism diopters of esodeviation. Permanent loss of bifixation is unfortunate, but it is a separate subject

unrelated to alignment success. The surgically aligned intermittent exophoric patients remain just as well aligned over time whether the outcome is bifixation or monofixation.

The greatest surgical concern to the patients, their families, and the surgeon about management of intermittent exophoria is the trend for gradual return of the exodeviation. A lesser concern is the frequency of overcorrection. So, allow me to discuss the outcomes reported in this paper as they pertain to the paramount concern about alignment stability and set the issue of bifixation loss aside.

Table I shows the outcome from primary surgery at last follow-up for the 52 patients—62% successful, 21% undercorrected, and 17% overcorrected. Four of the 9 overcorrected patients had the monofixation syndrome with an esodeviation that measured between 0 and 2 prism diopters at distance and between 2 and 6 prism diopters at near. I contend that such minimal esodeviations represent excellent alignment and contribute nothing to the trend for gradual return of exotropia. Therefore, I would revise the outcome at last follow-up to 69% successful, 21% undercorrected, and 10% overcorrection (Table II).

The trend for gradual increase in exodeviations is confirmed by comparing Table II with Table III, which shows my revision of the authors' outcome from primary surgery at the 6-month follow-up: 80% were suc-

TABLE I. OUTCOME FROM PRIMARY SURGERY AT LAST FOLLOW-UP

	N	%
Successful	32	62
Undercorrected	11	21
Overcorrected	9*	17

*4 with monofixation syndrome.

TABLE II. REVISED OUTCOME FROM PRIMARY SURGERY AT LAST FOLLOW-UP

	N	%
Successful	36*	69
Undercorrected	11	21
Overcorrected	5	10

*4 with monofixation syndrome.

cessful, 10% were undercorrected, and 10% were overcorrected. Five of the successful patients at 6-month follow-up drifted into the undercorrected group by the last follow-up at a mean of 4 years and 4 months. Note that the number of patients evaluated at 6-month follow-up was reduced to 51, since 1 patient was reoperated 3 weeks postoperatively.

Reoperations were performed on 11 patients, 8 for undercorrections (Table IV) and 3 for overcorrections (Table V). Three of undercorrected and 2 of the overcorrected patients were converted to successful alignment at last follow-up. None of the 3 reoperated for overcorrection remained esotropic, since the 1 failure was converted back to exotropia and is listed as an undercorrected patient after 2 surgeries.

According to my revision, which accepts the 5 monofixation syndrome patients as a successful outcome, the combined primary and secondary surgery yielded at the last follow-up a 79% successful outcome (Table VI). In round figures, Dr Ing should be able to state that the initial operation, in his experience, gives a 70% alignment success rate. For secondary surgery, the success rate is expected to approach 50%. These percentages are exactly what I have been citing for many years to patients undergoing surgery to correct their intermittent exotropia.

TABLE III. REVISED OUTCOME FROM PRIMARY SURGERY AT 6 MO FOLLOW-UP

	N	%
Successful	41	80
Undercorrected	5	10
Overcorrected	5	10

*4 with monofixation syndrome.

TABLE IV. REVISED OUTCOME FROM SECONDARY SURGERY FOR UNDERCORRECTION AT LAST FOLLOW-UP

	N	%
Successful	3*	38
Undercorrected	5	63
Overcorrected	0	0

*1 with monofixation syndrome.

TABLE V. REVISED OUTCOME FROM SECONDARY SURGERY FOR OVERCORRECTION AT LAST FOLLOW-UP

	N	%
Successful	2	67
Undercorrected	1	33
Overcorrected	0	0

TABLE VI. REVISED SUCCESSFUL OUTCOME FROM COMBINED PRIMARY AND SECONDARY SURGERY AT LAST FOLLOW-UP

	N	%
Initial	36*	69
Secondary surgery	5†	46
combined surgery	41	79

*4 with monofixation syndrome.
†1 with monofixation syndrome.

EDWARD L. RAAB, MD. I would like to address three points.

The first is whether you approach all intermittent exotropia cases that you operate by recession of the lateral recti. In a paper co-authored by Dr Parks and me, one of our ancillary findings was that when there is superimposed convergence insufficiency, a recession-resection procedure appeared to present some advantages. If such cases are part of your series, this could have affected your percentages of success and failure.

The second question is whether there is a dilemma when monofixation syndrome is an outcome parameter. You could have the paradox of having completely corrected the exodeviation, which would be a success under one of your definitions, yet with the sensory outcome of the monofixation syndrome, which you would classify as a failure.

Finally, if your emphasis in this communication is on outcome for the enlightenment of managed care entities, among others, perhaps calling the monofixation syndrome a failure outcome emphasizes a negative, namely absence of foveal fusion, that in ordinary visual circumstances is less critical than the restoration of peripheral fusion and at least partial steropsis.

ALBERT BIGLAN, MD. A long time ago, Phil Knapp and I had a discussion during a coffee break at one of the AAPO & S meetings. He stated that intermittent exotropia is one of the most difficult problems that we treat. It was early in my career and I was a little skeptical, but I began to appreciate his wisdom over the years. As I gain experience with intermittent exotropia, it seems to be a more difficult problem than I initially thought. When we were residents and had a child with exotropia, we would want to proceed with surgery. Technically, it is one of our easier strabismus procedures to perform. Our early results were usually satisfactory but with time, results became disappointing. Usually patients with intermittent exotropia have excellent stereo acuity. We should be concerned about the small potential for loss of stereo acuity that can occur with prolonged over correction.

I have had the opportunity to counsel a neurosurgical resident about 2 years into his training. His chief of service observed that the resident did not seem to have good abilities when using the operating microscope. On examination he had deficient stereo acuity. He is now in a different discipline as a result of that. Stereo acuity is a valuable attribute for some occupations.

I commend Dr Ing for looking at intermittent exotropia. I guess that what I am really trying to say is that I am concerned about the over corrections that we get and their potential for reducing stereo acuity. But my real question is, why can't we do better in treating this problem?

GEORGE L. SPAETH, MD. This was a very interesting paper and I am especially appreciative of the discussion, because the discussion dealt with success, and that, of course, relates to the fundamental question (the only question) that we really need to be asking ourselves constantly, and that is, what is our purpose as a physician? What are we trying to do? It also reminds me how difficult it is to define success. Some of you knew my father and may remember some aspects about him. One story I like about him relates to a case of a child with exotropia. He had performed surgery and ended up with a considerable exotropia. The mother pointed out to him and said, "Well, Dr Spaeth, what do you think?" His answer was, "Well, it's better than perfect!"

JOHN T. FLYNN, MD. I, too, would like to congratulate Dr Ing for candidly bringing his results to our attention. I would like to suggest, however, at the beginning of their paper, the authors asked a number of questions far beyond the number for which the 52 patients can provide an answer. At least an answer that those steely-eyed executives of HMO's would accept as truth.

The second point I would like to make is that these children have

some form of near-normal binocular vision at some distance. John Pratt-Johnson pointed this out in his study in which his success rate was only 41%. He based his criteria for a success on the absence of any suppression at any testing distance and the presence of normal fusional vergence amplitudes. I think we have to accept such stringent criteria if we are to really define how much better we make these children with either surgical or medical therapy. I realize that there are people in this audience thinking, perfect is the enemy of the good and we must do the best we can with what we have, but I think with regard to intermittent exotropia, we must think about taking our game, if you will, to another level and we have to look at data in all its aspects on these children.

The monofixation syndrome, and particularly monofixation syndrome after intermittent exotropia, is not an innocuous outcome. Those of us who treat adult strabismus know that monofixation can break down in the 20 to 25 year-old law student or business major and we see them all the time with asthenopic or diplopic complaints in our offices. Those two symptoms are awfully hard to get rid of. If the outcome (monofixation syndrome) is occurring in 10% of these cases, I think we should take that statistic very seriously.

The good news is this. In its wisdom, the National Eye Institute has created an organization which permits us to do simple, low budget, clinical trials on just this type of patient. None of us will have, literally, the hundreds of patients in our individual practice whose data we can use to study this entity. The NEI Study Center will permit us to pool, across our practices, information and outcomes on these kinds of patients. This is something from which I think we will all learn.

I would like to again congratulate Dr Ing for bringing his results to us for discussion.

TAYLOR ASBURY, MD. Strabismus remains in a comfort zone, not much change over the years. We have seen extraordinary advances in other parts of ophthalmology; cataract, cornea, retina and oculoplastics. I remember presenting a paper at the international meeting at Geissen in 1966. It was similar to the paper just presented. I do not remember the statistical details, but I remember the outcomes were very similar. We did study the fusion status based on preoperative evaluation in most cases. Even older children in the series at age 11 or 12 had postoperative stereoposis and third grade fusion although there was little pre-op indication of this potential. Others that appeared to be ideal patients to attain excellent fusion did not attain good fusion. I completely agree with Dr Parks that this paper under-reports its success rate. Mono fixational esodeviations really should be reported as successes since the eyes are aligned and the ocular dysfunction minimal. It is true that there is some dysfunction from monofix-

ational esodeviation, but it may be unavoidable based on current knowledge of the subject. Certainly the important surgical message is do not undercorrect.

I enjoyed the paper very much. It was well presented and well documented and certainly is thought provoking in an important area of strabismus. I congratulate the author.

Thank you.

ALAN SCOTT, MD. This topic deserves a controlled trial. Thirty to 40% of the patients in this series, and in comparable series, get unsuccessful results by the typical criterion that Dr Ing has pointed out. We have no good long-term historical control group by which to measure these patients. The closest we have is the older paper by Dr Hiles and Dr Costenbader. In that paper, 73% of the patients improved over time when followed from a period of 6 months for an average of 11 years. I think that Dr Ing's results are as good as any reported in the literature; yet, we really need to do better for these young children. A trial is the only way to get an answer. Thank you.

SUZANNE VERONNEAU-TROUTMAN, MD. My question to Dr Ing is also related to the remark of Dr Rabb, I am surprised that in 52 consecutive cases of intermittent exotropia you did only bilateral lateral rectus recessions. For my surgical decision, I rely on the prism adaptation test. Most of these patients build up at near, and sometimes their built up angle will be greater than the distance deviation. In these cases I would surely do an R and R. I would not operate on a child with intermittent exotropia before the age of 4 or 5 years. Thank you.

MALCOLM R. ING, MD. I will start point-by-point. To Dr Raab, yes there were 52 consecutive cases treated initially by a recession of the lateral rectus in each eye. This is the same question that was asked by Dr Veronneau-Troutman. Yes, they were all selected to have a recession of the lateral rectus recession with the use of the table shown. The issue of the resection of the medial rectus and recession of the lateral rectus versus bilateral lateral rectus recession, has been addressed in a previous study by Dr Parks and I rely on that. The data did not show that resection of the medial rectus was more effective in his paper. However, there are surgeons that do adhere to that (resect-recess school), and I have to recognize that. Let me just point out, though, that the patients we treated usually had a small phoria at near with much larger exotropia angles at distance, and I cannot even remember a single patient that had a larger angle at near or even as great for near as far distance in our series. So, in that case, I do not think I would have selected a resection of the medial for

these patients, even if I had chosen that type of surgery. The monofixation syndrome can exist, with or without deviation, as was mentioned by Dr Raab. That is a very good point. That is why I felt that sensory tests were necessary for the study and that is why they were done. You can definitlely find a monofixation syndrome without any motor deviation. Do we consider a monofixation result a failure or a success? We will get back to that a little later. This is the question that keeps coming up.

Dr Biglan, yes, intermittent exotropia in children is very hard to treat. I agree with that. You cannot measure the stereopsis of a young child of 1 or 2 effectively on a clinical basis. So, it is hard to tell whether these patients have actually evolved to or deteriorated to a monofixation syndrome. Since we cannot prove refined stereopsis to be in existence prior to surgery in the younger patients, we do not know if they have actually lost it. And, I think in your series, Dr Biglan, in your series of congenital exotropia, there was a high incidence of a monofixation result with very few having refined stereo-acuity after treatment. So, if these young children are presenting very early in life with a large angle exotropia, their chance of developing bi-fixation is somewhat diminished, I agree with that. Why can't we do better? Frankly, the answer is, I do not know. I turned my results over to a statistician, and he told me what we had as results, so that is the way it came out.

Dr Spaeth, asked what are we trying to do with our surgeries. This question goes back to the point that Dr Parks made. These patients are coming in because their parents are saying, "You know, there is something funny with my kid's eyes. They are going out." So, they are very upset about the situation. We know that progressively over time, there will probably be more suppression and we do treat with patching prior to surgery. We do not use minus lenses because many of them are very young, and won't wear glasses. But, how do we define success? If we refer back to what I did, I really didn't take the cosmetic appearance into account when turning these figures over to a statistician. However, Dr. Parks did. And I will say that I have to agree with his sentence that these patients with a monofixation syndrome are considered a success by the parents. They are totally successful as far as they are concerned. They don't think there is anything wrong, with their child that has a monofixation syndrome. I do the stereo tests and I think there is something wrong. It is a different way of looking at the same result.

Dr Flynn, 52 patients, yes, this is a small series. This is a small series done by 1 surgeon with 1 technique using 1 table. When you pool statistics with various investigators, you get tremendous variability, and I think that fact is the down side and somewhat the pitfall of combining a series because, if the doctors are not measuring the same way that I am measuring, or doing the same kind of surgery, they are certainly not going to come

up with the same result. So, yes, it does suffer from being a small series but I will defend it. Diplopia in the monofixation group? I do not recall any of the monofixation group having diplopia. I think we have to differentiate between the monofixators, and those with over-corrected exotropia that don't fuse, and maybe the latter group would, indeed, have double vision. Yes, I agree with that, but that was not found in the monofixation group. And stereo acuity was measured on all. Fusional amplitudes were not measured in this group because, first of all, a long time back, and I made this point in my A.O.S. thesis in 1981, and, also, in 1966 (a paper I did with Costenbader, Parks and Albert). I did the Worth 4-dot test at near and distance on these patients and I did fusional amplitude testing with all the patients. I was a "junior orthoptist" in these offices for quite a while. Twenty-five patients with Dr Parks and 25 with Dr Costenbader. All patients who fused Worth 4-dots had fusional amplitudes. That settled the question for me. There was no point doing fusional amplitude measurements with the troposcope if these patients showed Worth 4-dot fusion.

For Dr Asbury. Yes, I think the statistics are close to what we had previously many years ago and there has not been a large improvement of results following strabismus surgery and surgical management of these cases. I think the training of various surgeons and various personnel to measure the cases, to actually handle the cases, does vary however. Although, if you get enough numbers, perhaps the results will come out very close. We still do not have an answer, though, to your question as to why some surgery has not been successful. We still do not know why they have failed. There was a recent paper in *Binocular Vision* that showed fusion preoperatively was more important than stereopsis preoperatively in determining success. I read it, but I did not include it in my paper, and, in fact, I had submitted my paper prior to my reading it. The author stated that fusional amplitude ability was actually a better predictor of success in exotropia treatment than stereopsis, and that was an interesting point.

Dr Scott mentioned that we need to have a control series, and I think that would be ideal. However, I am not sure how we are going to set this up, as far as intermittent exotropia in the strabismus management. Because, if you ask parents, "Well do you want treatment versus no treatment?" I think they would choose treatment. Really, a fair answer is treatment, so I hope I will be able to set that up with maximum results. And, yes, I am aware of Dr Hiles' and Dr Costenbader's paper about the improvement of exotropia in some patients, and this is a small series. I cannot recall, though, that condition developing for any patients that I operated on (and this is a key point). The parents did not say, "You know, he is really getting better." They came in and said "You know, it is worse." So that answers your question, I think. They were <u>not</u> getting better. One

more point. The written manuscript is not completely covered in my discussion. I would like to address the issue, "Is it more common to have to operate on children, again, a second time after their initial surgeries?" (4 years or younger). "If you operate on them before 4 years versus those that are after 4 yeras, do you have to re-operate more often?" No, not according to the statistician, so, I just have to take his word for that.

Dr Veronneau-Troutman also mentioned that issue of bilateral recession versus resection. I cannot answer that at this point.

I want to finish, by saying, I want to thank Dr Parks for his very thorough review and complimentary remarks concerning this study. Although we may differ on what group to which to assign the monofixation syndrome outcome, either in a success column (as Dr Parks has done) or in a failure column, as done in this paper, we do agree upon the stability of this unique monofixation syndrome status. Furthermore, the parents are universally happy with a cosmetic outcome in these patients.

Thank you for your attention.