Selective Surgery for Intermittent Exotropia Based on Distance/Near Differences

Burton J. Kushner, MD

Background: Classic teaching suggests that surgery for intermittent exotropia should be based on distance/near differences. Divergence excess, according to tradition, should be treated with symmetric lateral rectus recessions; simulated divergence excess and basic deviations should be treated with a recess/resect procedure. This teaching, to our knowledge, has not been systematically tested.

Objectives: To evaluate the appropriateness of selective surgery based on distance/near differences and to determine if bilateral lateral rectus recessions affect the distance deviation more than the near deviation.

Patients and Methods: Patients with basic type intermittent exotropia were randomized to 2 groups, those receiving either unilateral recess/resect procedures or symmetric lateral rectus recessions. Patients with simulated divergence excess intermittent exotropia received symmetric lateral rectus recessions. Outcome was observed 1 year after surgery.

Results: Of 19 patients with basic exotropia receiving lateral rectus recessions, 10 patients (52%) had a satisfactory outcome compared with 14 (82%) of the 17 patients who had recess/resect procedures ($P<.05$). Of the 68 patients with simulated divergence excess, 55 patients (80%) had a satisfactory outcome after bilateral lateral rectus recessions. This result was significantly better than the outcome for patients with basic exotropia who underwent lateral rectus recessions ($P<.05$). The decrease in the distance/near difference after surgery was essentially identical for patients with basic exotropia who underwent lateral rectus recessions as for those who received recess/resect procedures (means, 2.4 prism diopters vs 2.1 prism diopters, respectively).

Conclusions: Although this study did not evaluate increasing the amount of symmetric lateral rectus recessions for patients with basic exotropia, these data suggest that patients with basic type intermittent exotropia should be treated with recess/resect procedures. Data also suggest that patients with simulated divergence excess do well with lateral rectus recessions. Recess/resect procedures and symmetric surgery affect distance/near differences equally in patients with basic exotropia.


In a series of classic articles, Burian and colleagues classified intermittent exotropia based on distance/near differences and recommended different surgical procedures based on this classification. They defined the condition of patients in whom the distance deviation equaled the near deviation as a basic type of exotropia and recommended it be treated with unilateral recess/resect surgery. Patients in whom the distance deviation exceeded the near deviation were considered to have a divergence excess type of exotropia; for such patients Burian and colleagues recommended symmetric lateral rectus recessions. They based these recommendations on the unproven hypothesis that bilateral lateral rectus recessions would affect the distance deviation more than the near deviation, and that a recess/resect procedure would affect the distance and near deviation equally. Scobee observed that many patients with an apparent divergence excess type of exotropia would manifest an increase in their near deviation after 24 hours of monocular occlusion. Subsequently it was determined that approximately 1 hour of occlusion was sufficient to elicit this increase. Burian and colleagues defined the condition of these patients as a simulated divergence excess type of exotropia. Because they believed these patients really had a near deviation that equaled the distance deviation but that it was masked by fusional vergences at near, they recommended that they be treated as if the patients had a basic type of exotropia and undergo recess/resect surgery. Subsequently, other authors have de-
SUBJECTS AND METHODS

Between 1985 and 1996 all patients seen consecutively in my private practice who were undergoing surgery for intermittent exotropia, and in whom the near deviation was within 10 prism diopters (Δ) of the distance deviation (prior to monocular occlusion or the use of +3 lenses at near) were included in this study subject to the following exclusion criteria: untreated or unsuccessfully treated amblyopia, the presence of an A or V pattern requiring treatment, simultaneous oblique muscle surgery, lateral incomitance of more than 10 Δ, history of previous strabismus surgery, the use of adjustable sutures, follow-up of less than 1 year, insufficient cooperation for the above-mentioned measurements, or unwillingness to be randomized. Because I wanted to limit this study to patients in whom accurate measurements could be obtained with the prism and alternate cover test, the lower age for inclusion was 3 years. Also, because I frequently use adjustable sutures on postadolescent patients and because I wished to eliminate the confounding variable that would be introduced by the use of adjustable sutures, I set the upper age limit for inclusion at 18 years. In addition, patients were excluded if I knew at the time of surgery that their follow-up would be carried out by the referring physician. I considered patients to have intermittent exotropia if their deviation was intermittently manifest at either distance or near. Consequently, I included patients who had a constant exotropia at distance but an intermittent exotropia at near. Randomization to 1 of 2 groups occurred when each patient was scheduled for surgery and after I obtained informed consent. One group, referred to as the “recess/resect group,” underwent a recession of the lateral rectus and a resection of the medial rectus of the nondominant eye. The second group, referred to as the “lateral rectus recession group,” underwent symmetric lateral rectus recessions. For both groups, surgery was based on the measurement obtained at 6 m with appropriate optical correction in place and prior to monocular occlusion. If patients had been treated with minus lens therapy or base-in prism prior to surgery, they were put in their appropriate cycloplegic spectacle correction without prism; it was with those spectacles that the measurements for this study were obtained. For myopic patients, the full cycloplegic refraction was dispensed. For hyperopic patients, spectacles were prescribed if there was any substantial astigmatic refractive error, anisometropia greater than one half diopter (D), or hyperopia greater than 2 D. In most cases, patients with hyperopic intermittent exotropia were given spectacles that incorporated approximately 1 to 1½ D less than the full cycloplegic hyperopic refraction. Outcome determination was made at the earliest examination date performed at least 1 year after surgery (range, 12-15 months). An outcome was considered satisfactory if there was between 10 Δ of exophoria and 5 Δ of esophoria. An intermittent or manifest tropia of any amount, either exotropic or esotropic, was considered an unsatisfactory outcome. Patients who underwent a reoperation, who needed prisms after surgery, or who needed manipulation of their accommodation with plus or minus lenses to meet the aforementioned criteria were considered to have an unsatisfactory outcome. Table 1 gives the popular surgical formula that was used for both groups. In addition, any patients in whom the angle of exotropia at 6 m increased after 1 hour of monocular occlusion or while looking out a window at a far distant target were excluded from this study because they were the subject of a simultaneously conducted, different randomized clinical trial (see “Comment” section for significance of this exclusion). The outcome measurements were not masked.

The decision to perform surgery on a given patient was not made according to a rigid predetermined protocol; however, certain factors consistently influenced the decision. In general, surgery was recommended if there was a deterioration of the frequency or magnitude of the exotropia, despite nonsurgical therapy (eg, alternate occlusion, prisms, or minus lens therapy, or a combination of these). These nonsurgical modalities were attempted in most patients who were younger than 7 years; typically I have found such treatment approaches to be most effective in this age range. In addition, surgery was advised if there was a manifest tropia present more than 50% of the time as determined either by examination or by obtaining an ophthalmic history.

For each patient I calculated the preoperative distance/near difference by subtracting the near angle of exotropia (prior to monocular occlusion or the use of +3 lenses) from the deviation obtained at 6 m, and compared this with the distance/near difference (calculated the same way) obtained 1 year after surgery. By subtracting the distance/near difference 1 year after surgery from the preoperative distance/near difference, I obtained the drop in the distance/near difference that occurred for each patient as a result of surgery. During the same period, all patients I operated on for simulated divergence excess exotropia (Burian’s classification) were treated with symmetric lateral rectus recessions according to the same surgical formula and analyzed according to the aforementioned criteria. Concurrent with this study, another clinical trial was being conducted at our facility on patients with intermittent exotropia. It focused on patients with intermittent exotropia who manifested an increase in their deviation when looking out a window, or at 6 m after 1 hour of monocular occlusion. They were randomized to surgery either for the initial deviation at 6 m or for the larger deviation. Patients in that study who had simulated divergence excess and who were randomized to surgery for the initial deviation at 6 m (standard treatment) were included in the analysis for this study of symmetric lateral rectus recessions for simulated divergence excess.

scribed good results in treating patients with all 3 of these patterns of intermittent exotropia with symmetric lateral rectus recessions.

In the 18th Annual Scobee Lecture, November 10, 1987, Dallas, Tex, I reported that patients with a simulated divergence excess exotropia (according to Burian’s classification) did as well as patients with a true divergence excess pattern if they were treated with bilateral lateral rectus recessions. However, patients with a basic type of exotropia did not do as well if treated with bilateral lateral rectus recessions as patients with either true divergence excess or simulated divergence excess exotropia. I explained my findings based on a concept of distance/near differences in intermittent exotropia that differed from that of Burian. Rather than considering a patient in whom the distance exotropia exceeded the near exotropia to have...
an excess of divergence, I conceptualized the patient as having a strong convergence or fusional mechanism holding the eyes straighter at near. I described the patient in whom the near deviation increased after prolonged monocular occlusion as having a “tenacious proximal fusional” (TPF) mechanism. This phenomenon appears to be similar to what had been described previously as a slow vergence, or vergence aftereffect. I speculated that the presence of the TPF mechanism would work in the patient’s favor for maintaining alignment after surgery. Accordingly, I proposed that the patient with simulated divergence excess type of exotropia could be treated equally satisfactorily by receiving lateral rectus recessions or a recess/resect procedure, depending on the surgeon’s choice. Patients who lacked the TPF mechanism had a poorer fusional process and might benefit from a recess/resect procedure, which tends to tether the eye against abduction. Also, the incomitance produced by a recess/resect procedure may have sensory advantages over symmetric surgery in these patients. Recession/resect surgery typically results in an exotropia in the field of action of the recessed lateral rectus for a prolonged period after surgery, and this tends to eliminate suppression. I therefore suggested that the difference in success between the outcome obtained with bilateral lateral rectus recessions and that obtained with a recess/resect procedure was unrelated to a differential effect on the distance vs near measurement. Instead, it was due to the relative tethering effect of the recess/resect procedure. In the Scobee lecture I proposed a prospective study to investigate the hypothesis that people with divergence excess exotropia and those with simulated divergence excess exotropia can be treated equally well with bilateral lateral rectus recessions, but patients with the basic type of exotropia would respond better with a recess/resect procedure. The primary purpose of this article is to report the results of that study. A secondary purpose is to investigate the validity of the hypothesis underlying the recommendation of Burian and colleagues—that surgery be based on distance/near differences. Specifically, that hypothesis is based on the unproven concepts that bilateral lateral rectus recessions affect the distance deviation more than the near deviation, and that a recess/resect procedure affects them equally.

**RESULTS**

During the enrollment period, I operated on 99 patients with a basic type of exotropia. Sixty-three patients were eliminated for the aforementioned exclusion criteria, leaving 36 patients who make up this study. Two patients (1 in each group) were excluded because they were lost to follow-up; 42 patients were excluded because they were enrolled in my other randomized clinical trial of patients with intermittent exotropia whose deviation increased after occlusion or while fixing outdoors. Another 19 patients were eliminated for meeting various exclusion criteria listed earlier.

Nineteen patients with basic exotropia were randomized to symmetric lateral rectus recessions, of whom 10 (52%) had a satisfactory outcome, 2 (11%) were overcorrected, and 7 (37%) were undercorrected. Seventeen patients underwent unilateral recess/resect surgery, of whom 14 (82%) had satisfactory outcomes, 1 (6%) was overcorrected, and 2 (12%) were undercorrected. This difference was significant (P>.02, χ² test). There were 68 patients with simulated divergence excess exotropia who underwent symmetric lateral rectus recessions who made up the control group and were subject to the same exclusion criteria as the study group. Fifty-five (81%) had a satisfactory outcome; 3 (4%) were overcorrected and 10 (15%) were undercorrected. These results differ significantly from the results of patients with basic exotropia who underwent lateral rectus recessions (P<.05, χ² test) but were essentially identical to the results of patients with basic exotropia who underwent recess/resect surgery. See Table 2 for descriptive characteristics of the 3 groups.

Table 3 compares the effects of recess/resect surgery and lateral rectus recessions on the distance/near difference in patients with basic exotropia. Data show that the 2 surgical procedures have essentially identical effects on the distance/near difference in patients with basic exotropia.

**COMMENT**

This study suggests that Burian and colleagues were correct in recommending that patients with a basic type of intermittent exotropia be treated with a recess/resect procedure. It does not support, however, their recommendation that patients with a simulated divergence excess type of exotropia must be treated similarly. This study also suggests that the hypothesis that lateral rectus recessions selectively affect the distance deviation more than the near deviation, and that the recess/resect procedure affects both deviations equally, is untrue. If distance/
near differences in a patient with intermittent exotropia are primarily a function of the TPF mechanism, the relative effect of surgery on the distance and near deviation, respectively, is self-adjusting in patients with basic exotropia. The amount of correction obtained at each distance is a function of how much deviation is present. Burian and colleagues1-4 had recommended that patients with simulated divergence excess exotropia be treated with a recess/resect procedure. Others have suggested they can be as effectively treated with symmetric lateral rectus recessions.7,9,10,18 This study does not directly compare the effectiveness of those 2 procedures for simulated divergence excess exotropia. Indirectly, however, these data suggest that patients with simulated divergence excess exotropia can be treated effectively with either procedure. My results using lateral rectus recessions in this group of patients were essentially as good as those obtained for patients with basic exotropia who were treated with a recess/resect procedure. This is in contradiction to von Noorden’s19 conclusion that results would be better if the recommendations of Burian were followed. In von Noorden’s study, there was one group in which he treated both divergence excess and simulated divergence excess with symmetric lateral rectus recessions, and another in which he treated these 2 subtypes differently according to Burian and colleagues’ recommendations. The latter group had better results. In his report, he did not separate the results for the subsets of patients with simulated divergence excess from those of the patients with true divergence excess in each group. He only compared the results for each group, both of which contained a mixture of patients with divergence excess and simulated divergence excess. This makes it difficult to determine how the 2 different treatment approaches affected the results for simulated divergence excess exotropia. Also, his study did not address the treatment of basic exotropia.

Hardesty et al9 reported equally satisfactory results using symmetric lateral rectus recessions for all subsets of intermittent exotropia, regardless of the distance/near difference. This is different from my findings. Hardesty et al relied on only a 5Δ difference between the distance and near measurement for the purpose of classification; Burian and Spivey2 had recommended a 10Δ difference; others have relied on a 15Δ value.39 This would result in Hardesty et al labeling some patients as having a divergence excess pattern who would be considered to have a basic pattern according to the recommendations of Burian and colleagues.1-4 These criteria would tend to homogenize the outcomes between the 2 groups of patients described by Hardesty et al, and might explain some of the differences between his results and mine.

I wish to stress that this study does not prove that a recess/resect procedure is better, per se, than symmetric lateral rectus recessions for basic intermittent exotropia. It only suggests as much within the context of the specific surgical formulae I was comparing. Possibly symmetric lateral rectus recessions could work as well as recess/resect surgery if a larger amount of recession is performed. Mims and Wood32 have reported that they increase the amount of lateral rectus recession in patients with intermittent exotropia as the size of the near deviation approaches that of the distance deviation. This study does not evaluate the effectiveness of increasing the amount of symmetric lateral rectus recession for patients with basic exotropia. I do not believe, however, that the poorer results I obtained in my lateral rectus recession group were simply a matter of an inadequate amount of recession. The mean deviation in my 2 groups immediately after surgery (≈1 week) was essentially identical. Instead, it appeared as if the recess/resect procedure guarded against later exotropic drift. In the other aforementioned clinical trial, however, I found that 23 patients with basic exotropia who underwent symmetric lateral rectus recessions for the largest deviation measured (eg, after prolonged occlusion or while looking out a window) had a 74% success rate.37 Although this is a poorer outcome than that obtained in my study with recess/resect surgery for basic exotropia, and better than that obtained for symmetric lateral rectus recessions, the numbers are too small to be significant. Further studies will be needed to determine if increasing the surgical dose will produce better results with symmetric lateral rectus recessions in basic exotropia.

In general this study confirms the hypothesis that I proposed in 1988.7 Specifically, I had found that patients who did not have the TPF mechanism (patients with a basic exotropia) fared more poorly with lateral rectus recessions than patients who had the TPF mechanism (simulated divergence excess exotropia). I postulated that a recess/resect procedure might work better in patients who do not have this beneficial mechanism because of the tethering effect caused by the recess/resect procedure. On the other hand, I suggested that patients who had the benefit of the TPF mechanism could be treated with whichever surgical procedure was the surgeon’s preference, either a recess/resect procedure or lateral rectus recessions. The relative benefit of one procedure over the other has little to do with its having a selective effect on the distance vs near deviation. In fact, there is substantial reason to doubt that patients whom Burian1-4 described as having a divergence excess type of exotropia actually have an excess of divergence.

### Table 3. Change in Distance/Near Difference After Surgery*

<table>
<thead>
<tr>
<th>Group</th>
<th>Preoperative Status</th>
<th>Postoperative Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance Exotropia (Range)</td>
<td>Distance/Near Difference (Range)</td>
</tr>
<tr>
<td>Lateral rectus recession group</td>
<td>21.7±2.8 (16 to 30)</td>
<td>5.1±3.7 (−5 to 10)</td>
</tr>
<tr>
<td>Recess/resect group (n=17)</td>
<td>25.9 (20 to 35)</td>
<td>4.3±2.2 (−5 to 10)</td>
</tr>
</tbody>
</table>

* Values expressed as mean±SD in prism diopters.
† Minus denotes near exotropia exceeded distance exotropia.
Studios have shown that such patients will be approximately 30\(\Delta\) more exotropic under deep anesthesia than in the awake state.\textsuperscript{21,22} This observation has been consistent with my own unpublished observations during the last 2 decades. It is difficult to explain the presence of a large exotropia at 6 m on the basis of an excess of active divergence, if the deviation increases further with the suspension of neuromuscular tonicus as occurs under deep anesthesia. Other authors have questioned the role of an active divergence mechanism in these patients.\textsuperscript{23-26}

This study needs to be viewed in the light of several limitations. My outcome criteria for a satisfactory result were arbitrary and can be subject to question. Some authors have used more liberal outcome criteria in studying intermittent exotropia, and some have used more stringent criteria.\textsuperscript{27-30} This study addressed only the outcome 1 year after surgery. It is recognized that intermittent exotropia tends to recur with time, and long-term follow-up is needed to determine a cure.\textsuperscript{29,30} In this study I specifically avoided referring to my satisfactory outcome patients as being “cured” because I do not know their long-term results. I was merely comparing 2 different treatment modalities and using the same outcome criteria for each group. Also, these were the same criteria used in my previously published report to which I wanted to compare these results. However, if I am correct in proposing that the beneficial effect of a recession/resect procedure is related to its tethering action against abduction, then possibly the apparent benefit will dissipate over time. If that were true, then using a recession/resect procedure might only delay failure. In theory, however, a longer period of good fusion might help maintain a long-term good outcome. Longer follow-up is needed to answer this question.

In addition, the lack of masking could possibly introduce some bias. Many patients were excluded from this study because their deviation increased in the distance after 1 hour of monocular occlusion or while looking out a window; they were recruited for another study. Consequently this study compared recession/resect surgery with lateral rectus recessions only for those patients with basic type intermittent exotropia who did not show an increase in their distance angle of exotropia with either of those 2 specific testing modalities. Whether those excluded patients would have responded differently and altered the outcome of this study cannot be determined. Finally, I emphasize that this study included only patients with intermittent exotropia without A or V patterns, oblique dysfunction, lateral incomitance, or a history of surgery. Also, it excluded patients who had a constant deviation at both distance and near. One cannot extrapolate results from this study with confidence to patients who have those criteria that were excluded. Although there is no reason to suspect that patients with those characteristics would behave differently, no data substantiates that assumption.

This article is the second of a 3-part series. The third part will appear next month.

Accepted for publication October 21, 1997.

Supported by an unrestricted grant from Research to Prevent Blindness Inc, New York, NY, and the Wisconsin Lions Foundation, Stevens Point, to the Department of Ophthalmology & Visual Sciences, University of Wisconsin, Madison.


Corresponding author: Burton J. Kushner, MD, 2870 University Avenue, Suite 206, Madison, WI 3705-3611 (e-mail: bkushner@facstaff.wisc.edu).

REFERENCES

Gerald B. Kara, MD, 1920-1998

Gerald B. Kara, MD, was born in Constantinople (now Istanbul), Turkey, in 1920, of Armenian parentage. He died February 18, 1998, after a long illness. His service to the New York Eye and Ear Infirmary, New York City, spanned almost a half century. Appointed senior surgeon and chief of service there in 1957, he was considered “the ophthalmologist’s surgeon,” and lectured and operated all over the world. His patients included baseball’s “Babe” Ruth, who—unknown to most—had only one “good” eye. Later at the Infirmary he served as chairman of the Research Committee. He also held appointments at Columbia University’s Institute of Ophthalmology; St Mary’s Hospital, Hoboken, NJ; St Charles Hospital, Long Island, NY; and Misericordia Hospital, New York City. He served as civilian consultant in ophthalmology to the US Air Force in 1961.

Dr Kara began his medical career at Hahnemann Medical University in Philadelphia, Pa, and continued postgraduate studies at Jersey City Medical Center, Jersey City, NJ; The New York Eye and Ear Infirmary; and the Institute of Ophthalmology, London, England, under Norman Ashton. He then studied with distinguished ophthalmologists such as Bernard Samuel, Algernon Reese, Conrad Behrens, and Daniel Kirby.

While seemingly introverted, Dr Kara was known by friends as a person of wit and great repartee. A fine historian, he wrote for the New York Medical Journal on “Two Hundred Years of Ophthalmology in New York State.” He was a philatelist, specializing in medical stamps, and a bibliophile, with a fine library of historical, biographical, and medical texts.

He is survived by his wife, Gisela, who had been his personal scrub nurse at the infirmary and during their foreign travels. He is also survived by 2 sisters, 2 nieces, and grandnieces and grandnephews. Gerald B. Kara will be dearly missed by his family, by me—a friend and colleague of many years—and by many other colleagues and grateful patients worldwide.

R. M. Fasanella, MD
Orange, Conn

Obituary

Correction

Error in “Abstract” and “Results” Sections. In the article titled “Selective Surgery for Intermittent Exotropia Based on Distance/Near Differences” in the March 1988 issue of the ARCHIVES (Arch Ophthalmol. 1988;116:324-328), the P values that should have been printed as P<.05 in the “Results” subsection of the “Abstract” and in the “Results” section were printed in error as P>.05.

The correct wording in the “Results” subsection of the “Abstract” section should have been:

Results: Of 19 patients with basic exotropia receiving lateral rectus recessions, 10 patients (52%) had a satisfactory outcome compared with 14 (82%) of the 17 patients who had recess/resect procedures (P<.05). Of the 68 patients with simulated divergence excess, 55 patients (80%) had a satisfactory outcome after bilateral/lateral rectus recessions. This result was significantly better than the outcome for patients with basic exotropia who underwent lateral rectus recessions (P<.05).

The correct wording in the “Results” section should have been:

There were 68 patients with simulated divergence excess exotropia who underwent symmetric lateral rectus recessions who made up the control group and were subject to the same exclusion criteria as the study group. Fifty-five (81%) had a satisfactory outcome; 3 (4%) were overcorrected and 10 (15%) were undercorrected. These results differ significantly from the results of patients with basic exotropia who underwent lateral rectus recessions (P<.05; χ2 test) but were essentially identical to the results of patients with basic exotropia who underwent recess/resect surgery.