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Relationship Between Motor Alignment at Postoperative Day 1 and at Year 1 After Symmetric and Asymmetric Surgery in Intermittent Exotropia

Se-Youp Lee* and Young Chun Lee†

*Department of Ophthalmology, College of Medicine, Keimyung University, Taegu City, South Korea; †Department of Ophthalmology, Uijongbu, St. Mary's Hospital, Catholic University, Uijongbu City, South Korea

Purpose: To evaluate the relationship between the motor alignment at postoperative day 1 and at year 1 following bilateral lateral rectus recession (BLR, symmetric surgery) and unilateral lateral rectus recession-medial rectus resection (R&R, asymmetric surgery) for the treatment of intermittent exotropia, X(T).

Methods: Forty-six patients with basic or pseudo-divergence excess type of X(T) underwent BLR and 57 patients underwent R&R. The motor alignment at postoperative day 1 was classified as overcorrected by 11–20 prism diopters (PD), overcorrected by 1–10 PD, orthotropic, or undercorrected by 1–10 PD of exotropia.

Results: There was a statistically significant relationship between the alignment at postoperative day 1 and at year 1 following both R&R and BLR surgery ($r = 0.74$, $r = 0.51$, respectively, $P < .05$). Patients overcorrected by 1–20 PD had a significantly higher success rate than those undercorrected by 1–10 PD on postoperative day 1 ($P < .05$). For R&R, a postoperative day 1 alignment of 1–10 PD resulted in the highest success rate of 73.7%. For BLR, a postoperative day 1 alignment of 11–20 PD showed the highest success rate of 76.9%. There were no significant differences in the success, undercorrection and overcorrection rates between the two surgical procedures after a 1-year postoperative period.

Conclusions: The alignment at postoperative day 1 can be a predictive factor of the surgical outcome in X(T). A postoperative day 1 overcorrection of 11–20 PD following BLR surgery and an overcorrection of 1–10 PD following R&R can lead to good results. **Jpn J Ophthalmol 2001;45:167–171** © 2001 Japanese Ophthalmological Society

Key Words: Bilateral lateral rectus recession, intermittent exotropia, unilateral lateral rectus recession-medial rectus resection.

Introduction

Of the various specific factors which contribute to the variability of the surgical results for intermittent exotropia, X(T), an initial postoperative overcorrection is known to be a major contributor.[1–7] An initial postoperative overcorrection is believed to eliminate not only suppression and stimulate fusional vergence but also to reduce postoperative exotropic drift. In cases of basic X(T), the choice between bilateral lateral rectus recession surgery (BLR, symmetric surgery) and unilateral lateral rectus recession-medial rectus resection surgery (R&R, asymmetric surgery) is largely a matter of preference. Moreover, the amount of initial postoperative overcorrection differs between surgeons. In BLR surgery, Raab and Parks[7] advised a 10 to 20 prism diopters (PD) of overcorrection, while Scott et al[5] advised a 4 to 14 PD of overcorrection. McNeer[8] recommended a 0 to 10 PD of overcorrection.

In R&R surgery, Parks[9] advised a few prism diopters

Received: April 26, 2000

Correspondence and reprint requests to: Se-Youp LEE, MD, Department of Ophthalmology, College of Medicine, Keimyung University, DongSan Medical Center, 194 DongSan-Dong, JungGu, Taegu City 700-712, South Korea

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Published by Elsevier Science Inc.

0021-5155/01/$–see front matter
PII S0021-5155(00)00351-8

Jpn J Ophthalmol
Vol 45: 167–171, 2001

of immediate postoperative overcorrection. Souza-Dias and Uesugui[2] recommended a 5 to 10 PD overcorrection; however, they cautioned that overcorrections and undercorrections sometimes are the result of greater or lesser amounts of initial overcorrection.

Therefore, the purpose of this study was to determine the relationship between the alignment of the eyes at postoperative day 1 and at year 1. In addition, we attempted to predict the success, undercorrection, and overcorrection rates at postoperative year 1 by examining the alignment at postoperative day 1 following BLR and R&R surgery.

Materials and Methods

This study includes 103 intermittent exotropes comprising 93 with the basic type and 10 with the pseudo-divergence excess type. Between January of 1993 and March of 1998, 46 patients underwent BLR surgery and 57 patients underwent R&R surgery at the Keimyung University Hospital. Of these patients, 45 were boys and 58 were girls. Their ages ranged from 3 to 17 years with a mean age of 7.1 years.

All patients met the following criteria: basic or pseudo-divergence excess type of X(T), a range of 20–40 PD of deviation angle, corrected visual acuity not worse than 20/30, and at least a 1-year postoperative follow-up period. Patients who had a visual acuity difference of more than three lines between the 2 eyes, oblique dysfunction, or previous ocular surgery were excluded.

Basic X(T) was defined as when distance deviation was within 10 PD of near deviation. The pseudo-divergence excess type of X(T) was defined as when distance deviation was larger than near deviation. When the X(T)patient was monocularly occluded for 45 minutes, however, the near deviation increased to within 10 PD of the distance deviation.

Cover-uncover testing was performed at both near and distance to determine whether the exodeviation was latent or manifest. The alternate prism-cover test was used to measure the deviation. All measurements were performed with optical correction in place if it had been prescribed.

All surgery was performed by the same surgeon (SYL; Keimyung University). We routinely attempted to deliberately overcorrect all basic and pseudo-divergence types of X(T). The amount of surgery was based exclusively on the extent of the deviation. In most cases, the muscles were operated upon using a fornix incision. To obtain an accurate measurement of the deviation at postoperative day 1, the ocular pain was controlled by local anesthetic (Alcaine).

The alignment at postoperative day 1 was classified as: overcorrected by 11–20 PD (Group I), overcorrected by 1–10 PD (Group II), orthotropic (Group III), and undercorrected with an exotropia of 1–10 PD (Group IV). All patients were examined at postoperative day 1 and year 1 and the alignment at distance fixation recorded.

The outcome was judged to be successful if there were no more than 10 PD of exophoria or 5 PD of esophoria, if the undercorrection was more than 10 PD exodeviation, and if the overcorrection was more than 5 PD of esodeviation at the 1-year follow-up examination.

Postoperative day 1 alignment was compared with the postoperative year 1 alignment. Comparisons of the relationships between the two surgical procedures were analyzed using the chi-square test and univariate linear regression analysis. A single regression equation was used for linear comparisons and its significance was evaluated by examining coincidence, parallelism and equal intercepts.[10]

In addition to the motor alignment at postoperative day 1 as a predictive factor, we also evaluated age at surgery, preoperative deviation angle, and types of surgical procedure. Age at surgery was classified as: 3–5 years old, 6–8 years old, and over 9 years old. Preoperative deviation angle was classified as: 20–29 PD and 30–39 PD.

Results

Preoperatively, the mean alignment and age of the patients who underwent BLR was 27.2 PD and 7.3 years old, respectively, and those who underwent R&R was 28.4 PD and 6.9 years old, respectively. There were no significant differences between the mean alignment or the age of the patients who underwent the two surgical procedures.

Group I: After Postoperative Year 1 (27 Patients)

For R&R surgery, the success rate was 71.4% (10/14), the overcorrection rate was 28.6% (4/14), and the undercorrection rate was 0% (0/14). For BLR surgery, the success rate was 76.9% (10/13), the overcorrection rate was 15.4% (2/13), and the undercorrection rate was 7.7% (1/13) (Figures 1 and 2).

Group II: After Postoperative Year 1 (38 Patients)

For R&R surgery, the success rate was 73.7% (14/19), the overcorrection rate was 10.5% (2/19), and

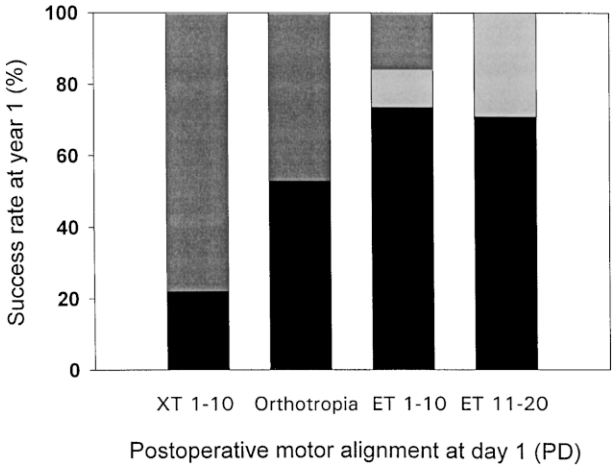

Figure 1. Surgical success rate according to initial alignment in monocular lateral recession and medial resection. ■ Success, ■ overcorrection, ■ undercorrection.

the undercorrection rate was 15.8% (3/19). For BLR surgery, the success rate was 57.9% (11/19), the overcorrection rate was 5.3% (1/19), and the undercorrection rate was 36.8% (7/19) (Figures 1 and 2).

Group III: After Postoperative Year 1 (21 Patients)

For R&R surgery, the success rate was 53.3% (8/15), the overcorrection rate was 0% (0/15), and the undercorrection rate was 46.7% (7/15). For BLR surgery, the success rate was 50% (3/6), the overcorrection rate was 0% (0/6), and the undercorrection rate was 50% (3/6) (Figures 1 and 2).

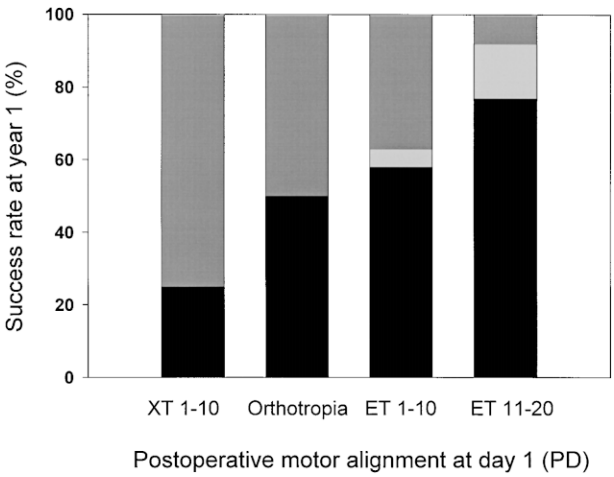

Figure 2. Surgical success rate according to initial alignment in bilateral lateral rectus recession. ■ Success, ■ overcorrection, ■ undercorrection.

Group IV: After Postoperative Year 1 (17 Patients)

For R&R surgery, the success rate was 22.2% (2/9), the overcorrection rate was 0% (0/9), and the undercorrection rate was 77.8% (7/9). For BLR surgery, the success rate was 25% (2/8), the overcorrection rate was 0% (0/8), and the undercorrection rate was 75% (6/8) (Figures 1 and 2).

The highest success rate was found in those patients in group II who underwent R&R surgery and those in group I who underwent BLR surgery. The overall success rate of R&R surgery after a 1-year postoperative period was 59.6% (34/57). The overall overcorrection rate was 10.5% (6/57) and the overall undercorrection rate was 29.8% (17/57). The overall success rate of BLR surgery at postoperative year 1 was 56.5% (26/46), the overall overcorrection rate was 6.5% (3/46), and the overall undercorrection rate was 37% (17/46) (Table 1). No significant differences were detected at postoperative year 1 between the success rates, undercorrection rates, and overcorrection rates for the two methods of surgery.

The highest incidence of patients with more than 5 PD overcorrection at postoperative year 1 were in group I who underwent R&R surgery. All 6 of these patients with more than 5 PD overcorrection were among those patients with more than 10 PD overcorrection on postoperative day 1. The 3 patients with more than 5 PD overcorrection who underwent BLR surgery were among those patients with 7-20 PD overcorrection at postoperative day 1.

Patients with a successful outcome had a mean postoperative day 1 alignment of -7.1 ± 7.4 PD following R&R surgery, and -8.3 ± 6.8 PD following BLR surgery. Patients with an overcorrection had a

Table 1. Comparison of Success Rate Following Unilateral Lateral Recession-Medial Resection and Bilateral Lateral Rectus Recession at Postoperative Year 1*

	Unilateral R&R†	Bilateral LR‡
Success	59.6% (34)	56.5% (26)
Undercorrection	29.8% (17)	37% (17)
Overcorrection	10.5% (6)	6.5% (3)
	100% (57)	100% (46)

*Values in parentheses are the number of patients.
†R&R: Unilateral recession-resection.
‡LR: Lateral rectus recession.

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mean postoperative day 1 alignment of −15 ± 4.5 PD following R&R surgery, and −13.6 ± 5.9 PD following BLR surgery. Patients with an undercorrection had a mean postoperative day 1 alignment of 2.1 ± 5.3 PD following R&R, and −1.3 ± 7.8 PD following BLR surgery.

There was a statistically significant relationship between the alignment at postoperative day 1 and that at year 1 in both R&R and BLR surgery patients ($r = 0.74$, $r = 0.51$, respectively; $P < .05$) (Figure 3). The regression equation in the case of BLR was Y = 0.58X + 10.3. For R&R surgery, the regression equation was Y = 0.73X + 9.83. The correlation coefficient was slightly higher for R&R (0.74) than for BLR (0.51), but no significant differences were found between the regression lines of the two surgical methods (Figure 3). At postoperative day 1, patients overcorrected by 1–20 PD had a significantly higher success rate than those undercorrected by 1–10 PD ($P < .05$).

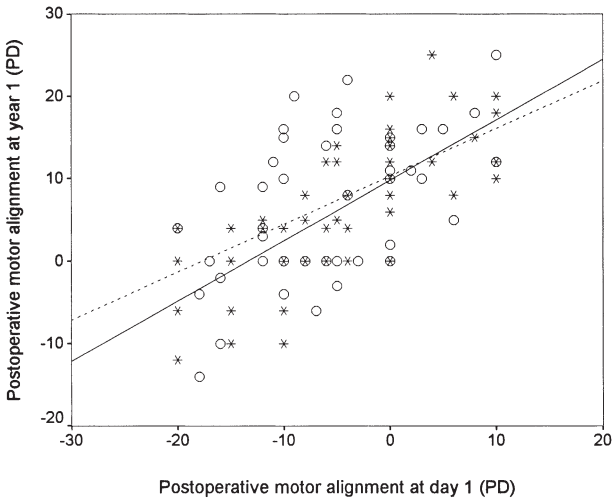

Figure 3. Comparison of scattergram and regression line of postoperative motor alignment at day 1 and year 1 following unilateral recession-resection (R&R) or bilateral lateral rectus recession (BLR) surgery. Regression equation for unilateral recession-resection is Y = 0.73X + 9.83 (Y = alignment at postoperative year 1, X = alignment at postoperative day 1, slope: 0.73, constant: 9.83, correlation coefficient: 0.74). Regression equation for bilateral lateral rectus recession is Y = 0.58X + 10.3 (Y = alignment at postoperative year 1, X = alignment at postoperative day 1, slope: 0.58, constant: 10.3, correlation coefficient: 0.51). There were no significant differences between the two lines. −: Esodeviation; +: exodeviation, solid line, *: R&R; dotted line, open circle: BLR.

Success Rate by Age at Surgery and Preoperative Deviation Angle

The success rate was 43.2% (16/37) in the 3- to 5-year-old group, 63.4% (26/41) in the 6- to 8-year-old group, and 72% (18/25) in the over 9-year-old group who underwent R&R or BLR surgery. There was no significant difference in the success rates among the three age groups ($P > .05$).

The success rate was 56.4% (31/55) in the 20–29 PD group, and 60.4% (29/48) in the 30–39 PD group who underwent R&R or BLR surgery. There was no significant difference in the success rate between the two preoperative deviation angle groups ($P > .05$). The age at surgery, the preoperative deviation angle, and the type of surgery did not significantly affect the surgical results after postoperative year 1 ($P > .05$).

Discussion

Almost all patients with X(T) require surgical correction at some time. The surgical results are more satisfactory if the operation is done while the patient still exercises fusion during some portion of the day. Moreover, many known variable factors, such as surgical method, age at onset, age at surgery, preoperative distance and near deviation, preoperative difference in the near and distance deviation angle, duration of the exodeviation, presence of amblyopia, anisometropia, and associated oblique dysfunction are known to affect the surgical outcome in X(T).[11] In addition, the importance of immediate postoperative alignment has been addressed by numerous studies,[1–7] although the best initial ocular alignment following surgery for X(T) remains controversial.

The surgical outcome after a 1-year postoperative period in relation to the initial day 1 alignment is shown Figures 1 and 2. Our study shows that an initial postoperative overcorrection of 11–20 PD following BLR surgery and an overcorrection of 1–10 PD following R&R surgery can lead to good surgical results. We agree with Raab and Parks[7] that an initial overcorrection is desirable after surgery. Most surgeons strive for an initial postoperative overcorrection to stabilize the long-term results. Parks advised surgeons who recess the lateral recti that they should anticipate a ±20 PD esotropia in the primary position on the second or third postoperative day, but, in the case of the recession-resection procedure, they should make only a few prism diopters of immediate postoperative overcorrection.[9] Knapp suggested that overcorrection would precipitate the appearance of a nasal scotoma. This reaction would reduce the temporal suppression and impede the re-

lapse of X(T).[12] Therefore, basic or pseudo-divergence excess type of X(T) must be surgically overcorrected in the early postoperative period in order to avoid relapse.

Some of our patients with overcorrection suffered diplopia from esodeviation and abduction insufficiency after surgery. We used alternating occlusion to decrease the diplopia and overcorrection during the waiting period. Alternating occlusion will not only eliminate diplopia but will also tend to decrease the angle of esotropia.[6] The patients with immediate postoperative orthotropia or undercorrection seemed comfortable; however, they frequently relapsed to exodeviation with time. They finally needed one additional operation despite the postoperative use of patching. In this study, 2 of 21 initially orthotropic (Group III) and 3 of 17 initially undercorrected patients (Group IV) underwent reoperation after postoperative year 1.

Currently, there is no general agreement on the effectiveness of the two surgical approaches to basic X(T).[13,14] Burian[13] advocated that R&R surgery should be performed on basic and pseudo-divergence excess types and that BLR surgery be performed on true divergence excess type. However Kushner[14] reported that BLR surgery affected distance and near deviation equally. Yukel et al[15] explained that even if the immediate postoperative results seem better with asymmetric surgery, there is no significant difference between the two surgical procedures in the long-term. Our results show that there was no significant difference in the success, undercorrection, and overcorrection rates between the two surgical procedures after postoperative year 1.

Good correlations between the initial and final measurements after surgery for X(T) have been noted by others.[3,4,7] The relationship between the alignment at postoperative day 1 and year 1 for the two kinds of surgery is shown in Figure 3. There was a statistically significant relationship between alignment at postoperative day 1 and at year 1 following R&R and BLR surgery. Moreover, good predictability existed between the alignment at postoperative day 1 and at year 1.

In this study, an initial overcorrection was very important after the two types of surgical procedures. However, not all patients with desirable amounts of initial overcorrection showed a good correlation between postoperative day 1 and year 1 measurements. One of the 4 overcorrected patients in Group I who underwent BLR surgery and one in Group II who underwent R&R surgery required reoperation after a year. The 4 undercorrected patients, in Group I who underwent BLR surgery and in Group II who underwent R&R surgery, were treated with patching.

In summary, a relatively good correlation was found between the postoperative day 1 alignment and the year 1 outcome. Therefore, the alignment at postoperative day 1 can be used as a predictive factor of the year 1 surgical outcome. A postoperative day 1 overcorrection of 11–20 PD in the case of BLR surgery and overcorrection of 1-10 PD for R&R surgery can lead to good results.

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