Original Article

Outcomes of Bilateral Lateral Rectus Resection in Residual Esotropia following Bilateral Medial Rectus Recession

Reza Nabie[1], Vahideh Manouchehri[1], Sepideh Rostam Meydan[2]

[1]Department of Ophthalmology, Nikookari Eye Hospital, Tabriz University of Medical Sciences, Tabriz, Iran, [2]Faculty of Medicine, Islamic Azad University, Tabriz Branch, Tabriz, Iran

Abstract

Purpose: To evaluate the success rate, dose-response ratio, and predictive factors of success in patients with residual esotropia (≥25 prism diopter [pd]) following bilateral medial rectus (BMR) recession who underwent bilateral lateral rectus (BLR) resection.

Methods: In a retrospective study, medical records were reviewed for 47 patients with equal or more than 25 pd residual esotropia following 6 mm BMR recession. Sex, age at second surgery, the interval between first and second surgery in months, visual acuity, refraction, presence of amblyopia, presence of dissociated vertical deviation or inferior oblique overaction/superior oblique overaction, preoperative and postoperative angle of deviation, amount of BLR resection, and months of follow-up were evaluated. Surgical success was defined as postoperative deviation within 8 pd of orthophoria.

Results: The mean age of patients at reoperation was 48.59 ± 21.46 months. The mean near and far residual esotropia before BLR resection was 34.57 ± 11.02 and 33.83 ± 10.99 pd, respectively, reduced to 8.12 ± 1.43 pd in near and 6.32 ± 2.1 pd in far postoperatively. The mean BLR resection dosage was 5.53 ± 1.22 mm and each millimeter of BLR resection (1 mm for each eye) corrected an average of 7.95 pd of deviation in near and 7.40 pd in far. The success rate was 74.5%. After analysis using multivariate logistic regression, there were no factors associated with success.

Conclusions: Bilateral rectus resection in patients with a previous BMR recession has acceptable outcomes. The recommended surgical table can be used as a guide by strabismus surgeons in patients with residual esotropia.

Keywords: Bilateral lateral rectus resection, Bilateral medial rectus recession, Residual esotropia

Address for correspondence: Vahideh Manouchehri, Department of Ophthalmology, Nikookari Eye Hospital, Tabriz University of Medical Sciences, Tabriz, Iran.
E-mail: manouchehriv@tbzmed.ac.ir
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Introduction

Strabismus surgeons face a number of challenges in the management of residual esotropia following bilateral medial rectus (BMR) recession, including deciding the type and extent of a secondary operation. Bilateral lateral rectus (BLR) resection and medial rectus (MR) re-recession are the most common surgeries performed in such cases.[1] There is no clinical trial that compares the two methods. However, lateral rectus (LR) resection seems more logical in patients with previous large BMR recession since MR re-recession may be more likely to lead to consecutive exotropia and convergence weakness.[2-4]

Although BLR resection is the most common surgery performed to correct residual esodeviation,[1] there is no consensus on the best surgical dosage, and many surgeons use their previous experience to determine the amount of resection.[5,6] There is a limited amount of data on the extent of correction gained with each millimeter of BLR resection.[7,8] Our experience has shown that resection based on surgical tables for unoperated muscles

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can cause overcorrection. Thus, we chose numbers that were 0.5 mm less than the proposed numbers in the standard table for primary BLR resection without a history of BMR recession given that the antagonist's muscles are weak here.[9] The aim of this study is to report the success rate and dose-response ratio in patients with residual esotropia (≥25 prism diopter [pd]) following BMR who underwent BLR resection along with the predictive factors of success in patients.

Methods

In this retrospective study, the medical records were reviewed for all patients with equal or more than 25 pd residual or recurrent esotropia following maximal BMR recession (6 mm) who underwent BLR resection as a secondary operation. All surgeries were performed by one surgeon (R.N.) in the Nikookari Eye Center, in Tabriz, Iran, between 2012 and 2020. This research adhered to the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of Tabriz University of Medical Sciences by the ethical code of IR.IAU.TABRIZ.REC.1399.033. Written informed consent was obtained from all patients or their guardians. Patients with developmental delays, restrictive or paralytic esotropia, or less than 3-month follow-up were excluded.

Data were collected for sex, age at second surgery time, the interval between first and second surgery in months, visual acuity in logMAR, refraction in diopter (D), presence of amblyopia, presence of dissociated vertical deviation (DVD) or inferior oblique overaction (IOOA)/superior oblique overaction (SOOA), preoperative and postoperative angle of deviation in pd, amount of BLR resection in millimeters (mm), and months of follow-up after BLR resection.

Deviations were measured using a prism and alternate cover at 6 m and 33 cm with an accommodative target, while patients were wearing corrective glasses. Krimsky test was used in patients with poor visual acuity. Full cycloplegic hyperopia >+2.00 D and anisometropia >+1.5 D were prescribed before surgery. Amblyopia was diagnosed if the difference of the best-corrected visual acuity between two eyes was more than two lines or if the patient was unable to maintain fixation with the nondominant eye. Dose-effect ratio was calculated as the amount of corrected deviation per 1 mm of BLR resection which showed the amount of correction for every 2 mm resection (1 mm for each eye). Surgical success was defined as postoperative deviation within 8 pd of orthophoria.

All surgeries were performed by one surgeon. Through the limbal conjunctival incision, the LR in each eye was resected symmetrically using surgical dosage as shown in Table 1 and sutured to the sclera with two single-armed absorbable 6-0 Vicryl (polyglactin 910; Ethicon). The numbers in Table 1 are 0.5 mm less than the numbers in the guideline recommended by Rosenbaum.[9]

The SPSS 23.0 for Windows (SPSS, Inc., Chicago, IL, USA) was used for the statistical analysis. Variables are described using frequency/percentage and mean with standard deviation. Paired *t*-tests and Chi-square test were used for analysis. Following univariate analysis, a multivariate logistic regression model was used to assess factors associated with successful results. Spearman's rank correlation was used to evaluate the association between BLR resection dosage and correction of esotropia. Results were considered statistically significant at $P < 0.05$.

Table 1: Surgical dosage

Esotropia (pd)	Resection (mm)
25	5
30	5.5
35	6
40	6.5
45	7
50	7.5
≥55	8

Pd: Prism diopter

Results

Of the 47 patients eligible for the study, 27 (57.4%) were male. The mean age of patients at the primary operation was 19.06 ± 14.01 months (range, 12–110 months). The mean primary esotropia before 6 mm of BMR recession was 60.63 ± 8.18 pd (range, 30–77 pd). Patients underwent BLR resection after a mean time of 16.89 ± 10.89 months (range, 6–46 months) and followed for a mean time of 44.71 ± 23.76 months (range, 6–87 months). The mean age of patients at reoperation was 48.59 ± 21.46 months (range, 24–125 months). Visual acuity in the last follow-up was measurable using a Snellen chart in 45 patients. The mean best-corrected visual acuity was 0.1 ± 0.09 logMAR units (range, 0–0.25 logMAR) in the right eye and 0.15 ± 0.09 logMAR units (range, 0–0.3 logMAR) in the left eye. The mean spherical equivalent of the right eye in the past follow-up was +1.23 ± 0.88 diopter (range, −1.5 to +4.5 logMAR) and +1.41 ± 0.92 diopter (range, −1 to +5.0 logMAR) in the left eye. Eleven patients were amblyopic at the time of the second surgery. Concurrent DVD was seen in five subjects and 12 subjects had IOOA/SOOA.

Mean near and far residual esotropia before BLR resection was 34.57 ± 11.02 (range, 25–60 pd) and 33.83 ± 10.99 pd (range, 25–60 pd), respectively. The mean BLR resection dosage was 5.53 ± 1.22 mm (range, 5–8 pd). Simultaneous weakening surgery on the inferior oblique was performed in 10 subjects. The mean postoperative esotropia was 8.12 ± 1.43 pd (range, 0–25 pd) in near and 6.32 ± 2.1 pd (range, 0–25 pd) in far. Successful outcomes were seen in 34 cases (74.5%). In patients with unsuccessful results, seven patients (14.8%) were undercorrected in which mean postoperative residual esotropia was 15.69 ± 5.02 pd (range, 10–20 pd) in near and 11.38 ± 5.31 pd (range, 12–20 pd) in far. Nevertheless, all were satisfied with the results. In six overcorrected patients (12.7%), mean postoperative exotropia was 18.02 ± 4.65 pd (range, 10–25 pd) in near and 18.98 ± 3.77 pd (range, 10–30 pd) in far, five of whom underwent a third operation for correction of consecutive exotropia with successful results.

Spearman's rank correlation showed a strong correlation between BLR resection dosage and correction of esotropia in near ($r = 0.42$, $P = 0.05$) and far ($r = 0.44$, $P = 0.05$) as shown in Figures 1 and 2. Each millimeter of BLR resection corrected an average of 7.95 pd ($P = 0.001$, 95% confidence interval [CI] = 5.15–10.75) of deviation in near and 7.40 pd ($P = 0.001$, 95% CI: 4.93–9.87) in far.

To evaluate predictive factors of successful outcomes, a multivariate logistic regression used factors including age in secondary surgery, the interval between primary and secondary surgery, amount of esotropia, amblyopia, anisometropia, DVD, IOOA/SOOA, and simultaneous surgery on oblique muscles. None of these factors was associated with success ($P > 0.05$). Results are shown in Table 2.

Discussion

The results of this study demonstrated that BLR resection with a dosage of 0.5 mm less than the numbers shown in the standard table in patients with a history of 6 mm of BMR recession had a success rate of 74.5%. Although the rate of undercorrected patients was higher than overcorrected ones (14.8% vs. 12.7%), all reoperations were performed on overcorrected patients, indicating that undercorrection is more esthetically acceptable for patients. A recommended table of surgical dosage was adjusted for different values of deviation [Table 3]. This table is calculated based on the dose-effect ratio of the study in patients who had successful outcomes (the amount of corrected deviation per 1 mm of BLR resection) which indicates how much resection is required to reach orthophoria. We did not find predictive factors for successful outcome, which is similar to other studies in this field.[10]

Residual esotropia is considered a common complication following BMR recession and different surgical plans are generally recommended to manage undercorrected esotropia.[11,12] Although BLR resection is commonly performed to correct residual esodeviation, clear data on surgical dosage does not exist, and many surgeons use their training and experience to determine the amount of resection. Limited data are available on the amount of correction gained with each millimeter of BLR resection. One reason for the wide range of reported successful outcomes for BLR resection, ranging from 52% to 87%,[5-8] is related to the diverse surgical dosage used during surgery.

An overcorrection rate of 8% and an undercorrection rate of 32% have been reported by Gunasekera *et al*.,[10] who used the surgical table of the American Academy of Ophthalmology for correction of residual esotropia. This table recommends higher numbers in comparison to our surgical table. Despite this, the amount of overcorrection in their study was lower, which could be due to various surgical techniques or different follow-up periods.

Morrison *et al*.[7] reported 7.3 pd correction per millimeter of BLR resection in a study with 14 patients who had a history of large BMR. Only near measurements were used for the calculation. In our study, each millimeter of BLR resection corrected an average of 7.9 pd of deviation in near and 7.4 pd in far. These results are compatible with Morrison's study. Mims and Wood[8] revealed a correlation between the effect of BLR resection and the amount of previous BMR and introduced the following formula: $2.39 + 0.25\,(\text{mm MR recession})^2 + 0.41\,(\text{mm LR resection}) = \text{pd of effect}$. They concluded that the use of this formula led to a higher success rate (87%). By putting the number 6 mm for the MR recession and the number 5.53 mm for the LR resection in the formula, the correction rate of 6.82 pd was calculated which was lower than the correction effect of our study.

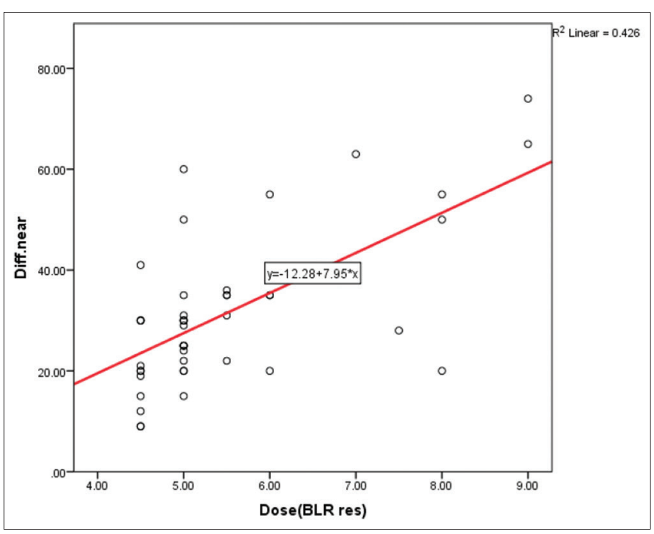

Figure 1: Correlation between bilateral lateral rectus resection dosage and correction of esotropia in near

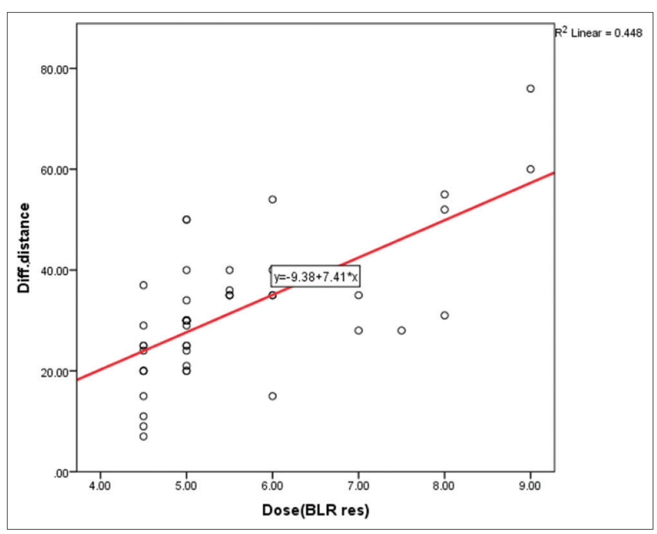

Figure 2: Correlation between bilateral lateral rectus resection dosage and correction of esotropia in far

Table 2: Results of multivariate logistic regression evaluating predictive factors of a successful outcome

	Success group	Failure group	*P*
Amount of esotropia (pd) mean±SD (range)	32.12±9.46 (25-60)	37.68±10.65 (25-60)	0.32
The interval between primary and secondary surgery (months) mean±SD (range)	18.78±15.89 (8-46)	14.80±11.64 (6-44)	0.09
Age in secondary surgery (months) mean±SD (range)	52.71±16.09 (24-125)	45.42±45.12 (30-115)	0.25
Anisometropia (%)			
No	12 (25.5)	28 (59.5)	0.13
Yes	2 (4.2)	5 (10.6)	
Amblyopia (%)			
No	9 (19.1)	27 (57.4)	0.19
Yes	5 (10.6)	6 (12.7)	
DVD (%)			
No	12 (25.5)	30 (63.8)	0.27
Yes	2 (4.2)	3 (6.3)	
IOOA/SOOA (%)			
No	21 (44.6)	14 (29.7)	0.51
Yes	5 (10.6)	7 (14.8)	
Simultaneous surgery on oblique muscles			
No	16	21	0.20
Yes	6	4	

Pd: Prism diopter, DVD: Dissociated vertical deviation, IOOA: Inferior oblique overaction, SOOA: Superior oblique overaction

Table 3: Recommended surgical dosages

Residual esotropia (pd)	Amount of BLR resection (mm)
25	4.5
30	5
35	5.5
40	6.5
45	7.5
50	8

Pd: Prism diopter, BLR: Bilateral lateral rectus

No prospective clinical trial studies comparing the two methods of BLR resection and MR re-recession have been conducted. In a study by Rajavi *et al.*,[13] the results of unilateral LR resection were compared to MR re-recession in patients with residual esotropia. They concluded that there was no clinically significant difference in the success rate of the two methods. However, in the re-recession group, the adduction deficit was 50% postoperatively and convergence insufficiency developed in 16.5% of subjects. King *et al.*[2] reported success rates of 40.6% and 57.5% for BMR muscle re-recession and BLR resection, respectively. The authors advocated BLR resection for the management of residual esotropia due to the higher overcorrection rate of re-recession group.

Important limitations of this study are the retrospective design and the relatively short follow-up time. The type of esodeviation was also not specified. Nevertheless, our study indicated that bilateral rectus resection in patients with a previous BMR recession has acceptable outcomes. The recommended surgical table can be used as a guide by strabismus surgeons in patients with residual esotropia.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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