Recurrence of Intermittent Exotropia after Bilateral Lateral Rectus Recession

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Abstract:

PURPOSE: The purpose of this study was to evaluate predictive factors for intermittent exotropia (XT) recurrence after bilateral lateral rectus (BLR) recession.

METHODS: This is a retrospective chart review of patients with XT who underwent BLR recession surgery between January 2007 and March 2017 with at least one postsurgical follow-up. Forty-one medical records were reviewed. Information collected included age, gender, systemic diseases, history of prematurity, family history of eye diseases, visual acuity, refraction, ocular alignment and control, stereoacuity, slit-lamp examination, fundoscopy, and amount of BLR recession. Successful alignment was defined as ≤8 prism diopters of esotropia or exotropia postoperatively.

RESULTS: The mean age of patients at the time of surgery and follow-up time was 9.2 ± 12.3 years (y) and 23.6 ± 36.5 months (m), respectively. The mean amount of BLR recession was 6.5 ± 1.0 mm. Recurrence rate was 43.9% on the last follow-up. Age at surgery and at the time of last follow-up were significantly higher in the recurring group (P = 0.04 and P = 0.05, respectively). Postoperative angle of misalignment during the first 3 months was correlated with exotropia recurrence. No statistical significance was found among the remaining factors studied.

CONCLUSIONS: The recurrence rate of XT in our study was 43.9%; it was increased in patients operated at older age and amid those with significant exotropia detected in the early postoperative period (within 3 months of surgery).

Keywords: Bilateral lateral rectus recession, intermittent exotropia, strabismus, surgery

Introduction

Intermittent exotropia (XT) is the most common form of exotropia (XT). It is a major primary comitant form of strabismus in the childhood period.¹ It is defined as an outward ocular misalignment and estimated to be present in 1%–2% of the pediatric population.² The angle of deviation in intermittent XT ranges usually from 20 to 40 prism diopter (PD). Treatment forms to restore binocular vision, and normal ocular alignment can be nonsurgical, such as patching, orthoptic therapy, and over-minus lenses and/or surgical, the latter being the focus of our study.³ Traditional surgical treatments have been two-muscle surgery, unilateral lateral rectus recession, and medial rectus resection or bilateral lateral rectus (BLR) recession, with the choice of procedure classically based on eye exam parameters such as measured distance/near deviation.² Postsurgical recurrence is not uncommon and has been described by many authors with various associated prognostic factors.⁴⁵ Lee et al. showed that the larger the preoperative angle, the greater was the recurrence.⁶ However, a retrospective cohort study revealed that postoperative recurrence was not affected by any factor.⁷ In yet another study, the only significant

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prognostic factor was the angle of deviation at distance the first day after surgery. Recurrence rate also varied by the type of surgery and by the definition of recurrence in different studies.

We aimed at evaluating the recurrence of XT (defined as >8 PDs of misalignment) after BLR recession surgery and to study preoperative and postoperative prognostic factors.

**Materials and Methods**

This was a retrospective chart review of patients undergoing BLR recession by a single surgeon (CA) for XT at the Ophthalmology Department, American University of Beirut Medical Center, between January 2007 and March 2017. The study was approved by the Institutional Review Board of the American University of Beirut, and it adheres to the Declaration of Helsinki. Informed consent was waived because of the retrospective nature of the study.

**Patient selection**

Patients were selected if they had XT as the main diagnosis at presentation and underwent BLR recession with postsurgical follow-up of at least 1 month. Patients with missing information in their charts, limited eye examinations, history of prior ocular surgeries, vertical strabismus, paralytic strabismus, strabismus with restricted motility, other ocular comorbidity, or systemic disease (such as developmental delay, cerebral palsy, or brain tumor/pathology) were excluded from the study.

**Clinical definition**

Successful postoperative alignment was defined as a postoperative deviation of ≤8 PDs of exotropia or esotropia. Recurrence was defined as postoperative exotropia of more than 8 PD.

All patients underwent BLR recession by one surgeon (CA). After performing a limbal peritomy, the lateral rectus muscle was isolated on a Jameson hook; a double armed 6–0 vicryl suture was used to engage the muscle at the insertion and was double locked on each side. The muscle was then dissected off the globe and re-attached directly to sclera at the determined recession site. The amount of recession was based on the surgical table by Buckley et al.

**Data collection**

Data collected included age of the patient in years (y), gender, systemic diseases, history of prematurity, family history of eye diseases, preoperative and postoperative eye exam parameters (visual acuity, cycloplegic refraction, slit-lamp examination, stereoacuity when available using the Titmus fly test, and ocular motility assessment at distance and near with alternate cover testing and level of control), as well as intraoperative parameters (intraoperative magnitude of muscle movement, which muscle was operated, and technique of surgery).

**Outcomes**

The study’s main outcome measure was the frequency of postsurgical exotropia recurrence and predictive factors, namely angle of preoperative deviation, control of the intermittent tropia, stereoacuity, age at surgery, spherical equivalent, gender, amount of lateral rectus recession, and postoperative deviations at different postoperative time points (1 week–3 months, 3 months–6 months, 6 months–1 year, and more than 1 year).

**Statistical analysis**

Data were entered into SPSS V21 (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp., USA) to perform data analysis and correlations including Chi-square tests, frequency distributions, and mean comparisons. Correlation between the amount of muscle recession and postoperative outcomes was analyzed. ANOVA was used as well for multivariate comparison. Statistical significance was set at $P \leq 0.05$.

**Results**

**Patient characteristics**

Out of a total of 228 patients with XT, 41 underwent BLR recession surgery. The female-to-male ratio was 1:3. The mean age of the patients at the time of surgery was 9.2 ± 12.3 years. The mean follow-up time was 23.6 ± 36.5 months. All patients included underwent BLR muscle recession, with a mean amount of 6.5 ± 1.0 mm. Two patients had a family history of exotropia. Demographic characteristics are outlined in Table 1.

**Pre- and post-surgery outcomes**

Recurring exotropia, defined as XT >8 PDs after 1 month postoperatively, was demonstrated in 18/41 (43.9%) patients.

**Table 1: Demographic characteristics of the study patients**

| Parameters                        | Mean±SD (n=41) |
|-----------------------------------|---------------|
| Age at the time of surgery (years)| 9.2±12.3      |
| Follow-up time (months)           | 23.6±36.5     |
| Preoperative SE (diopters)        |               |
| OD                                | 0.6±1.4       |
| OS                                | 0.7±1.5       |
| Preoperative XT (PD)              |               |
| Distance                          | 26.4±8.2      |
| Near                              | 26.5±8.7      |
| Amount of BLR recession (mm)      | 6.5±1.0       |

SD: Standard deviation, BLR: Bilateral lateral rectus, SE: Spherical equivalent, XT: Intermittent exotropia, PD: Prism diopters
of patients at a mean follow-up of 15.5 ± 16.9 m. The remaining 23/41 (56.1%) were orthotropic and considered successfully aligned. No overcorrections were observed. Small-angle esotropia is an expected transient outcome few weeks after surgery. This was demonstrated only in the early postoperative period in one patient who had recurring exotropia later and in three successfully aligned patients. Poor control of the tropia was not associated with recurrence of exotropia: 83% of the recurrent group had poor control preoperatively as compared to 96% of the successfully aligned group, \( P = 0.17 \) [Table 2]. When looking at stereocuity, poor preoperative stereocuity tended to be seen more in the recurrent group as compared to the nonrecurrent group (44% vs. 18%, respectively, \( P = 0.22 \)).

Comparison of preoperative and postoperative characteristics between the recurring and nonrecurring groups showed statistically significant differences in age at the time of surgery and age at the time of last follow-up (\( P = 0.04 \) and \( P = 0.05 \), respectively) with older patients at higher risk of recurrence. Postoperative angle of exotropia was higher in the recurring group compared to the nonrecurring group at all postoperative time points, but statistical significance was lost at 3–6 months [Table 2]. As far as preoperative angle of misalignment, it was found to be slightly higher in the recurring group, but not significantly so. Similarly, no association was noted with spherical equivalent, or gender. In the recurring group, exotropia recurrence was seen at an average of 2.2 months postoperatively.

The amount of BLR recession was similar between groups (\( P = 0.17 \)). A trend of decreased success rate with increasing amount of BLR recession was shown, but this did not reach statistical significance [Figure 1]. Most patients had BLR recession of more than 5 mm with equal distribution between recurring and nonrecurring groups (\( P = 0.28 \)).

### Table 2: Preoperative and postoperative parameters in relationship to exotropia recurrence, mean±standard deviation

|                                | No recurrence (23; 56.09%) | Recurrence (18; 43.91%) | \( P \)  |
|--------------------------------|-----------------------------|--------------------------|---------|
| Age at surgery (years)         | 5.4±3.1                     | 14.1±17.2                | 0.04    |
| Age at last follow-up (years)  | 7.2±4.1                     | 15.5±16.9                | 0.05    |
| Female/male ratio              | 14/7=2                      | 9/11=0.8                 | 0.17    |
| Preoperative XT control (%)    |                             |                          |         |
| Poor                           | 96                          | 83                       | 0.17    |
| Good                           | 4                           | 17                       | 0.17    |
| Preoperative stereocuity (%)   |                             |                          |         |
| Poor (\( \leq 400 \) s)       | 18                          | 44                       | 0.22    |
| Good (\( \geq 200 \) s)       | 82                          | 56                       | 0.22    |
| Preoperative XT (PD)           |                             |                          |         |
| Distance                       | 24.5±7.3                    | 29.0±9.7                 | 0.11    |
| Near                           | 24.1±7.1                    | 29.3±8.7                 | 0.05    |
| Preoperative SE (diopters)     |                             |                          |         |
| OD                             | 1.3±0.8                     | 0.7±1.2                  | 0.70    |
| OS                             | 0.6±1.7                     | 0.8±1.2                  | 0.11    |
| Follow-up time (months)        | 26.4±39.3                   | 20.1±33.2                | 0.58    |
| Postoperative XT (PD)          |                             |                          |         |
| 1 week-3 months                |                             |                          |         |
| Distance                       | 3.2±3.7                     | 13.3±7.5                 | 0.001   |
| Near                           | 2.6±3.9                     | 10.8±9.9                 | 0.003   |
| 3-6 months                     |                             |                          |         |
| Distance                       | 4.7±6.4                     | 16.1±10.1                | 0.07    |
| Near                           | 2.3±4.1                     | 12.6±10.6                | 0.06    |
| 6 months-1 year                |                             |                          |         |
| Distance                       | 2.8±3.8                     | 15.5±3.4                 | 0.003   |
| Near                           | 2.0±2.8                     | 16.8±5.7                 | 0.008   |
| >1 year                        |                             |                          |         |
| Distance                       | 3.3±4.1                     | 18.0±2.8                 | 0.02    |
| Near                           | 2.4±4.3                     | 14.0±8.5                 | 0.29    |
| Amount of BLR recession (mm)   | 6.3±0.9                     | 6.7±1.1                  | 0.17    |
| Number of patients with BLR recessed (mm) | | | |
| \( \leq 5 \)                   | 3                           | 1                        | 0.28    |
| \( >5 \)                       | 20                          | 17                       |         |

SD: Standard deviation; SE: Spherical equivalent; BLR: Bilateral lateral rectus, XT: Intermittent exotropia, PD: Prism diopters
Discussion

Our study evaluated postoperative recurrence rate of XT after BLR recession by a single surgeon and in a single institution using 8 PDs as a cutoff for successful alignment. Exotropia drift is common after XT surgery, resulting in exotropia recurrence;\cite{3} 56.1% of our patients were successfully aligned, while 43.9% showed recurrence defined as exotropia of >8 PDs. A comparison of pre- and post-operative parameters between the recurring and nonrecurring groups showed that age at surgery was significantly higher among patients who had recurrence. Residual postoperative XT noted after surgery was associated with recurrence, especially in the first 3 months after surgery. Better stereoacuity was associated with a trend of lower recurrence rates, whereas exotropia control was not correlated with recurrence.

The definition of successful exotropia surgery varies from one study to another. Maruo et al.\cite{8} defined success as a residual exotropia of <4 PD,\cite{8} whereas Kushner had a less stringent success target defined as <10 PD.\cite{12} Many similar studies on this topic used 10 PD as a cutoff for successful alignment.\cite{9,10,12‑17} We chose 8 PD as that allows binocularity and monofixation as observed in studies on monofixation syndrome and demonstrated in the field of binocularity and fusion.\cite{18} The success rate of the current study at a mean of 23.6 months of follow-up was 56.1%. A few studies attempted to elaborate on success rate post-BLR recession specifically, with varying results ranging from 41% to 83%.\cite{10,12} This variation could be attributed to many factors, including the definition of surgical success, sample size, patient age, and follow-up time.\cite{10,14,19}

The choice for the best timing of surgery for exotropia in children remains ambiguous. Burke advocated delay of surgery for monitoring progression of the angle of deviation, and to allow more accurate measurements, thus decreasing the need for reoperation.\cite{20} On the other hand, Abroms et al.\cite{21} supported early surgery because it yielded better results, avoiding a delay in fusion, which would lead to irreversible sensory deficits.\cite{21} In our study, age at the time of surgery was 9.2 ± 12.3 years, higher than other studies done on this topic. We found that patients who were younger at the time of surgery tended to recur less and those who were successfully aligned at the end of their last follow-up were younger than those who recurred. We believe that surgery at a younger age permits better fusion and promotes lasting sensory and motor alignment.

According to Lim et al., Rutrum, Raab, and Parks and Stoller et al., preoperative deviation did not play a role in exotropia recurrence,\cite{9,10,13,16,22} which agreed with our results, while Gezer reported that smaller preoperative angles of deviation were associated with more favorable outcomes.\cite{23} In our study, the preoperative angle was smaller in the successfully aligned group, although not statistically significantly. Neither stereoacuity nor control of exotropia was predictive of recurrence. However, most of our patients had poor control preoperatively.

Postoperative alignment has also been studied as a factor. Lim et al. found that recurrence rate was significantly decreased with smaller angle of deviation at 1, 3, 6, and 12 months after BLR recession for XT patients.\cite{9} This is consistent with the results of our retrospective study. Significant residual exotropia lessens the likelihood of sensory fusion.

### Table 3: Comparative table of studies on intermittent exotropia surgical outcomes after bilateral lateral rectus recession

| Study                        | Lim et al.\cite{10} | Ing et al.\cite{19} | Arda et al.\cite{14} | Al-Haddad et al. |
|------------------------------|---------------------|---------------------|----------------------|------------------|
| Number of patients           | 511                 | 52                  | 37                   | 41               |
| Mean age at surgery±SD (years)| 6.3±1.9             | 4.7                 | 6.8±2.9              | 9.2±12.3         |
| Female/male ratio            | 1.1                 | -                   | -                    | 1.3              |
| Mean follow-up time±SD (months)| 19.1±9.1           | 52                  | 17.1±9.5             | 23.6±36.5        |
| Recurrence (%)               | 27.4                | 38                  | 8.6                  | 43.91            |
| Preoperative XT (PD)         |                     |                     |                      |                  |
| Distance                     | 32.9±6.0            | -                   | 29.7±8.1             | 26.4±8.2         |
| Near                         | -                   | -                   | 20.9±11.7            | 26.5±8.7         |

SD: Standard deviation, XT: Intermittent exotropia, PD: Prism diopters
Although our study is similar to that by Lim et al. and Ing et al. [Table 3], we had a wider age group including adults while they included only children (below 15 years). Ing et al. agreed with our study in terms of success rate, but did not define a postoperative value for exotropia recurrence; they considered any postoperative tropia as recurrent. Lim et al. had a more generous definition for exotropia recurrence: postoperative angle of deviation >11 PD as compared to >8 PD in our study, which might explain their lower recurrence rate and their different conclusions regarding age at surgery. We chose the limit of 8 PD to allow monofixation and binocularity, which translates to a very satisfactory postoperative sensory status.

Limitations of our study included

Its small sample size and retrospective nature. Our study focused only on BLR recession and not on other surgeries performed for XT (recession and resection). Better preoperative tropia control was not predictive of surgical success, but only few of our patients had good preoperative control and proceeded with surgery, so this conclusion is not of high certainty. Only patients with follow-up visits post surgery were included in our retrospective chart review, which may have increased the chance of having recurring XT. It should also be noted that many patients were lost to follow-up 3 months or more after surgery, due to travels or local follow-ups.

Conclusions

Our study showed a recurrence rate of 43.9% in XT after BLR recession using a cutoff of 8 PD as a criterion for surgical success. We also demonstrated that the recurrence of exotropia was increased with older age at the time of surgery and with significant residual exotropia in the first 3 months postoperative period. Other risk factors showing a trend for recurrence but with no significance were larger preoperative angle of misalignment, increasing amount of BLR recession, worse stereoacuity, and longer follow-up time.

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Conflicts of interest

There are no conflicts of interest.

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