The Survival Analysis after Symmetric and Asymmetric Surgery in Basic Intermittent Exotropia with Equal Dominance

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Abstract
Background: Long-term surgical outcomes were compared between bilateral lateral rectus recession (BLR) and unilateral lateral rectus recession combined with medial rectus resection in the same eye (R&R) for therapy of basic type intermittent exotropia (IXT) with equal dominance.
Methods: Eighty-six subjects (3–11 years old) with the basic IXT with equal dominance who underwent surgery were reviewed retrospectively, at least 18-month follow-up, including 48 patients underwent R&R surgery and 38 underwent BLR surgery at a single center. Surgical outcomes between groups were compared.
Results: No statistical difference was detected between BLR group and R&R group at all intervals with the exception of the last examination, demonstrating a higher success rate and a lower undercorrection rate in the BLR group than R&R group at the last visit (76.3% vs 60.4%, P =0.04; 15.8% vs 35.4%, P =0.04 ). Postoperative recurrence continued in the R&R group, and it was lower in the BLR group. Stereaoacity and control showed overall improvement following both surgeries for basic intermittent exotropia. but this improvement had no statistical difference between groups(P>0.05). Cumulative probability of survival was lower in the R&R group than in the BLR group (P =0.027, log-rank test).
Conclusions: The BLR group had a better outcome than R&R group at final visit, which may be due to the difference in the recurrence rate over time.

Background
Intermittent exotropia (IXT) is the most common type of strabismus\(^1\),\(^2\), affecting 3% of the population under 7 years of age.\(^3\) The characteristic of the particular eye position misalignment is an intermittent outward deviation of one eye, which is easy to appear when the child is tired or on distance fixation.\(^4\) Surgery is the main therapy for intermittent exotropia, which could give satisfactory ocular alignment and binocular function.\(^5\) It is reported that the success rate of surgery for treatment of IXT varied from 27% to 85.1%.\(^6\)-\(^17\)
On the basis of reports from a lot of research, the cure rate of BLR ranged from 42% to 69%, and it randed from 27% to 85.1% for R&R.\(^6\)-\(^17\) The dispute about which method of strabismus surgery was
better for treatment of IXT still exists. Some authors have reported a higher proportion of patients with a ideal outcome with R&R. \textsuperscript{111,116} while others have reported more success with BLR surgery. \textsuperscript{9,17} Moreover, some experts and savants have revealed a notable exotropic drift over time with the R&R surgery. \textsuperscript{89}

Jeoung demonstrated that the unilateral R&R surgery resulted in a better outcome than BLR recession procedure in the patients with exotropia with a dominant eye. \textsuperscript{7} But, in the patients with intermittent exotropia with equal dominance, convincing surgical procedure has not been established. As far as we know, this topic has not been studied alone. This study aimed to compare the surgical outcome of BLR versus R&R procedure in the patients with basic IXT with equal dominance.

Methods

Patients who underwent BLR or R&R surgery for basic type of IX(T) with equal dominance (the difference between deviation at distance and at near less than 10PD after 45min monocular covering) between May 2017 and March 2018 were reviewed. Medical informed consent document was signed by all subjects or their parents, and This study was approved by the Institutional Review Board of Children’s Hospital of Nanjing Medical University.

Eye dominance was determined based on the results of repeated cover-uncover tests alternatively, at least three times per eye. During the tropical period of strabismus, which always showed a fixation shift to the dominant eye after the occluder was removed. otherwise, one eye have equal advantages with the other.

All surgeries were performed using the same operating table by the same surgeon (TABLE 1) under general anesthesia based on the largest distance deviation ever measured. The choice of surgical procedure was made by surgeon who were not biased towards BLR or R&R in basic exotropia. R&R or BLR were performed after discussion with the patient and his or her parents. Meanwhile, the three decides which eye to perform the R&R operation on.

Patients had a history of systemic anomaly, a history of squint or other ocular surgery, amblyopia, and/or restrictive or paretic strabism were excluded.
Retrospectively reviewed the patient's medical records and extract the age at the time of operation, gender, best corrected visual acuity, refractive errors, deviation angle preoperatively (PD) at near and distance, associated strabismus (oblique function disorder, dissociated vertical deviation [DVD], A-V pattern and vertical deviation), follow-up time, lateral incomitancy, and operation type performed (R&R/BLR). The difference of vision acuity between two eyes equal or greater than 2 lines was named amblyopia, a spherical or cylindrical difference between the two eyes greater than 1.50D was named anisometropia. the angle of exodeviation for primary gaze was more than lateral gaze by 5PD was named lateral incomitancy. the one who had oblique muscle overactions, A-V pattern, or DVD not requiring operative treatment was contained.

The whole involved subjects underwent a comprehensive ophthalmic examination before operation. the prism-alternate cover testing was performed to measure the squint angle at distance (6 m) and near (1/3 m) in primary and lateral gaze, with accurate spectacle correction if necessary.

Postoperative deviations at postoperative 1 week, 1 month, 6 and 18 months to the last examination were collected. Patients with diplopia caused by postoperative overcorrection received full-time alternating patch treatment for four weeks until diplopia disappeared. If the esotropia does not decrease after the patch has been applied for 4 consecutive weeks, cycloplegic refraction was put on the agenda again; and hyperopia that exceeds 0.50D was corrected completely. Patients who exhibited constant esodeviation with hyperopia of less than 0.50D were prescribed base-out Fresnel prisms. Incorporating prism into ordinary glasses was prescribed when the prism had to be worn for several months. The strength of the prism glass must be changed several times to keep fusion. We changed the strength of the prism glasses based on the minimum deviation angle to maintain fusion, and recommended weaning the prism when orthotropia was achieved in patients without the prism.

Reoperation was performed for overcorrected subjects if esotropia of ≥15 PD persisted ≥6 months after operation.

Surgery results were divided into 3 categories: recurrence/undercorrection (exotropia/phoria ≥10PD ), success (esotropia/phoria ≤5PD to exotropia/phoria≤10PD ), and overcorrection (esotropia/phoria ≥5 PD ) according to postoperative deviation angle at distance. Reoperation was needed to treat
recurrent exotropia when the maximum angle of exodeviation was at least 15 PD or greater or the patient's fusion control was poor, in which the increase in the apparent phase of exotropia was noticed frequently by clinicians or parents.

Sensory status was assessed by a nearby Titmus stereo test. Stereopsis of ≤80 seconds of arc was defined as good.

The control of deviation is assessed by using the Modified Newcastle Control Score (MNCS)\(^\text{19}\). The MNCS combines both subjective and objective methods of control into a simple grading system that could distinguish and quantify the various severity levels in IDEX. The total MNCS ranges from 0 to 9, MNCS 4 was a suitable surgical threshold.

STATISTICAL ANALYSIS

SPSS 19.0 was used to conduct statistical analysis. Continuous data and categorical data were expressed as mean(SD) and counts(percentages) respectively. Continuous data was compared using Chi square test for continuity correction and Fisher's exact test. Categorical data was compared using an independent t-test. K-M survival analysis and log-rank test were used to compare surgical outcome. p <0.05 was deemed statistically significant.

Results

Preoperative Patient Characteristics:

Among 194 patients who underwent surgery, 108 were excluded, The reasons were as follows: patients with a dominant eye(80); true divergence excess and convergence insufficiency (10); insufficient follow-up period (10); severe amblyopia (5); neurologic disorder (3). Our study contained 38 patients undergoing BLR surgery (BLR group) and 48 patients undergoing unilateral R & R surgery (R&R group).

The general features of the two groups are shown in Table 2. No significant difference in age at surgery, age at onset, distance and near deviation, initial refractive error, associated strabismus(oblique function disorder, DVD, A-V pattern, and vertical deviation), Lateral incomitancy, follow-up time, MNCS scores and Stereopsis between the two compared groups (p>0.05)(TABLE 2).

Surgical Outcome:
Mean postoperative deviations at distance did not differ between groups at all intervals with the exception of 18 months and the last examination (P = 0.03 at 18 months; P = 0.01 at the last visit, independent t test). Mean deviations after surgery at near also didn't differ at postoperative 1 week and 1 month but was less exotropic in the BLR group than in the R&R group after that, with a statistical significance at 6 months, 18 months and the last examination after surgery (P = 0.03, P = 0.02, P = 0.01, independent t test). but, there was no significant statistical difference at 12 months (P = 0.08, independent t test) (FIGURE 1).

Postoperative outcomes demonstrated that the overcorrection rate decreased and the recurrence rate increased in each group with the time passing after operation. Surgical results at each postoperative follow-up time by 18 months after surgery were not different between the two groups (P > 0.05, χ² test). However, the BLR group was associated with a numerically higher success rate than R&R group at the final visit (76.3% vs 60.4%, P = 0.04, χ² test) (TABLE 3).

The cumulative probability of having exotropia of 10 PD or more at either distance or near at any time point of follow-up period from one week to the last examination was 21.1% (7/38) in the BLR group and 33.3% (17/48) in the R&R group. Of these patients, 37.5% (3 of 7) in the BLR group and 31.3% (5 of 17) in the R&R group underwent reoperation. Exotropia ≥10 PD at near, distance, or both was no longer present among participants with residual exotropia who did not undergo reoperation and completed a visit for 18 months or more (1 of 4 (20%) in the BLR group and 1 of 12 (18.2%) in the R&R group).

The cumulative probability of constant esotropia of ≥6 PD at either distance or near at any time point of follow-up period from 1 week after surgery was 15.8% (6/38) in the BLR group and 12.5% (6/48) in the R&R group, 83.3% (10/12) of participants in both treatment groups who met the constant esotropia outcome were prescribed nonsurgical treatment (5 of 6 in the BLRc group and 5 of 6 in the R&R group). Among nonsurgical treatment participants and completed the 18-months or more visit, constant esotropia was no longer present in 4 of 5 in the BLRc group versus 3 of 5 in the R&R group.

Two patients underwent reoperation, 1 of 38 patients in the BLR group and 1 of 48 patients in the R&R group. Surgeries were performed at 14 and 16 months respectively after the first R&R and BLR
procedure. The proportions of overcorrection decrease most significantly within 3 months after surgery (TABLE 3).

Using Kaplan-Meier survival analysis, the estimate mean surgical failure time in the BLR group was 16.6 ± 0.9 months and in the R&R group was 14.8 ± 1.0 months. The cumulative probability of surgical cure in the R&R group was significantly higher than that in the BLR group. (P= 0.027, log rank test; FIGURE 2).

Postoperative Exodrift:

The amount of exodrift between each visit did not differ between BLR group and R&R group (P>0.05, independent t test). The largest exodrift occurred between postoperative 1 month and 6 months at distance and near in both groups, and this was 3.75Δ±4.21Δ(2.16Δ±5.15Δ) in the BLR group and 4.30Δ±5.58Δ(4.84Δ±6.84Δ) in the R&R group. The amount of exodrift from postoperative 1 week to the last examination was 8.62Δ±7.15Δ(7.37Δ±8.18Δ) in the BLR group and 12.46Δ±7.67Δ(10.64Δ±8.69Δ) in the R&R group, and these amounts differ significantly between groups (P=0.01; P=0.03, independent t test).

Effect On Stereoacuity and Exotropia Control:

No significant difference was observed in terms of postoperative stereopsis status between groups (P=0.724, χ² test). Five subjects (13.8%) in the BLR group and 6 subjects (19.7%) in the R&R group who had no preoperative sensory fusion ability obtained sensory fusion after surgery. After the operation, no patients lost preoperative stereoacuity, but 3(5.2%) subjects of the BLR group and 7 (15.2%) subjects of the R&R group postsurgery stereoacuity decreased, (TABLE 4).

The results showed that the MNCS scores variation was of no statistical difference between groups, In the BLR and R&R groups, the proportions of subjects with control of ≤ 3 at baseline were 24% and 25%, and it becomes 79% (30 of 38) and 79% (38 of 48) at the 18-month visit. Fifteen patients in total postsurgery control score decreased compared with presurgery, 5 in the BLR group and 10 patients in the R&R group(TABLE 5).

Discussion
We studied the influence of surgical type on long-term surgical outcomes of patients with basic type intermittent exotropia with equal dominance. BLR group was associated with a numerically higher success rate than R&R group at the last visit (18.13 ± 1.2 months, 18.24 ± 1.1 months, respectively). This may be attributable to a difference in recurrence rate over time: the exodeviation and recurrent rate tended to increase more quickly in the R&R group than in the BLR group as the follow-up period became longer.

There was no unitary viewpoint on the effectiveness of two surgical methods in treating basic type IXT. Wang Lihua reported that the success rate of R&R operation was significantly higher than that of BLR operation (R&R 85.1% vs BLR 65.8%, p = 0.04) after a mean follow-up of 15 months\(^{11}\). Besides, Chia\(^{16}\) noted that subjects receiving R&R showed better outcome at 1 year follow-up (R&R 74.2% vs BLR 42.2%). However, Maruo and associates’ report suggested that\(^{17}\) BLR produced a better outcome at 4-year follow-up (success 66.7% with BLR vs 32.8% with R&R). In a recent multicenter, randomized clinical trial, long-term outcomes were compared between 101 patients who underwent BLR and 96 patients who underwent R&R to treat basic type IXT, significant differences were not observed in suboptimal surgical outcome by 3 years between the two groups.\(^{20}\) But, to the best of our knowledge, this is the first study to explore the influence of surgical type on surgical outcomes of patients with basic type intermittent exotropia with equal dominance, and we found BLR had a better outcome than R&R at more than 18-month follow-up. R&R showed more exotropic deviation from sixth months at distant fixation, resulting in a higher recurrence rate and lower success rate. This is different from Jeoung 's research, he found that better surgical results were obtained with the unilateral R&R procedure.\(^{5}\)

Subsequent exotropic\(^{8,9}\)\(^{21−23}\) shift with R&R was common, the reasons attributed for higher recurrence in the R&R group may be as follows. Firstly, a medial rectus resection may cause an initial tethering effect, which will result in initial success. But, noncomitance of lateral gaze could cause a gradual loss of fusion and exotropic shift. Secondly, the resected medial rectus tension exists for a long time can result in muscle stretching, which may cause a weakness of the tethering effect. Also,
other factors, such as age at surgery, should be considered. Previously, S H Lim and associates found that patients who underwent resection procedures with younger age tended to acquire a higher recurrence rate than patients with older age.

In diplopia patients, occlusion treatment was performed for 4 weeks after operation, and prism glasses were prescribed when patients with symptoms non improvement thereafter. Among these initial postoperative esotropia patients, 3 had prolonged diplopia. In all overcorrection cases, the MNCS score was greater than 4, and stereopsis was greater than 200 seconds of arc before surgery. These results indicate that the postoperative overcorrection was related to the preoperative control ability and sensory factors.

The difference of initial postoperative mean esodeviation was not found between the persistence of postoperative esotropia and transient postoperative esotropia. In our study, the persistence of postoperative esotropia was independent of the initial postoperative angle of deviation. We also found that postoperative esodeviation usually returns to orthophoria within 6 months, and its resolution may be related to postoperative wound healing, which usually takes 4 to 6 weeks, and exotropia drift, most occur in the first 6 weeks after exotropia operation. The chances of restoring to orthophoria are small for more than 6 months, we consider a second surgical intervention for these patients to avoid the risk of loss of stereopsis and amblyopia in young children.

It is noteworthy that one patient in the R&R group and one patient in the BLR group who changed from orthophoria to overcorrection between postoperative 12 months and 18 months were put on conservative therapy. However, the two participants were both performed lateral rectus muscle advancement on the previous recessed eye as esodeviation becoming larger and larger. Postoperative results were all satisfactory. Two children were both slight hyperopia without refractive correction before surgery.

Outcome assessments would be different because of a series of outcome measures reported, including sensory function (stereopsis), motor alignment (angle of deviation), control or a combination of the above. Our study mentioning "success" was determined based on motor
standards with the deviation of esotropia/phoria ≤ 5PD and exotropia/phoria ≤ 10PD. Therefore, patients with exotropia/phoria > 10 PD can be classified as recurrence even they had well fusion control ability. So, recurrence of exotropia doesn't always mean reoperation and unsatisfactory outcome. The recurrence rate should be distinguished from the rate of reoperation or satisfactory level.

Our study used a conventional dose of surgery. Different surgical dose may produce different results. We were encouraged to use a larger amount of recession than we used for BLR recessions (augmenting). 25–28 Although the augmented recession may decrease failure rates due to residual exotropia, it may do so at the cost of increased failure rates due to overcorrection.

This study has some limitations. First, it was a retrospective study. Therefore, we cannot control all influential factors such as age at surgery, refractive error, amblyopia, fixation preference, and preoperative angle of deviations. Next, because of the chosen patients who were followed up for more than 18 months, ascertainment bias may exist. Patients with unsatisfactory outcomes might be followed up for a longer time, and those with satisfactory results might not return to the eye hospital, this could cause a higher recurrence rate. However, most patients included in our study were followed for at least 18 months.

Abbreviations
BLR: Is used for ‘Bilateral lateral rectus recession’; R&R: Is used for ‘unilateral recess-resect’; PD: Is used for ‘prism diopters’.

Declarations
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Author information
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Affiliations
Authors’ contributions
SDS contributed to study design and coordination, conducted the data analysis, and assisted in drafting and revising the manuscript. QJ was involved in data acquisition, data interpretation, and critical revision of the manuscript. CZJ helped to interpret the data and to draft and revise the manuscript. All authors have given final approval of the version to be published.

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Ethics declarations
Ethics approval and consent to participate
We adhered to the tenets of the Declaration of Helsinki. Ethics approval was obtained from the the ethics committee of Children’s Hospital of Nanjing Medical University. All participants involved were informed of the purpose of this study and a written consent was obtained from themselves.

Consent for publication
Not applicable

Competing interests
The authors declare that they have no competing interests.

References
1 Bruce A, Santorelli G. Prevalence and risk factors of strabismus in a UK multi-ethnic birth cohort. Strabismus 2016;24:153–60.
2 Goseki T, Ishikawa H. The prevalence and types of strabismus, and average of stereopsis in Japanese adults. Jpn J Ophthalmol 2017;61:280–5.
3 Pathai S, Cumberland P M, Rahi J S. Prevalence of and early-life influences on childhood strabismus: findings from the Millennium Cohort Study. ARCH PEDIAT ADOL MED 2010, 164(3): 250-257.
4 Buck D, Powell C J, Rahi J, et al. The improving outcomes in intermittent exotropia study: outcomes at 2 years after diagnosis in an observational cohort. BMC ophthalmol 2012, 12(1): 1.
5 Lavrich J B. Intermittent exotropia: continued controversies and current management. CURR OPIN OPHTHALMOL 2015, 26(5): 375-381.

6 Ekdawi NS, Nusz KJ, Diehl NN, et al. Postoperative outcomes in children with intermittent exotropia from a population-based cohort. J AAPOS 2009;13:4-7.

7 Jeoung JW, Lee MJ, Hwang JM. Bilateral lateral rectus recession versus unilateral recess-resect procedure for exotropia with a dominant eye. Am J Ophthalmol 2006;141:683-8.

8 Chia A, Seenyen L, Long QB. Surgical experiences with two-muscle surgery for the treatment of intermittent exotropia. J AAPOS 2006;10:206-11.

9 Choi J, Chang JW, Kim SJ, et al. The long-term survival analysis of bilateral lateral rectus recession versus unilateral recession-resection for intermittent exotropia. Am J Ophthalmol 2012;153:343-51.

10 Ruttum MS. Initial versus subsequent postoperative motor alignment in intermittent exotropia. J AAPOS 1997;1:88-91.

11 Wang L, Wu Q, Kong X et al, Comparison of bilateral lateral rectus recession and unilateral recession resection for basic type intermittent exotropia in children. Br J Ophthalmol 97:870-873. 12 Fiorelli V M B, Goldchmit M, Uesugui C F, et al. Intermittent exotropia: comparative surgical results of lateral recti-recession and monocular recess-resect. ARQ BRAS OFTALMOL 2007, 70(3): 429-432.

13 Donahue S P, Chandler D L, Holmes J M, et al. A randomized trial comparing Bilateral lateral rectus recession versus unilateral recess and Resect for Basic-Type intermittent exotropia. Ophthalmology, 2019, 126(2): 305-317.

14 Xie F, Zhao K, Zhang W. Comparison of surgical outcomes between bilateral recession and unilateral recession-resection in moderate-angle intermittent exotropia. J AAPOS 2019;23(2): 79-86.

15 Kushner BJ. Selective surgery for intermittent exotropia based on distance/near differences. Arch Ophthalmol 1998;116(3):324-328.

16 Chia A, Seenyen L, Long QB. Surgical experiences with two-muscle surgery for the treatment of intermittent exotropia. J AAPOS 2006;10(3):206-211.

17 Maruo T, Kubota N, Sakaue T, Usui C. Intermittent exotropia surgery in children: long term outcome regarding changes in binocular alignment. A study of 666 cases. Binocol Vis Strabismus Q
2001;16(4):265–270.

18 Kushner B J. Bilateral Lateral Rectus Recession vs. Unilateral Recess-Resect for Intermittent Exotropia. Ophthalmology, 2019, 126(2): 318-319.

19 Buck D, Clarke M P, Haggerty H, et al. Grading the severity of intermittent distance exotropia: the revised Newcastle Control Score. Br J Ophthalmol 2008, 92(4): 577-577.

20 Donahue S P, Chandler D L, Holmes J M, et al. A randomized trial comparing Bilateral lateral rectus recession versus unilateral recess and Resect for Basic-Type intermittent exotropia. Ophthalmology, 2019, 126(2): 305-317.

21 Ekdawi NS, Nusz KJ, Diehl NN, Mohney BG. Postoperative outcomes in children with intermittent exotropia from a population-based cohort. J AAPOS 2009;13:4-7.

22 Kim WJ, Kim MM. The clinical course of recurrent intermittent exotropia following one or two surgeries over 24 months postoperatively. Eye (Lond) 2014;28:819-24.

23 Scott WE, Keech R, Mash AJ. The postoperative results and stability of exodeviations. Arch Ophthalmol 1981; 99:1814-8.

24 S H Lim, J S Hong, M M Kim, Prognostic factors for recurrence with unilateral recess-resect procedure in patients with intermittent exotropia, Eye (Lond) 2011; 25(4): 449–454.

25 Lee SY, Hyun Kim J, Thacker NM. Augmented bilateral lateral rectus recessions in basic intermittent exotropia. J AAPOS 2007;11(3):266e268.

26 Arda H, Atalay HT, Orge FH. Augmented surgical amounts for intermittent exotropia to prevent recurrence. Indian J Ophthalmol 2014;62:1056–9.

27 Kim J-S, Yang HK, Hwang J-M. Long-term outcomes of augmented unilateral recess-resect procedure in children with intermittent exotropia. Plos One 2017;12:e0184863

28 Magli A, Esposito Veneruso P, Chiariello Vecchio E, et al. Divergence excess intermittent exotropia: long-term effect of augmented Bilateral lateral rectus recession. Semin Ophthalmol 2018;33:512–6.

Tables

TABLE 1. Surgical dosage for intermittent exotropia patients.
| Prism Diopters (PD) | BLR (mm) | R&R (mm) |
|--------------------|--------|--------|
| 15                 | 4      | 4/3    |
| 20                 | 5      | 5/4    |
| 25                 | 6      | 6/4.5  |
| 30                 | 7      | 7/5    |
| 35                 | 7.5    | 7.5/5.5|
| 40                 | 8      | 8/6    |
| 45–50              | 9      | 9/6    |

BLR, bilateral lateral rectus recession; R&R, unilateral lateral rectus recession combined with medial rectus resection.

**TABLE 2.** Baseline characteristics of each group
|                                | BLR(38)       | R&R(48)       |
|--------------------------------|---------------|---------------|
| Gender (female: male)          | 18:20         | 18:30         |
| Age at onset (Y)               | 3.1 ± 3.3     | 3.8 ± 2.4     |
| Age at operation (Y)           | 7.1 ± 2.4     | 6.5 ± 2.7$    |
| Preoperative angle of deviation (PD) |              |               |
| At distance                    | 26.86 ± 6.43  | 28.53 ± 8.44  |
| At near                        | 27.04 ± 7.57  | 28.66 ± 9.73  |
| refractive error (spherical equivalent; D) |        |               |
| OD, mean value (range)         | −0.14 (-5.50 ~ +5.25) | 0.04 (-5.00 ~ +5.50) |
| OS, mean value (range)         | −0.07 (-5.75 ~ +5.00) | 0.02 (-4.50 ~ +4.75) |
| Anisometropia (n)              | 3             | 2             |
| Follow-up time (months)        | 17.5 ± 1.0    | 17.64 ± 1.13  |
| Lateral incomitancy, no. of patients | 1             | 4             |
| Modified Newcastle control score\[\text{nCS}\] |              |               |
| ≥4                             | 9             | 12            |
|                                | 29            | 36            |
| Stereopsis (s)                 | 12            | 18            |
| ≥80                            | 26            | 30            |

Y = year; OD = right eye; OS = left eye; R&R = unilateral lateral rectus recession and medial rectus
resection, BLR = bilateral lateral rectus recession, PD = prism dioptres. P < 0.05 shown in boldface.

\( \zeta \) P value by Chi-square test.; \( \xi \) P value by the independent t test; \( \delta \) P value by Fisher’s exact test; \( \xi \) P value by Chi square test for continuity correction

TABLE 3. Surgical success rates in BLR and R&R groups.
| Time after surgery | Surgical outcome | BLR(38)  | R&R(48)  | $P^\zeta$ value |
|-------------------|------------------|---------|---------|----------------|
| 1 week            | success          | 31[81.6%] | 39[81.3%] | 0.97           |
|                   | overcorrection   | 5       | 5       |                |
|                   | undercorrection  | 2       | 4       |                |
| 1 month           | success          | 32[84.2%] | 40[83.3%] | 0.91           |
|                   | overcorrection   | 3       | 2       |                |
|                   | undercorrection  | 3       | 6       |                |
| 6 months          | success          | 30[78.9%] | 38[79.2%] | 0.98           |
|                   | overcorrection   | 2       | 2       |                |
|                   | undercorrection  | 6       | 8       |                |
| 12 months         | success          | 29[76.3%] | 33[68.8%] | 0.44           |
|                   | overcorrection   | 3       | 3       |                |
|                   | undercorrection  | 6       | 12      |                |
| 18 months         | success          | 28[73.7%] | 31[64.6%] | 0.37           |
|                   | overcorrection   | 3       | 3       |                |
|                   | undercorrection  | 7       | 14      |                |
| Final visit       | success          | 30[76.3%] | 28[60.4%] | 0.04           |
|                   | overcorrection   | 2       | 3       |                |
|                   | undercorrection  | 6       | 17      |                |

$P^\zeta$ value by Chi-square test
TABLE 4. Postoperative stereopsis of the patients in the Bilateral Lateral Rectus Recession Group (the BLR group) and the Unilateral Recess-Resect Procedure Group (the R&R group)

| stereopsis variation | BLR group (n=38) | R&R group (n=48) | P value |
|----------------------|------------------|------------------|---------|
| Improved             | 24               | 28               |         |
| Invariant            | 10               | 12               | .45     |
| Deterioration        | 4                | 8                |         |

TABLE 5. Postoperative control score of the patients in the Bilateral Lateral Rectus Recession Group (the BLR group) and the Unilateral Recess-Resect Procedure Group (the R&R group)

| NCS scores variation | BLR group (n=38) | R&R group (n=48) | P value |
|----------------------|------------------|------------------|---------|
| Improved             | 28               | 26               |         |
| Invariant            | 5                | 12               | .1      |
| Decreased            | 5                | 10               |         |
Figure 1

The mean angle of deviations at each postoperative time in the Bilateral Lateral Rectus Recession (BLR) group and the Unilateral Lateral Rectus Recession–Medial Rectus Resection (R&R) group for basic-type intermittent exotropia with equal dominance. In the angle of deviation, the minus means esodeviation, and plus means exodeviation.
Figure 2

Kaplan-Meier Survival curves were compared between the bilateral lateral rectus recession group (BLR group) and the unilateral recess-resect procedure group (R&R group) for intermittent exotropia with the equal dominance by using the log-rank test. Results there was a remarkable difference (P<0.05) in the cumulative probability of survival between the groups, showed that the survival probability of BLR group was better than R&R group.