·Clinical Research·

Long-term postoperative outcomes of bilateral lateral rectus recession *vs* unilateral recession-resection for intermittent exotropia

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Abstract

• AIM: To discuss the long-term postoperative results of bilateral lateral rectus recession (BLR) and unilateral lateral rectus recession-medial rectus resection (RR) in therapy of intermittent exotropia.

• METHODS: We retrospectively analyzed 213 cases of intermittent exotropia who underwent surgery between 2008 and 2010. The patients were grouped into BLR group and RR group. Motor outcomes were divided into three groups on the basis of the angle of deviation after surgery: overcorrection (esotropia/phoria >5△), orthophoria (esotropia/phoria ≤5△ to exotropia/phoria ≤10△), and undercorrection/recurrence (exotropia/phoria >10△). Titmus test was used to evaluate stereoacuity, the stereoacuity <800s of arc meaned the patients had stereopsis. Surgical outcome including motor criteria and sensory status were compared at postoperative 6, 12, 24mo and at 36mo examination between groups.

• RESULTS: At 12, 24mo after surgery, the motor outcomes had no difference (P>0.05) between groups. However, the motor outcomes at 6, 36mo were signally different in each group, indicating the success rate in RR group at 6mo was higher than that in BLR group (83.02% *vs* 82.24%, P<0.05) but the result was contrary at the 3y examination (60.75% *vs* 43.40%, P <0.05). No statistical significance were found in the sensory outcomes between the groups at mean of 3.7y follow-up.

• CONCLUSION: The motor outcomes in RR group were better than in BLR group at 6mo after surgery, while the 3y outcomes were better in BLR group. This may be due to the recurrence rate of the BLR was lower than the RR group´s.

• KEYWORDS: intermittent exotropia; operation; treatment effect
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INTRODUCTION

Intermittent exotropia accounts for well over half of all cases of exotropia, which is the commonest kind of strabismus in childhood, and it is characterized by intermittent divergence deviation of the visual axis [1]. Management for intermittent exotropia contains observation, orthoptics, over minus spectacles, and alternate patching, and surgery [2]. At present, surgery is the main method in order to get content and steady ocular alignment and binocular single vision. Surgical correction can give pleasing outcomes at the early postoperative time, but quite constantly, in order to gain the stable orthophoria, more than one operation is needed [3]. Although the discordance about the best surgical method, the two main methods are bilateral lateral recession and unilateral lateral rectus recession-medial rectus resection. The orthophoria rate of operation in therapy of intermittent exotropia ranges from 33% to 85.1% [3-6]. The orthophoria rate performing the bilateral lateral rectus recession (BLR) method ranges from 48.3% to 80% [7-11], and using unilateral lateral rectus recession-medial rectus resection (RR) it differed from 42.7% to 85.1% [6,12-15]. Some authors have stated RR has lower incidence of overcorrection and less risk of complication [16], while others have reported BLR provides more stable surgical results [17]. At the time of this writing, there was no conclusion which surgical methods provides better outcomes over a long-term period of follow up.

The primary objective of the research was to compare the long-term outcomes between the different methods for therapy of intermittent exotropia after surgery.

SUBJECTS AND METHODS

Two hundred and thirteen patients diagnosed with intermittent exotropia and performed either the BLR or RR procedures between January 31, 2008 and January 31, 2010 at the Affiliated Hospital of Medical College Qingdao University, and ≥3y follow up were enrolled.

Patients with no amblyopia, anisometropia and the best corrected visual acuity ＞20/25 snell chart were enrolled, Exclusion criteria included reoperation and anterior strabismus operation, and/or other ocular abnormalities such as paralytic or restrictive exotropia, amblyopia or anisometropia patients, an A or V pattern and inferior oblique surgery.

Data of the age of onset of the intermittent exotropia, the age of the surgery, the duration from initiation of the intermittent exotropia to operation, gender, and the type of operation underwent (BLR/RR) were recorded. Preoperative deviation, Postoperative deviations at postoperative 6, 12, 24 and 36mo; preoperative stereoacuity and postoperative stereoacuity at mean of 3.7y after surgery; and follow-up time were also recorded. The angle of the deviations at the distance and near after operation were measured in the same way as that of preoperative angle of the deviations.

All recruited patients performed complete ophthalmologic examinations before surgery, the angle of deviation were measured with the prism and alternate cover testing at distance (5 m) and nearness (33 cm), A few uncooperative patients used the modified Krimsky method. The stereoacuity was measured with Titmus test.

According to the preoperative angle of deviation, surgical dosage ranged from 5 mm to 10 mm (7.58±0.86) for BLR, and for RR, lateral rectus recession ranged from 4 mm to 9 mm (6.31±1.66) and medial rectus resection from 3 mm to 7 mm (4.87±0.77). Motor results were fell into 3 groups: overcorrection (esotropia/phoria＞5△), orthophoria (esotropia/phoria≤5△ to exotropia/phoria ≤10 △), and undercorrection/recurrence (exotropia/phoria ＞10 △) on the basis of the angle of deviation at distant fixation after surgery. If stereoacuity was less than 800s of arc, we considered that the patients had stereopsis.

Statistical Analysis SPSS17.0 was used for statistical analysis. The patients' data such as the age of onset of the intermittent exotropia, the age of the surgery, the duration from onset of the intermittent exotropia to operation, *etc*. and the angle of deviation in each group before and after surgery were assessed with the use of an independent t-test. A χ^2 test was applied to compare motor results at each follow-up time after surgery and the final result at 3y after surgery, and it was also used to compare sensory outcomes at mean follow-up. In addition, the influence of surgical procedures on recurrence rate was evaluated by the use of logistic regression test. P values ＜0.05 was regarded as statistically significant.

RESULTS

Two hundreds and thirteen patients were recruited in this study, 107 patients, included 60 females and 47 males, underwent BLR and 106 cases, included 51 females and 55 males, performed RR. The mean age onset of the deviation was 8.12±5.70y in BLR group and 7.89±7.23y in RR group. The mean age at the time of the first operation was 13.81±7.81y in BLR group and 14.25±7.81y in RR group. The mean persistent time from the initiation of the intermittent exotropia to the fist operation was 5.82±5.55y in BLR group and 6.49±5.59y in RR group. The mean follow-up time after the first operation was 3.7y in both of the groups. The best-corrected visual acuity at the original examination were similar between the groups. No statistically significant difference were found between groups in the mean age of onset, first operation, mean duration from initiation of the intermittent exotropia to first operation (P>0.05). None of the preoperative stereopsis for each group reached statistical significance. However, in this study patients' mean angle of deviation at near and distance before the first operation were found signal differences between BLR and RR group (P< 0.05), 44.39±15.26△ at near and 41.68±17.03△ at distance in BLR group, and 68.21±23.04△ at near and 58.82±27.60△ at distance in RR group (Table 1).

The mean deviation at distance and nearness after surgery were not significant difference in each group at 6mo postoperatively. However, at postoperative 1y, deviations at distance get more evident in R&R group than in BLR group, displaying statistically remarkable differences (P=0.02, independent t-test). At postoperative 2 and 3y, the mean angle of deviation had no difference at distance and nearness (Table 2).

Sensory outcomes were similar in each group at the mean of 3.7y follow-up: 57 patients had preoperative stereopsis while 96 patients had postoperative stereopsis in BLR group, the recovery rate is 78%; 58 patients had preoperative stereopsis and 87 patients had postoperative stereopsis in RR group, the recovery rate is 60.4%. The motor outcomes at postoperative 12 and 24mo were not different between BLR and RR group (P＞0.05, χ^2 test). However, at 6mo and 36mo after operation, they were distinctly different in each group, showing a higher orthophoria rate in RR group at 6mo (83.02% *vs* 82.24%, P＜0.05) and a higher orthophoria rate in BLR group at the final examination (60.75% *vs* 43.40%, P＜0.05). Recurrence may be resulted in surgical failure, and the rate of recurrence increased over time (Table 3).

Table 1 Preoperative patients data in bilateral lateral rectus recession group and unilateral lateral rectus recession-medial rectus resection group

Groups	BLR	RR	*P*
n	107	106	
F:M	60:47	51:55	
Age at onset (a)	8.12±5.70	7.89±7.23	0.79
Age at operation (a)	13.81±7.81	14.25±7.81	0.68
Persistent Time from initial of deviation to operation (a)	5.82±5.55	6.49±5.59	0.38
Preoperative angle of deviation (prism diopters)	44.39±15.26 (at near)	68.21±23.04 (at near)	<0.05
	41.68±17.03 (at distance)	58.82±27.60 (at distance)	<0.05

BLR: Bilateral lateral rectus recession; RR: Unilateral lateral rectus recession-medial rectus resection; Results are expressed as mean±standard deviation; *P* value by the independent *t*-test.

Table 2 Postoperative angle of deviation at distance (at near) prism diopters in bilateral lateral rectus recession group and unilateral lateral rectus recession-medial rectus resection group

Follow-up time (mo)	BLR	RR	*P*
6	5.00±4.62 (5.61±4.34)	4.60±4.19 (4.10±4.36)	0.5 (0.01)
12	5.35±5.97 (4.95±6.60)	8.42±7.34 (9.42±7.52)	0.001 (<0.01)
24	8.90±6.06 (8.80±6.14)	9.33±6.05 (9.78±7.03)	0.6 (0.3)
36	9.05±6.58 (9.19±7.36)	10.20±6.43 (10.33±7.48)	0.2 (0.3)

BLR: Bilateral lateral rectus recession; RR: Unilateral lateral rectus recession-medial rectus resection; *P* value by the independent *t*- test.

Table 3 Postoperative results in bilateral lateral rectus recession group and unilateral lateral rectus recession-medial rectus resection group *n* (%)

Follow-up time (mo)	Operative results	BLR no. of patients	RR no. of patients	*P*
6	Overcorrection	15 (14.02)	6 (5.66)	<0.05
	Orthophoria	88 (82.24)	88 (83.02)	
	Recurrence	4 (3.74)	12 (11.32)	
12	Overcorrection	9 (8.41)	5 (4.72)	0.09
	Orthophoria	80 (74.77)	71 (66.98)	
	Recurrence	18 (16.82)	30 (28.30)	
24	Overcorrection	5 (4.67)	4 (3.77)	0.48
	Orthophoria	70 (65.42)	62 (58.49)	
	Recurrence	32 (29.91)	40 (37.74)	
36	Overcorrection	3 (2.80)	4 (3.77)	<0.05
	Orthophoria	65 (60.75)	46 (43.40)	
	Recurrence	39 (36.45)	56 (52.83)	

BLR: Bilateral lateral rectus recession; RR: Unilateral lateral rectus recession-medial rectus resection; Overcorrection: esotropia/phoria>5$^{\triangle}$, orthophoria: esotropia/phoria≤5$^{\triangle}$ to exotropia/phoria≤10$^{\triangle}$, recurrence: exotropia/phoria>10$^{\triangle}$, *P* value by the χ^2 test.

Logistic regression analysis showed that surgical manner was associated with recurrence ($P<0.05$). Other factors such as the age at deviation onset, the age of operation, the duration from deviation onset to operation, and the preoperative angle of deviation could not significantly influence recurrence.

DISCUSSION

This paper concluded with a discussion of the long-term effect of different surgical methods for the patients with intermittent exotropia. In our study, of the 213 cases after exotropia surgery, surgical outcomes at 12mo and 24mo for therapy of intermittent exotropia had not differ in each group ($P>0.05$, χ^2 test). However, surgical outcomes at 6mo in RR group were superior to the result in the BLR : 82.24% in BLR group *vs* 83.02% in RR group; while the rate of surgical success at 3y after surgery were higher in BLR group: 60.75% in BLR group *vs* 43.40% in RR group. The primary reason of this difference was diverse recurrence over time: the rate of undercorrection in BLR was low (36.45%), but recurrence occurred frequently in RR group (52.83%).

The rate of orthophoria reported in the previously published studies ranges from 48.3% to 80% [7-11] with BLR, and performing RR it ranges from 42.7% to 85.1%[6,12-15]. In the present study, at 6mo, the success outcome of the BLR was observed in 88 patients (82.24%) while 88 cases (83.02%) with RR, demonstrating patients who performed unilateral lateral rectus recession-medial rectus resection method had better surgical results than those who used bilateral lateral recession process, which was similar to Wang *et al* [6],

Jeoung *et al* [10] series. They reported surgical success in patients who underwent RR was better in patients who underwent BLR. The unilateral lateral rectus recession-medial rectus resection surgery can strengthen the power of medial rectus in a short time; and a medial rectus resection causes the initial tethering effect, which may resulted in better surgical outcome in this group, but the effect of this method is unstable, most of all the long-term effect is not ideal.

More recently some researches showed that patients who were submitted to the RR process obtained better alignment than patients with BLR after 12mo follow-up, but it was more inclined to exodeviation over time [18]. A medial rectus resection resulted in the original tethering effect, the tethering effect may lead to the success in a short time, but long persistent strain on the resected medial rectus can give rise to muscle stretching, and the tethering effect was decreased over time. In this study, no difference were found in the orthophoria rates between the groups at postoperative 12 and 24mo. However, ultimately, the BLR group revealed a preferable operative results than the RR group at 3y follow-up, and a higher recurrence rate in RR group at the final examination.

We observed the mean deviation at each postoperative time, no statistically significant between the groups at distance and near. However, exotropic drift occurred more frequently in RR group from 1y follow-up at distance and nearness, demonstrating that the RR group was prone to undercorrection during these periods. So our study support the viewpoint that subjects who submitted to bilateral lateral recession surgery had preferable and more steady long-term operative results than patients who submitted to unilateral lateral rectus recession-medial rectus resection. But more comparative research is needed to certify this viewpoint, because a report by Ekdawi *et al* [4] stated the patients who performed bilateral lateral recession and the patients who performed unilateral lateral rectus recession-medial rectus resection had similar success rates after a mean 8y follow up.

In this actual study, the angle of deviation before the surgery in BLR group was larger than that in RR group. The angle of deviation before the operation might influence the dosage of operation, and then the operative result might be affected by the dosage of surgery. In addition, some studies have manifested the preoperative angle of deviation did not have a significant effect on the operative results[19]. Therefore, much more research is needed.

In a former study, Pratt-Johnson *et al* [20] considered that patients could obtain good outcome if they performed surgery before the 4 years old. Some authors concluded that the age of onset and age at operation influence long-term outcome. However, neither of them was statistically significant in the study, which was similar to the result of Choi *et al*'s[17].

The prism and alternate cover testing was performed to determine the total amount of exodeviation, which was the major approach for the measurement of the angle of deviation. This method was used to measure the preoperative and postoperative deviation in this study. But this method might not discriminate exophoria form exotropia, and could exaggerate the recurrence of exodeviation.

At present, success in operative therapy for intermittent exotropia is decided by deviation size and fusional control, the criteria for success are not uniform. Generally, Orthophoria was decided by motor criteria with a deviation of $\pm 8^{\triangle}$ or $\pm 10^{\triangle}$. In our study, the motor criteria were used to determine the motor result, recurrence means subjects who had exodeviation of $>10^{\triangle}$. We used the rate of recurrence as the indicators for estimate of the motor result, at 3y the recurrence rate in RR group was higher than in BLR group, and the recurrence rate become much higher over time.

In this study, we will provide the long-term sensory outcomes. The stereopsis is considered to be a possible factor that can affect operative outcome. However, the recovery rate of stereopsis were no difference between BLR group and RR group at the mean of 3.7y. Therefore, further research is needed.

This study has several weaknesses. Its retrospective nature is limited by some confounding factors and uneven follow-up. Next, some of the patients may have sought ophthalmic care outside of the area, or patients with satisfying outcomes might not come back to the hospital and patients showing worse outcomes are more likely to return for ophthalmic care. Thereby, there could be an ascertainment bias. However, all cases of our cases who had strabismus operation continued to be followed in our clinic. Third, we did not classify intermittent exotropia by their specific type (basic, divergence excess, *etc*), which have been presented to influence operative results.

In conclusion, this research of operation for intermittent exotropia in patients showed that motor outcomes at postoperative 12 and 24mo had no difference between the groups. But motor outcomes in unilateral lateral rectus recession-medial rectus resection group were better than those in bilateral lateral recession group at 6mo after surgery and the motor outcomes at postoperative 36mo were better in bilateral lateral recession group than in another group. Recurrence might lead to surgical failure, the imparity of recurrence rate may result in the difference of the surgical

result in each group: 36.45% with BLR *vs*52.83% with RR.

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