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Bilateral Lateral Rectus Recession versus Unilateral Lateral Rectus Recession-Medial Rectus Resection in Treatment of Basic Intermittent Exotropia

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Abstract:

Background: To compare the surgical effectiveness and postoperative alignment stability of Bilateral Lateral Rectus Recession (BLR) versus Unilateral Lateral Rectus Recession combined with Medial Rectus Resection (RR) in the management of basic intermittent exotropia (IXT). **Methods:** A prospective randomized interventional study was conducted on forty cases with basic IXT at Benha University Hospital. Participants were equally allocated into two groups: BLR group (n=20) and RR group (n=20). Pre- and postoperative assessments included measurement of near and far deviation angles using prism and alternate cover test, stereopsis evaluation, and visual acuity. Follow-ups were conducted at 1, 3, and 6 months postoperatively. Surgical success was defined as alignment within ten prism dioptres (PD) of orthophoria. **Results:** Both groups demonstrated significant reductions in near and far deviation from baseline at all follow-up points ($P < 0.001$). At 6 months, the RR group showed substantially lower median near deviation (0 PD [range -10 to 20]) compared to the BLR group (7 PD [range -10 to 30], P = 0.028). Far deviation was also substantially lower in RR group (0 PD vs. 9 PD, P = 0.041). Surgical success was achieved in 70% of RR group and 65% of BLR group (P = 0.361). Multivariate regression identified the RR technique as a significant predictor of improved far deviation at 6 months (B = -6.624, P = 0.038). **Conclusion:** Both BLR and RR are effective for managing basic IXT. However, RR demonstrated superior outcomes in reducing ocular deviation and maintaining alignment stability at six months postoperatively.

Keywords: Strabismus, Medial Rectus Resection, Intermittent Exotropia, Lateral Rectus Recession.

Introduction

Intermittent exotropia (IXT), which presents as an intermittent outward deviation of the eyes, stands as the most prevalent strabismic condition, with an incidence of approximately 1% across the population. This ocular disorder typically presents during childhood and demonstrates a higher prevalence in females compared to males. Clinically, the control of eye deviation in IXT cases can fluctuate significantly throughout the day, influenced by factors such as visual attention, fatigue, and ambient conditions [(1)].

The exact etiology of IXT remains uncertain. However, current evidence suggests an imbalance in ocular motor control, wherein divergence tone surpasses convergence tone, a finding that is often clinically correlated with hypometric adduction saccades [(2)].

IXT is clinically classified into four distinct types based on differences in near-distance exodeviation: basic exotropia, true divergence excess, convergence insufficiency, and pseudo-divergence excess. Each subtype is differentiated primarily by specific criteria involving the measurement of the angle of deviation at varying fixation distances and under distinct testing conditions, such as monocular occlusion or lens adaptation [(3)].

While nonsurgical interventions, including part-time patching and corrective over-minus lenses, are occasionally employed in managing IXT, surgical correction remains the definitive approach to attain long-term ocular alignment stability and improve binocular visual performance. Surgical management commonly involves BLR or unilateral RR in the same eye, with the decision tailored to the specific clinical presentation, degree of deviation, and the operating surgeon's discretion [(4)].

This study aims to investigate the efficacy of BLR versus unilateral recession and RR for the treatment of cases with basic IXT.

Patients and Method

Study design and population.

This prospective interventional study was conducted at the Department of Ophthalmology, Faculty of Medicine, Benha University during the period from January to October 2024, and included forty cases diagnosed with basic IXT. Cases were randomly allocated into two equal groups: **the bilateral group**, in which cases underwent BLR surgery, and **the unilateral group**, in which cases underwent unilateral lateral rectus recession combined with medial rectus resection.

Informed written consent was obtained from all participants prior to enrolment. The study protocol was approved by the Ethical Committee of the Faculty of Medicine, Benha University, and adhered to the principles outlined in the Declaration of Helsinki (**Approval code: MS 6-10-2023**).

Inclusion criteria encompassed cooperative cases of both sexes, aged over 4 years, who were undergoing surgical correction and capable of providing clear data for interpretation. All included cases were diagnosed with basic-type IXT, defined by a near exodeviation within five prism diopters (PD) of the distant deviation. Cases were excluded if they presented with amblyopia, other subtypes of IXT (divergence excess, convergence insufficiency), neurological deficits or developmental delays, oblique muscle dysfunction, alphabet pattern strabismus (A, V, Y, X), significant vertical deviations, or a history of previous extraocular muscle surgery.

All patients were subjected to

Comprehensive medical and ophthalmic history taking

The evaluation of each case began with the collection of demographic data and a thorough review of their medical history to identify any comorbidities, such as hypertension (HTN), diabetes mellitus (DM), or other systemic conditions. Any prior ocular surgeries or treatments were also noted, as these could impact surgical planning and visual prognosis.

Ophthalmologic and orthoptic evaluation

All cases underwent thorough preoperative and postoperative ophthalmologic and orthoptic assessments. Best Corrected Visual Acuity (BCVA) was measured using a Snellen chart, both with and without optical correction, and the obtained values were transformed into log MAR format for statistical analysis. Angles of deviation were assessed using the prism and alternate cover test at both distance (6 meters) and near (33 cm), with appropriate spectacle correction. Prior to surgery, monocular patching was performed for one hour to classify IXT based on Burian’s classification, and only cases with the basic type were enrolled. Stereopsis testing was performed using the Titmus Fly Test in cooperative cases to evaluate binocular depth perception. Slit-lamp biomicroscopy, fundus evaluation using a +90D lens, and indirect ophthalmoscopy were employed to examine the anterior and posterior segments in detail.

Surgical details and postoperative care

Surgical planning was individualized based on binocular fixation preference. Cases demonstrating alternate fixation underwent bilateral lateral rectus recession (BLR-rec), while those with unilateral fixation were selected for unilateral recession-resection (R&R) surgery on the non-fixing eye. The surgical dose was determined by the largest deviation measured via the prism and alternate cover test. All surgeries were performed under general anaesthesia using a limbal incision approach. Specific techniques for muscle disinsertion and reattachment were followed according to standard surgical principles for lateral rectus recession and medial rectus resection. Cases were assessed immediately after surgery and at regular follow-ups after 1, 3, and 6 months.

Outcome Assessment

The primary outcomes measured included the success of surgical alignment and the need for reoperation. Success was defined based on the resolution or significant reduction of ocular deviation and satisfactory binocular vision postoperatively. Data from follow-up visits were used to determine the stability of surgical results and identify any cases requiring further intervention.

Statistical analysis

Statistical analysis and data management were conducted using SPSS software, version 27 (IBM Corp., Armonk, NY, USA). The distribution of quantitative variables was evaluated through the Shapiro-Wilk test and graphical visualization techniques. Based on the distribution characteristics, quantitative data were expressed as mean ± SD for normally distributed variables and as median with range for non-normally distributed variables. Categorical variables were described using frequencies and percentages. For intergroup comparisons, the independent t-test was applied to parametric data, while the Mann–Whitney U test was used for non-parametric variables. Intragroup comparisons of preoperative and postoperative continuous data were performed using the paired t-test for normally distributed variables and the Wilcoxon signed-rank test for non-normally distributed variables. Categorical outcomes were evaluated using the Chi-square test or Fisher’s exact test, depending on data characteristics. Multivariate linear regression was done to predict Far and near angle of deviation at 6 months. Estimates of the regression coefficients were accompanied by 95% confidence intervals. All tests were two-sided, with statistical significance defined as a p-value less than 0.05.

Results

General and baseline characteristics

With respect to general and baseline characteristics, no substantial variations were detected between the two groups in sex distribution (P = 0.525), age (P = 0.269), baseline BCVA (P = 0.856), or baseline stereopsis measured in arc seconds (P = 0.826). **Table 1**

Near and far angles of deviation

The near angle of deviation was comparable between the studied groups at baseline (P = 0.677), one month (P = 0.07), and three months (P = 0.117) postoperatively. However, at six months postoperatively, the unilateral group showed a markedly lower near deviation compared to the bilateral group (P = 0.028). **Table 2, Figure 1-A**

Within-group analysis demonstrated a substantial reduction in near deviation from baseline in both groups (P < 0.001 for each). **Table 2**

The far angle of deviation was comparable between the studied groups at baseline (P = 0.899) and at one month postoperatively (P = 0.148). However, at three months (P = 0.049) and six months (P = 0.041) postoperatively, the unilateral group demonstrated a markedly lower far deviation compared to the bilateral group. **Table 2, Figure 1-B**

Within-group analysis showed a significant reduction in far deviation from baseline in both groups (P < 0.001 for each). **Table 2**

Outcomes

The overall surgical outcome, including success and types of failure (overcorrection or undercorrection), was insignificantly different between the two groups. Surgical success was achieved in 65% (13/20) of the bilateral group and 70% (14/20) of the unilateral group, while failure occurred in 35% and 30% of the groups, respectively. Among failed cases, overcorrection occurred in 1 case (5%) in the bilateral group and 3 cases (15%) in the unilateral group, whereas undercorrection was seen in 6 cases (30%) and 3 cases (15%), respectively (P = 0.361). **Table 3**

Recurrence was observed in 3 cases (15%) in the bilateral group and 1 case (5%) in the unilateral group, with no notable variation (P = 0.605). **Table 3**

Among those who failed surgical success, the need for reoperation was also insignificantly different, with 2 of 7 cases (28.6%) in the bilateral group and 1 of 6 cases (16.7%) in the unilateral group requiring reintervention (P = 0.592). **Table 3**

Regression to predict near and far angles of deviation at six months.

Multivariate linear regression was conducted to explore potential predictors of near angle deviation at the six-month postoperative interval. It showed that undergoing unilateral lateral rectus surgery was associated with a lower near angle of deviation at six months (B = -4.545, 95% CI: -10.335 to 1.246), with no statistical significance (P = 0.120). Sex also was markedly associated with a greater near angle of deviation (B = 6.048, 95% CI: 0.202 to 11.894, P = 0.043). However, age was not substantially associated with near deviation at six months (P = 0.838). **Table 4**

Multivariate linear regression analysis was employed to identify potential predictors of far angle of deviation at six months postoperatively. It showed that undergoing unilateral lateral rectus surgery was the only significant predictor, being associated with a significantly lower far angle of deviation at six months (B = -6.624, 95% CI: -12.87 to -0.378, P = 0.038). Alternatively, age (P = 0.56) and sex (P = 0.461) were not significant predictors. **Table4**

Table 1: General and baseline characteristics of the studied groups

		Bilateral (n = 20)	Unilateral (n = 20)	P-value
Age (years)	Median (range)	10 (4 - 14)	7 (4 - 14)	0.269
Sex				
Males	n (%)	10 (50)	12 (60)	0.525
Females	n (%)	10 (50)	8 (40)	
Baseline BCVA	Mean ±SD	0.9 ±0.1	0.9 ±0.1	0.856
Baseline stereopsis (arc seconds)	Median (range)	400 (200 - 800)	400 (200 - 800)	0.682

n: number, BCVA: Best corrected visual acuity.

Table 2: Near and far angles of deviation between the studied groups

	Bilateral (n = 20)	Unilateral (n = 20)	P-value
Near angle of deviation			
Baseline	45 (25 - 50)	43 (25 - 50)	0.677
One-month	3 (-15 - 20) $^{\Delta}$	-2 (-20 - 20) $^{\Delta}$	0.07
Three-month	5 (-10 - 30) $^{\Delta}$	0 (-20 - 20) $^{\Delta}$	0.117
Six-month	7 (-10 - 30) $^{\Delta}$	0 (-10 - 20) $^{\Delta}$	**0.028***
P-value	**<0.001***	**<0.001***	
Far angle of deviation			
Baseline	**38 (25 - 50)**	**38 (25 - 50)**	0.899
One-month	**3 (-10 - 20) Δ**	**0 (-20 - 20) Δ**	0.148
Three-month	**5 (-10 - 30) Δ**	**0 (-20 - 20) Δ**	0.049*
Six-month	**9 (-10 - 30) Δ**	**0 (-15 - 20) Δ**	0.041*
P-value	**<0.001***	**<0.001***	-

Data were presented as median (range), n: number, *: Significant P-value, $^{\Delta}$: Significant from baseline.

Table 3: Patients' outcomes between the studied groups

		Bilateral (n = 20)	Unilateral (n = 20)	P-value
Outcome				
Surgical success	n (%)	13 (65)	14 (70)	0.361
Overcorrection	n (%)	1 (5)	3 (15)	
Under correction	n (%)	6 (30)	3 (15)	
Recurrence	n (%)	3 (15)	1 (5)	0.605
Need for reoperation†	n (%)	2 (28.6)	1 (16.7)	0.592

†: The percentage was calculated based on those who failed surgical success, n: number.

Table 4: Multivariate linear regression to predict near and far angle of deviation at six months.

	B (95% CI)	P-value	B (95% CI)	P-value
Age (years)	-0.099 (-1.077 - 0.878)	0.838	-0.306 (-1.36 - 0.749)	0.56
Sex	6.048 (0.202 - 11.894)	**0.043***	2.317 (-3.988 - 8.623)	0.461
Unilateral lateral rectus	-4.545 (-10.335 - 1.246)	0.120	-6.624 (-12.87 - -0.378)	**0.038***

B: regression coefficient, CI: Confidence interval, *: Significant p-value.

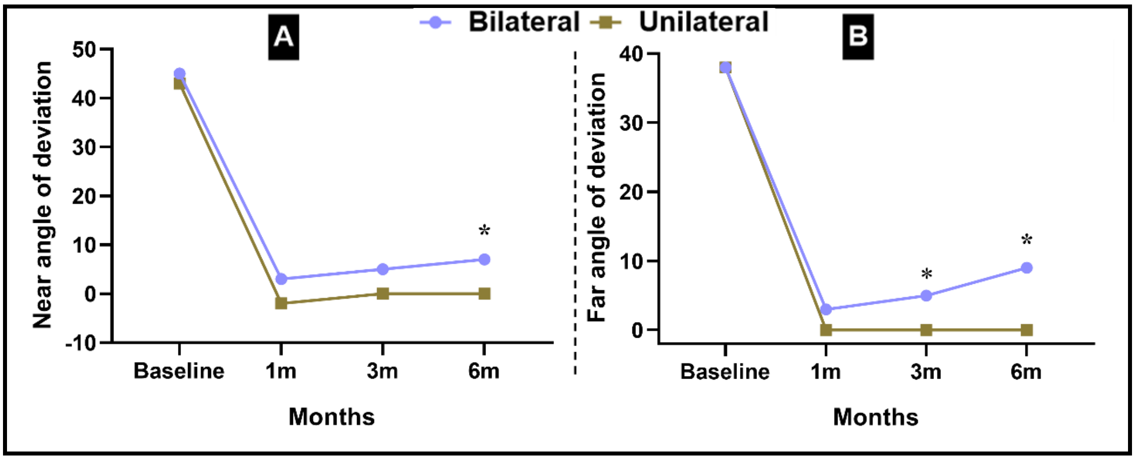

Figure 1: Median A) near and B) far angles of deviation between the studied groups

Discussion

IXT represents the most frequently encountered strabismic condition, marked by intermittent external ocular deviation, with onset commonly occurring in childhood and a higher prevalence observed among females [5]. It is believed to result from an imbalance between divergence and convergence control [6]. Based on near-distance deviation differences, IXT is classified into four subtypes, with basic exotropia being the most common. Although nonsurgical options exist, surgery remains the definitive treatment. This study compared the outcomes of BLR and unilateral RR in cases with basic IXT.

A significant postoperative reduction in near deviation was observed in both the BLR and RR groups, confirming the effectiveness of both surgical techniques in correcting ocular misalignment in basic IXT. However, the RR group achieved a markedly lower near deviation at six months (0 PD vs. 7 PD; P = 0.028), suggesting a more sustained corrective effect. This enhanced outcome may be due to the convergence-strengthening action of medial rectus resection. Despite the variations in alignment, surgical success rates were comparable between groups (70% in RR vs. 65% in BLR; P = 0.361), indicating that both techniques are valid options. Interestingly, sex was associated with residual near deviation in regression analysis (P = 0.043), possibly reflecting anatomical or hormonal influences on ocular motor control.

Our findings align with Wang et al. [7], who reported a higher success rate in the RR group (85.1%) relative to BLR (65.8%, P = 0.037), with fewer under-corrections (6.4% vs. 23.7%, P = 0.023). However, they noted a greater near deviation reduction in the BLR group, likely due to their longer follow-up (14.8 months vs. 6 months in our study). A meta-analysis by Song et al. [8] also supports our results, showing RR yields better short-term outcomes (OR = 0.56, 95% CI: 0.33–0.94), while BLR provides greater long-term stability beyond two years (OR = 2.49, 95% CI: 1.61–3.86). Similarly, Kushner [9] reported an RR success rate of 82% vs. 52% in BLR (P < 0.05), reinforcing the superior early stability of RR, despite similar distance/near disparity control.

Supporting studies further reinforce our observations. Chia et al. [10] found RR had a higher one-year success rate (74.2%) compared to BLR (42.2%) but noted increased exotropic drift with RR (P = 0.01). Lee and Lee [11] emphasized that overcorrection on day 1 predicted long-term success, highlighting the importance of early alignment. Fiorelli et al. [12] reported comparable success in BLR (69%) and RR (77%), especially across different preoperative deviation ranges. In contrast, Choi et al. [13] found BLR had better long-term success (58.2% vs. 27.4%; P < 0.01) at a 3.8-year follow-up, suggesting RR may lose its corrective strength over time. These findings underscore that while RR may offer superior early outcomes, longer-term follow-up is essential to evaluate sustained alignment.

A significant postoperative reduction in far deviation was observed in both surgical groups, confirming the efficacy of BLR and RR in correcting distance ocular misalignment in basic IXT. However, the greater reduction in the RR group at three and six months suggests superior long-term distance alignment stability. This enhanced outcome is likely attributed to the restrictive effect of medial rectus resection, which augments convergence and counters divergence forces. Supporting this, multivariate regression identified RR as the only significant predictor of improved far deviation at six months (B = -6.624, P = 0.038), reinforcing its effectiveness in maintaining distance alignment.

According to the meta-analysis by Sun et al. [14] RR showed a superior success rate over BLR (OR = 0.50, 95% CI: 0.31–0.79, P = 0.003), a reduced recurrence rate (OR = 2.44, 95% CI: 1.17–5.10, P = 0.02), and no substantial variations in overcorrection rate (OR = 0.85, P = 0.75). Jeoung et al. [15] reported a satisfactory outcome in 83.3% of RR cases compared to 48.3% in BLR group (P = 0.012), further confirming RR's advantage in sustaining alignment and minimizing recurrence. These findings are consistent with our results, highlighting RR's greater efficacy in both near and far deviation control.

However, some studies have reported higher overcorrection rates with RR. Jeoung et al. [15] noted a 7.6% overcorrection rate in RR group, relative to none in BLR group. This was attributed to poor preoperative sensory status, such as constant exotropia or low stereopsis, which may increase the risk of overcorrection. In contrast, our study found no significant variation in stereopsis outcomes (P = 0.786), likely due to differences in cases selection, as we included only basic IXT cases. Similarly, Oliva and Morgado [16] found higher success with RR across three randomized trials (201 cases), and reduced recurrence in two trials (154 cases), consistent with our findings of superior far deviation reduction at three and six months in the RR group.

Additional evidence from Joyce et al. [17] supports the short-term superiority of RR, with one randomized trial reporting an 82% success rate for RR versus 52% for BLR (P < 0.02), while also noting greater exotropic drift in RR over time. Bang et al. [18] reported long-term outcomes showing substantial far deviation reduction in both groups, but greater stability in the BLR group at five years. Interestingly, their six-month data showed better distance control in BLR (mean 3.62 ± 4.70 PD) than RR (6.13 ± 5.31 PD, P = 0.016), contrasting with our results. These discrepancies may reflect the impact of follow-up duration, cases profiles, or surgical dose, underscoring the need for longer-term studies to clarify these differences.

While the findings provide valuable insights, they should be interpreted considering certain limitations. The relatively small cohort may impact the generalizability of the conclusions, and the six-month observation period may not adequately reflect long-term outcomes, including potential late-onset recurrence or overcorrection phenomena. Additionally, the study did not stratify cases based on factors such as preoperative control scores or fusional capacity, which could influence surgical results.

Conclusion

Both BLR and unilateral RR proved to be effective surgical options for managing basic IXT, with comparable success rates, supporting their overall efficacy in achieving ocular alignment. However, unilateral RR demonstrated a greater reduction in both near and far deviation over time and was a predictor of better far deviation outcomes, suggesting superior long-term alignment stability.

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