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

Abstract

Objectives: To compare the surgical efficacy and alignment stability of Bilateral Lateral Rectus Recession (BLR) versus Unilateral Lateral Rectus Recession-Medial Rectus Resection (RR) in the treatment of basic intermittent exotropia (IXT).

Methods: A prospective randomized interventional study was conducted on 40 patients 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 10 prism diopters (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 significantly 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 significantly lower in the RR group (0 PD vs. 9 PD, $P = 0.041$). Surgical success was achieved in 70% of the RR group and 65% of the 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: Intermittent Exotropia, Lateral Rectus Recession, Medial Rectus Resection, Strabismus.

Introduction

Intermittent exotropia (IXT) is recognized as the most prevalent form of strabismus, characterized primarily by intermittent outward deviation of the eyes, and affecting approximately 1% of the general 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 patients 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, convergence insufficiency, true divergence excess, 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 achieve stable ocular alignment and enhance binocular visual function. Among surgical options, bilateral lateral rectus recession (BLR) and unilateral lateral rectus recession with medial rectus resection (RR) in the same eye are widely utilized procedures, with clinical selection often guided by the patient's specific clinical subtype, angle of deviation, and surgeon preference (4).

This study aims to investigate the efficacy of BLR versus unilateral recession and RR for the treatment of patients 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, and included forty patients diagnosed with basic IXT. Patients were randomly allocated into two equal groups: **the bilateral group**, in which patients underwent BLR surgery, and **the unilateral group**, in which patients underwent unilateral lateral rectus recession combined with medial rectus resection. Informed written consent was obtained from all participants prior to enrollment. 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.

Inclusion criteria encompassed cooperative patients of both sexes, aged over 4 years, who were undergoing surgical correction and capable of providing clear data for interpretation. All included patients were diagnosed with basic-type IXT, defined by a near exodeviation within 5 prism diopters (PD) of the distant deviation. Patients 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 patient 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 patients underwent thorough preoperative and postoperative ophthalmologic and orthoptic assessments. This included measuring Best Corrected Visual Acuity (BCVA) using a Snellen chart both with and without visual correction; results were subsequently converted into logMAR units 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 patients with the basic type were enrolled. Stereopsis testing was performed using the Titmus Fly Test in cooperative patients to evaluate binocular depth perception. A full anterior and posterior segment examination was also conducted using slit-lamp biomicroscopy and fundus examination with a +90D lens and indirect ophthalmoscopy.

Surgical details and postoperative care

Surgical planning was individualized based on binocular fixation preference. Patients 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 anesthesia 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. Patients 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

Data management and statistical analysis were done using SPSS version 27 (IBM, Armonk, New York, United States). Quantitative data were assessed for normality using the Shapiro-Wilk test and direct data visualization methods. According to normality, quantitative data were summarized as means and standard deviations or medians and ranges. Categorical data were summarized as numbers and percentages. Quantitative data were compared between the groups using Independent T Test and Mann–Whitney U Test for parametric and non-parametric variables, respectively. For within-group comparisons (preoperative vs. postoperative values in the same group): Paired t-test was used for normally distributed continuous variables. Wilcoxon signed-rank test was used for non-normally distributed continuous variables. Categorical data were compared using the Chi-square or Fisher's exact test. Multivariate linear regression was done to predict Far and near angle of deviation at 6 months. The regression coefficient with 95% confidence intervals were calculated. All statistical tests were two-sided. P-values less than 0.05 were considered significant.

Results

General and baseline characteristics

Regarding general and baseline characteristics, the study found no significant differences between both groups in terms of age (P = 0.269), sex (P = 0.525), baseline BCVA (P = 0.856), and baseline stereopsis (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 significantly lower near deviation compared to the bilateral group (P = 0.028). **Table 2, Figure 1-A**

Within-group analysis demonstrated a significant 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 significantly 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 patient (5%) in the bilateral group and 3 patients (15%) in the unilateral group, whereas undercorrection was seen in 6 patients (30%) and 3 patients (15%), respectively (P = 0.361). **Table 3**

Recurrence was observed in 3 patients (15%) in the bilateral group and 1 patient (5%) in the unilateral group, with no statistically significant difference (P = 0.605). **Table 3**

Among those who failed surgical success, the need for reoperation was also insignificantly different, with 2 of 7 patients (28.6%) in the bilateral group and 1 of 6 patients (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 analysis was conducted to identify potential predictors of near angle of deviation at six months postoperatively. 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 significantly 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 significantly associated with near deviation at six months (P = 0.838). **Table 4**

Multivariate linear regression analysis was conducted 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). In contrast, age (P = 0.56) and sex (P = 0.461) were not significant predictors. **Table 4**

Discussion

IXT is the most common type of strabismus, characterized by intermittent outward eye deviation, often presenting in childhood and more frequently in 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 bilateral lateral rectus recession (BLR) and unilateral lateral rectus recession-medial rectus resection (RR) in patients 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 significantly 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 differences 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 significantly 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%) compared 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.

A meta-analysis by **Sun et al.** (14) also demonstrated that RR had a significantly higher success rate than BLR (OR = 0.50, 95% CI: 0.31–0.79, P = 0.003) and was associated with a lower recurrence rate (OR = 2.44, 95% CI: 1.17–5.10, P = 0.02), with no significant difference in overcorrection rates (OR = 0.85, P = 0.75). **Jeoung et al.** (15) reported a satisfactory outcome in 83.3% of RR patients compared to 48.3% in the 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. noted a 7.6% overcorrection rate in the RR group, compared to none in the 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 difference in stereopsis outcomes (P = 0.786), likely due to differences in patient selection, as we included only basic IXT cases. Similarly, **Oliva and Morgado** (16) found higher success with RR across three randomized trials (201 patients), and reduced recurrence in two trials (154 patients), 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 significant 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, patient profiles, or surgical dose, underscoring the need for longer-term studies to clarify these differences.

This study has some limitations. The relatively small sample size may limit the generalizability of the findings, and the six-month follow-up period may not fully capture long-term surgical outcomes, including late recurrence or overcorrection. Additionally, the study did not stratify patients based on factors such as preoperative control scores or fusional capacity, which could influence surgical results.

Conclusion

Both BLR and unilateral lateral rectus recession-medial RR were effective surgical approaches for correcting basic IXT, achieving comparable success rates, indicating their overall efficacy in restoring 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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Conflict of interest: none.

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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)	
Overcorrection	n (%)	1 (5)	3 (15)	0.361
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.

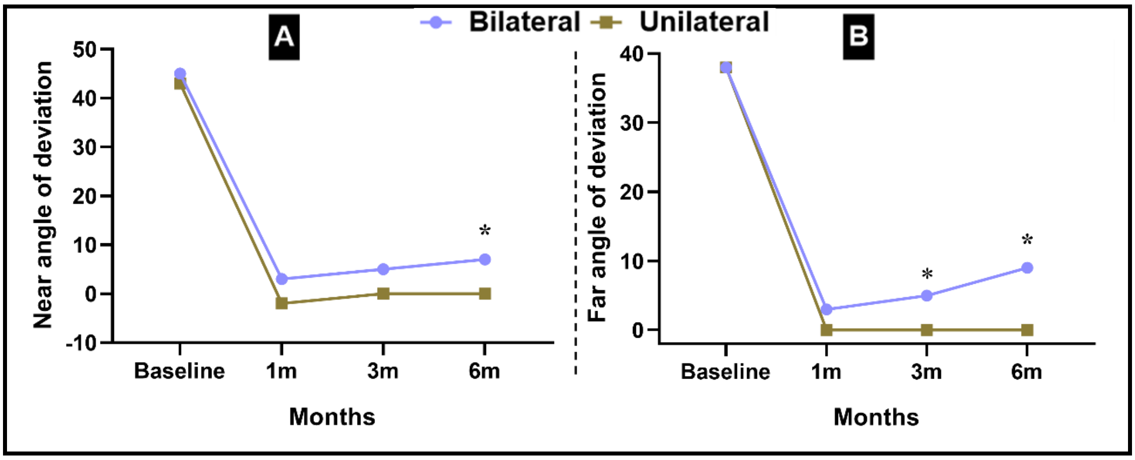

Figure 1: Median A) near and B) far angles of deviation between the studied groups