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Effect of Bilateral Lateral Rectus Recession in Intermittent Exotropia according to the Limbus Insertion Distance

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Abstract

Purpose: The aim of this work was the evaluation of the effect of the limbus insertion distance (LID) of the lateral rectus on the surgical results of bilateral lateral rectus recession in intermittent exotropia (IXT) in children and adults. **Patients and Methods:** This retrospective study included 76 patients. The patients were divided into two groups: group I (age 5 - 13 y), group II (>13 y). All the patients had basic type of intermittent exotropia (IXT) and all of them underwent bilateral lateral recessions according to the preoperative angle of deviation. Intraoperatively, the distance of limbus insertion was measured by surgical calipers. The dose response effect was calculated as the difference between the preoperative angle and postoperative angle divided by total amount of recession and cases were followed at 1 month, 3 months, 6 months and 12 months postoperative. **Results:** The mean LID in group I was (6.2 ± 0.61 mm) and (6.1 ± 0.55 mm) in group II. The mean dose response (MDR) at 1 year postoperative was (2.32 ± 0.25 mm) in group I and (2.26 ± 0.23) in group II. In patients with LID < 5.5, the mean dose response was (1.98 ± 0.26) compared with that of patients with LID > 6.25 mm who had larger mean dose response (2.52 ± 0.15). There was a significant positive correlation between the LR muscle LID and the dose-response effect. **Conclusion:** There is positive correlation between the LID of the LR muscle and the recession effect in bilateral lateral rectus recession in treatment of IXT.

Keywords

Intermittent Exotropia, Limbus Insertion Distance, Bilateral Lateral Rectus Recession

1. Introduction

Although intermittent exotropia (IXT) is the most common form of exotropia [1], some causes of IXT remain obscure with tendency of frequent post-surgical recurrence [2] [3]. Squint surgeons recommended early postoperative overcorrection to achieve best long-term results [4] [5].

Many studies were evolved to predict the surgical outcome in IXT patients [6]. Many factors were considered to facilitate the appropriate surgical outcomes [7].

Various factors have been supposed to be predictive of surgical outcomes of IXT, of which the LR muscle LID was reported to be used as a predictor of the effect of muscle recession in unilateral and bilateral recession surgery in children [8].

Our study was done to investigate the correlation between the lateral rectus (LR) muscle LID and the postoperative results of surgery of recession in intermittent XT both in children and adults.

2. Patients and Methods

This retrospective study investigated 76 patients who operated by the same surgeon (M.A.Ghali) in Zagazig university ophthalmology department between May 2014 and April 2015. The study had the approval of the institutional review board (IRB) of Zagazig Faculty of Medicine.

All patients with basic intermittent XT underwent bilateral LR recession were recruited in this study. Patients with anatomic abnormalities, abnormal anterior segment structures, high myopia (>−6), amblyobia, previous squint surgery, nystagmus, associated vertical deviation, anisometropia > 2D and those with convergence insufficiency were excluded from this study. Also patients with large Intermittent XT angle > 55 Δ were also discarded.

Complete ophthalmic examination including cycloplegic refraction, prism and alternate prism cover test at distance of 6 m in primary, dextroversion and levoversion, also measuring angle at 30 cm in primary gaze while patients wearing their glasses. Stereoacuity (Titmus optical CO, Petersburg VA, USA) was done for all patients.

All patients underwent bilateral LR recession to alleviate exotropia under general anaesthesia based on surgical **Table 1**.

In all surgeries, the lateral rectus muscle was exposed through limbal conjunctival approach and hooked. After the dissection of the LR muscle from the sclera, a surgical caliper which graded with 0.25 mm was used to measure the limbus insertion distance (LID) (the distance between midpoint of the posterior edge of the LR muscle insertion and the grey-white line of the corneal limbus).

Sex, age, preoperative stereoacuity, LID of LR muscle, preoperative angle of deviation, the angle of deviation at postoperative months 1, 3, 6, 12 at primary gaze were collected.

The mean dose response (MDR) was measured as the difference value between preoperative and postoperative angle of deviation and the divided by total

Table 1. Amount of surgery used in bilateral LR muscle recession in patients with basic IXT (mm).

Preoperative angle of deviation	Amount of BLRR
20 Δ	5.5 mm
25 Δ	6 mm
30 Δ	7 mm
35 Δ	7.5 mm
40 Δ	8.5 mm
45 Δ	9 mm
50 Δ	10 mm
55 Δ	11 mm

amount of recession at 12 months postoperatively.

The difference of limbal insertion distance between both eyes was analyzed by Kappa test showing good agreement.

SPSS programme was used to analyze the collected with a level of significance of <0.05, the power of study 80% - 95% c.i. Student t test, and Mann-whitney U test were used for data analysis. Pearsons correlation coefficient (r) to study association between MDR and LID, and logestic linear regression used to predict the value of MDR from angle deviation and LID.

3. Results

Seventy six patients (34 males, 42 females) were included in this study. All of these patients had intermittent exotropia without incommitance, the mean age was (13.39 ± 8.37), demographics of patients in this study are summarized in Table 2.

The patients were divided into two groups according to age; Group I (age: 5 - 13 years), Group II (age: >13 years).

The Kappa test showed no significant difference between LID of both eyes, so we used the mean value of LID, overall mean LID of LR muscle was (6.2 ± 0.61) in group I and was (6.1 ± 0.55) in group II, the difference in LID between both eyes is shown in Table 3.

In group I, the amount of LR recession was (mean± SD) (16.09 ± 2.48) range from (11 - 22), the angle of preoperative exodeviation was (37.78 ± 8.09) compared with (−0.11 ± 2.73) at postoperative month 1, (−1.04 ± 2.73) at postoperative month 3, (−1.34 ± 2.53) at month 6 and (−1.23 ± 2.34) one year postoperative.

In group II, the mean amount of recession was (17.03 ± 2.97) range from (11 - 22), the mean angle of preoperative exodeviation was (40.65 ± 9.08) compared with (−1.23 ± 3.114) at postoperative month 1, (−1.13 ± 3.02) at postoperative month 3, (−1.12 ± 3.1) at month 6 and (−1.3 ± 1.82) one year postoperative. Table 4 showed the differences between both groups in preoperative angle of

Table 2. Demographics of patients in this study.

Parameter	Group I (n = 45)	Group II (n = 31)	Total (n = 76)		P
Sex (M/F)	17/28	17/14	34/42	$x^2 = 2.1$	0.15
Age	7.71 ± 2.29	21.65 ± 6.98	13.39 ± 8.37	T = 12.4	0.01*
Spherical equivalent (Diopters)	−1.5 ± 1.6	−1.2 ± 1.1	−1.3 ± 1.4	T = 0.323	0.63
Preoperative stereoacuity (<100)	31 (69%)	22(70%)	53 (70%)	$x^2 = 0.038$	0.85
Preoperative XT (Δ)	37.78 ± 8.09	40.65 ± 9.46	38.95 ± 8.73	1.4	0.51

*Statistically significant M/F: male/female X^2 chi square test.

Table 3. Differences in LID between both eyes in both groups.

Difference in mm	Group I (45)	Group II (31)	x^2	P
X = 0.0 mm	11 (24.4%)	7 (22.6%)	0.04	0.85
X = 0.25	9 (20%)	8 (25.8%)	0.10	0.75
X = 0.5	16 (35.6%)	12 (38.6%)	0.00	0.97
X = 0.75	5 (11.1%)	2 (6.5%)	0.08	0.77
X = 1 mm	3 (6.7%)	2 (6.5%)	0.00	0.97
X > 1 mm	1(2.2%)	0 (0%)	0.69	0.40

Table 4. Preoperative angle of deviation, postoperative angle and total amount of recession in both groups.

	Group I	Group II	t test	P
Preoperative angle of deviation	37.78 ± 8.09	40.65 ± 9.08	1.4	0.16
Amount of Recession	16.09 ± 2.48	17.03 ± 2.97	1.4	0.08
Postoperative angle 1 m median range	0 (−6/5)	−2 (−7/4)	mann-Whitney 477.0	0.01*
Postoperative angle 3 m median range	0 (−6/5)	−2 (−5/3)	mann-Whitney 385	0.12
Postoperative angle 6 m median range	0 (−6/5)	−2 (−6/4)	mann-Whitney 367	0.16
Postoperative angle 12 m median range	0 (−6/5)	−2 (−6/4)	mann-Whitney 388	0.13

*Statistically significant.

deviation, amount of LR recession and postoperative angle at 1, 3, 6, 12 months postoperative.

There was no significant difference in any of the above factors between both groups except for the first visit postoperatively.

According to LID measures, each group was subdivided to 3 groups; Group A (4 - ≤5.5), Group B (>5.5 - ≤6.25) and Group C (>6.25 - ≤7.25). No statistically significant difference was found between both groups according to this subdivision Table 5.

Correlations and multiple regression analysis were preformed to show the effect of different parameters. Only preoperative angle and LID showed positive correlation with MDR (Tables 6-8).

The mean dose response effect in group I was (2.315 ± 0.25) while in group II was (2.26 ± 0.23).

There was positive correlation between the MDR and both LID and preoperative angle of deviation (Figure 1, Figure 2). Table 9 showed comparison between both groups according to MDR.

Table 5. Comparison between both groups according to LID.

	group (1)	group (2)	x^2	P
Group A (4 - ≤5.5),	6 (13.3)	2 (6.5)		
Group B (>5.5 - ≤6.25	19 (42.2)	18 (58.1)	3.14	0.37
Group C (>6.25 - ≤7.25)	20 (44.4)	11 (35.5)		

Table 6. Correlations between the mean of limbus insertion distance (LID) and preoperative angle with MDR Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.160	0.199		0.802	0.425
	Mean LID	0.275	0.030	0.649	9.021	0.001*
	Preoperative angle	0.012	0.002	0.412	5.719	0.001*

[a]Dependent Variable: MDR; *Statistically significant; so MDR = 0.16 + (0.28 * mean LID) + (0.01 * angle of deviation).

Table 7. Correlations between the mean of limbus insertion distance (LID) and MDR Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.544	0.224		2.423	0.018
	Mean LID	0.285	0.036	0.674	7.855	0.001*

[a]Dependent Variable: MDR; *Statistically significant; so MDR = 0.54 + (0.28 * mean LID).

Table 8. Correlation analysis between LID, preoperative angle of deviation and age with MDR.

	P (r) GROUP1	P(r) GROUP 2	P(r)
MDR/LID	0.70 (0.01*)	0.62 (0.01*)	0.67 (0.01*)
MDR/ANGLE deviation	0.51 (0.01*)	0.45 (0.01*)	0.47 (0.01*)
MDR/age	0.23 (0.12)	−0.10 (0.59)	−0.09 (0.47)

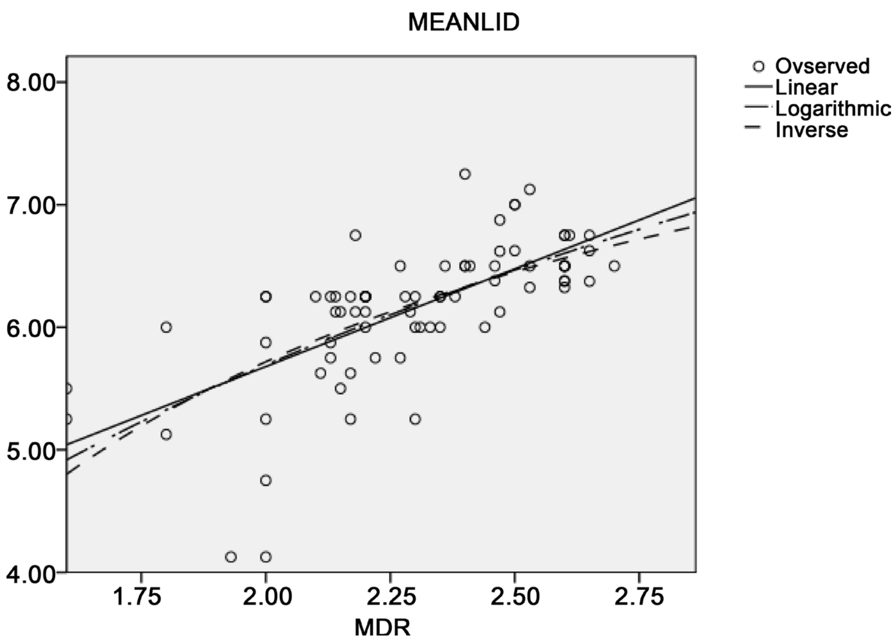

Figure 1. Regression curve between LID and MDR.

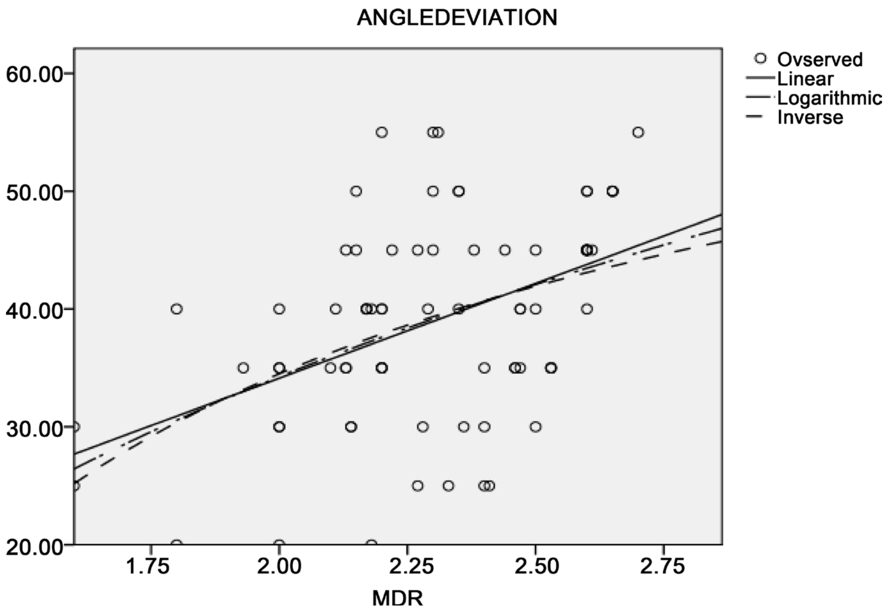

Figure 2. Regression curve between angle of deviation and MDR.

Table 9. Comparison between both groups and subgroups according to MDR.

	Group I (MRD)	Group II (MRD)	t	p
A	1.93 ± 0.23 1.6 - 2.3	2.08 ± 0.12 2 - 2.17	0.82	0.44
B	2.23 ± 0.15 2 - 2.53	2.16 ± 0.2 1.60 - 2.38	0.96	0.34
C	2.52 ± 0.09 2.36 - 2.70	2.46 ± 0.18 2.15 - 2.65	1.14	0.27

4. Discussion

The aim of this work was the evaluation of the correlation between LR muscle LID and effect of surgical recession in XT patients. The study found that there is positive correlation between LID and the mean dose response effect of total amount of bilateral recession of LR at 12 months postoperatively which suggests that the LID of LR could be considered a predictive indicator for surgical outcome of IXT.

Many studies had investigated various factors to predict outcome of the IXT surgery. Several factors have been reported including age of surgery, preoperative deviation angle and high AC/A ratio [9] [10] [11]. Our study also showed significant positive correlation between mean dose response and preoperative angle of deviation.

We tried in this study to minimize the effects of other factors which may affect the dose response. We divided our patients into two groups according to age: group I (5 - 13 y) and group II (>13) to decrease the influence of age in our results, but no significant differences were found between both group in mean dose response effect postoperative at different visits.

The width of LR muscle tendon was found to be related significantly to the surgical recession effect when the amount of the deviation preoperatively was less than 25 Δ [12]. In this study, we didn't measure the tendon width which must be considered in future studies.

In current research, we investigated the LR muscle LID as a potential predictor factor for the surgical effect in bilateral recession of LR in different age groups.

Lee *et al.*, previously, investigated the LID correlation with the results of unilateral and bilateral LR recession in age group (4 - 15 y) and they proved that LID has positive correlation with the dose response effect [8].

The correlation between LID and strabismus was investigated in other previous studies [13] [14].

The posterior fixation sutures of rectus tendons increase the pulley effect [15], so the excessive recession would move LR insertion nearer to pulleys which in turn increase the response of the recession.

The mean LR muscle LID in this study was (6.15 ± 0.6) which was comparable to that of lee study which was (5.8 ± 0.7).

Also, the mean response dose was (2.29 ± 0.29) which is lesser than that of Lee *et al.* (4.3 ± 1) at the end of follow up period. This may be attributed to the difference between both studies in mean preoperative angle of deviation as it was in this study (38.9 ± 8.9) compared to (25 ± 5.4) in Lee's study.

In our study, we found that there is positive correlation between LID and dose response effect in both groups. When LID was <5.5 mm, the dose response was smaller and when LID > 6.25, dose response is larger, so increasing amount of recession is recommended in smaller LID and decreasing amount of recession in large LID to achieve best results.

The MDR can be calculated using this equation:

$$MDR = 0.16 + 0.28 * LID + 0.01 * \text{preoperative angle}$$

So, if the preoperative angle was 30, and LID was 7, the MDR will be 2.86. So we recommend bilateral rectus recession 5.5 mm. While if LID was 4.25, the MDR will be 1.65, so here we recommend bilateral 9 mm.

Some authors used anterior segment optical coherence tomography (AS OCT) to measure the LID and compared their measurements with that of intraoperative measurements and they proved the accuracy of AS OCT measurements [16]. However, surgeons must confirm measurements intraoperatively.

Our study has some limitations: the small sample size, being a retrospective study and relatively short follow up period though we followed up our patients till 1 year postoperatively in comparison to previous study of Lee *et al.* in which the follow up period was shorter (only 6 months).

Also we enrolled in our study wide range of preoperative angle of exodeviation from (20 - 50 Δ) which may interfere with the fairness of the results. Further studies must be done on larger sample size, longer follow up periods, taking in mind the insertion width and the LID of medial rectus muscle as it may also be the effect of surgical correction.

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