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Unilateral Medial Rectus Resection versus Plication in Residual Intermittent Exotropia after Bilateral lateral Rectus Recession

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Abstract

Surgical approaches for correcting residual or recurrent strabismus depend on the former operation pattern and on the angle of deviation. Unilateral medial rectus resection (UMRR) shows good outcomes for small angle, ≤ 25 PD. Muscle plication is an alternative, but still there is not enough literature comparing plication results with resection. To compare between unilateral medial rectus resection (UMRR) versus unilateral medial rectus plication (UMRP) in treatment of residual Intermittent exotropia X(T) after bilateral lateral rectus recession (BLR). 30 patients with residual X(T) angle ranged from 10-25PD after BLR, age ranged from 3-30 years were included in our prospective cohort study, they were divided into two groups: Group I (14 patients) underwent UMRP and Group II (16 patients) underwent UMRR. Follow-up period was three months following surgery. Success was defined as angle of deviation between 8 PD esodeviation and exodeviation. Postoperative, the success rate was 92.9% in group I and 87.5% in group II, without significant difference ($p=1.000$). By the end follow-up 92.9% in group I and 75.0% in group II has no limitation of abduction, with no statistically significant difference ($p=1.000$). UMRP for correction of residual X (T) is better than UMRR in success rate and in abduction deficits, 3 months after surgery, but it was not a statistically significant difference.

Keywords: Strabismus, Intermittent exotropia, Residual exotropia, Plication, Resection, Recession, Medial rectus, Lateral rectus.

1. Introduction

X (T) is the commonest type of strabismus, which makes up about 75-90% of the exotropia cases, affecting around 1% of the general population. It affects females more than males, more prevalent in the Middle East, East Asia, and subequatorial Africa than in the U.S.A. [1], [2]. The surgical correction of

X (T) is usually BLR or unilateral LR recession & MR resection (R&R). Although X (T) can be controlled by primary surgery, postoperative exodrift and recurrence are common, so reoperation might be required [3]. Usually in recurrent or residual XT after BLR, the secondary surgery is unilateral or bilateral MRR, as the LR re-recession is usually

ruled out because the large degree of LR recession in the primary surgery [4]. Unilateral MR surgery shows good outcomes for moderate exodeviations (≤ 25 PD) [5]. Muscle plication recently attracts attention as an alternative to resection in strabismic patients [6][7]. Plication is a vessel-sparing surgery that is characterized by its simplicity and less probability to surgical trauma and hemorrhage than resection surgeries [8]. However, its relative efficacy is difficult to determine due to sparse literature comparing plication results with resection. The aim of our study is to compare the results of UMRR versus UMRP in treatment of moderate residual X (T) after BLR.

2. Patients and Methods

This is a prospective interventional comparative study, approved by the Ethics Committee of the Faculty of Medicine (for Girls), Al-Azhar University, Cairo, Egypt. The study was carried out over the period between March 2022 to January 2023 at the Ophthalmology department, of Alexandria University Hospitals, and included 30 patients with residual X(T) after BLR, whom before study enrolment, informed written consent was obtained from them. Patients were divided randomly into 2 groups according to treatment protocol:

- Group I: 14 patients underwent UMRP.
- Group II: 16 patients underwent UMRR.

Patients with history of paralytic or restrictive exotropia, inflammation or trauma, other ocular diseases, or any chronic systemic diseases like Down syndrome or cerebral palsy were excluded from this study. Prior to surgery the medical and surgical history was taken, complete ocular examination was done including best-corrected visual acuity, anterior and posterior segment examination using slit lamp and indirect ophthalmoscope, measurement of angle of deviation at distance and near (Krimsky

test, alternate prism cover test) and ocular motility evaluation at nine cardinal visual gazes.

2.1 Surgical Procedures

Operations were performed under general anesthesia and using a fornix approach.

2.2 MR Resection

After incision of conjunctiva and tenon capsule Fig. (1), MR was hooked and dissected from its surrounding tissues Fig. (2), then it was sutured by Vicryl 6–0 according to the amount of supposed resection from its insertion Fig. (3), then it was resected at 1 mm anterior to these sutures Fig. (4) and the residual muscle was sutured at its primary insertion to the sclera Fig. (5).

2.3 MR Plication

Same as resection up to the muscle suturing, then the sutures were passed through two scleral bites at 1 mm anterior to the muscle insertion, and during tightening and fixing the sutures the plicated muscle part was folded anteriorly Fig. (6). Table (1) shows surgical dosage (mm) followed for residual exotropia in the present study based on the surgeon's experience.



Fig. 1: Conjunctiva and tenon capsule incision using a fornix approach.

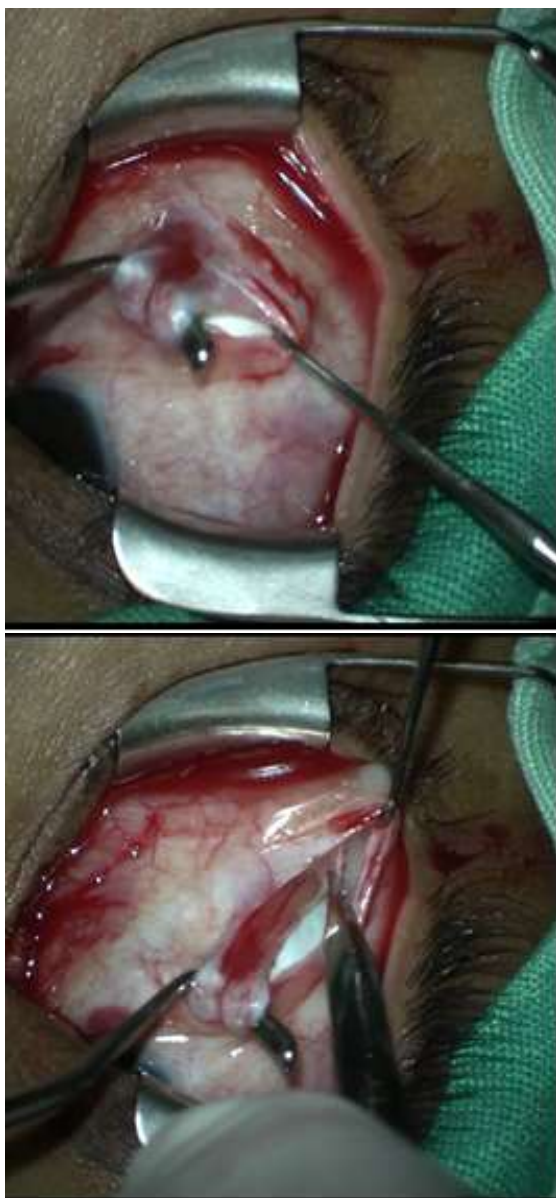


Fig. 2: Medial recruits are hooked and dissected from its surrounding tissues.

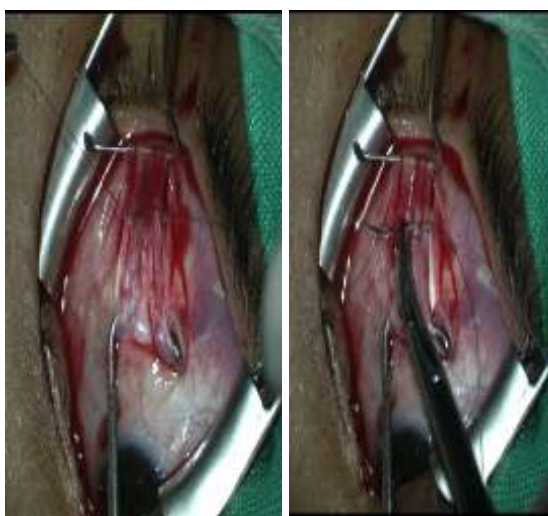


Fig. 3: Medial rectus suturing according to the amount of supposed resection from its insertion by Vicryl 6-0.



Fig. 4: The muscle is cut from its insertion (resection of MR in group II).



Fig. 5: The resected muscle is sutured to the sclera at its primary insertion.

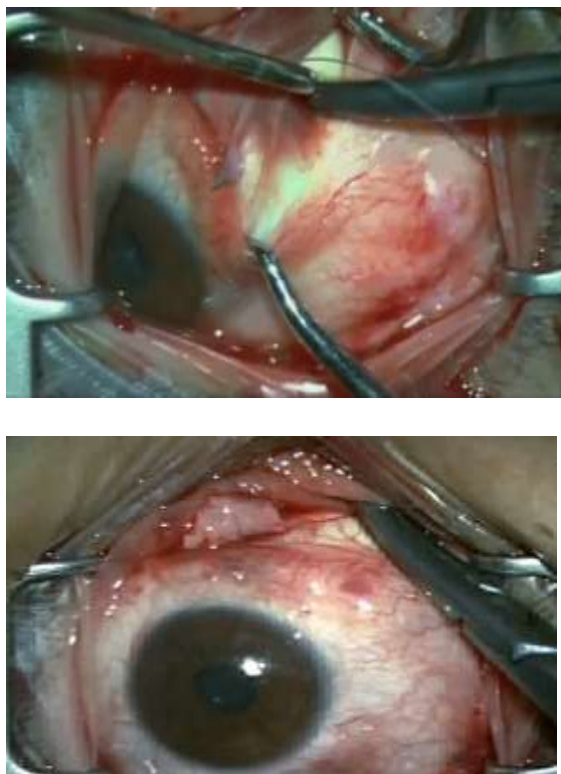


Fig. 6: Plication of MR in group I; the sutures are passed through the scleral at 1 mm anterior to the muscle insertion, the muscle is folded during tightening the sutures.

2.4 post-operative management

A combination of antibiotic/steroid eye drops was prescribed 6 times /day post-operative, and withdrawal was gradual over 4 weeks.

2.5 Follow-up

3 months after surgery and the postoperative alignment was measured using prism and cover tests.

2.6 Statistical analysis

The independent Student's t-test paired t-test, χ^2 test and Fisher's exact test were used to compare the patient's characteristics and the surgical outcomes. Statistical analyses were performed using (SPSS15.0.1 for windows; SPSS Inc, Chicago, IL), and p value <0.05 were considered statistically significant.

3. Results

Table 1. shows Surgical dosage (mm) followed for residual exotropia in the present study based on the surgeon's experience. As shown in table 2 thirty patients with residual (X)T after BLR were included in this study, age ranged from 3-30 years with a mean of 8.47 ± 7.26 years. 12 patients were males (40%) and 18 were females (60%). Patients were divided into two groups: Group I : 14 patients underwent UMRP, Group II: 16 patients underwent UMRR. The pre-operative angle of deviation ranged from 10-25 PD with a mean of 14.64 ± 4.22 PD in group I and 16.1 ± 3.94 PD in group II ($p = 0.349$). The mean amount of previous BLR surgery was 7.00 ± 1.18 SD in group I compared to 6.88 ± 1.2 SD in group II ($p=1.00$). As shown in table 3 postoperative deviations and success rates: the mean residual angle of deviation 3 months postoperative was 2.29 ± 4.57 SD for group I and 1.50 ± 5.96 SD for group II with no statistically significant difference ($p= 0.692$). Orthotropic with no angle of deviation was found in 8 patients in group I and 9 patients in group II. As shown in table 4 the success rate was 92.9% in group I, was 87.5% in group II, without statistically significant difference ($p=1.000$). As shown in table 5 amount of MR strengthening and its dose response: the mean amount of MR plication was 5.07 ± 1.27 SD compared to 5.38 ± 1.2 SD for resection ($p= 0.507$). The mean of MR dose response (PD/mm) was 2.87 ± 0.19 SD for plication compared to 2.98 ± 0.23 SD for resection. The difference was not statistically significant ($p= 0.176$). As show in table 6 postoperative limitation of abduction: 13 patients in group I had no limitation of abduction and 12 patients in group II had no limitation of abduction with no statistically significant difference ($p= 1.000$). Other than that, there was no other complication (intra-operative or post-operative).

Table 1: Surgical dosage in the present study:

Exotropia (PD)	MR plication / resection (mm)
10 (n=4), 12(n=6)	4 mm
14 (n=5), 16(n=5)	5 mm
18 (n=5)	6 mm
20 (n=3)	7 mm
25 (n=2)	8 mm

PD: Prism diopters; MR: Medial rectus.

Table 2: Demographic data and clinical characteristics of the two study groups:

		Group I	Group II	P- value
N.		14 (46.7%)	16 (53.3%)	
Age (years)	Mean $\pm$ SD	7.93 $\pm$ 7.07	8.94 $\pm$ 7.62	0.711 (1)
	Range	3-30	3-28	
Sex	Male	6 (42.9%)	6 (37.5%)	0.765 (2)
	Female	8 (57.1%)	10 (62.5%)	
BCVA (Log MAR)	OD	0.023 $\pm$ 0.048	0.015 $\pm$ 0.038	0.655(1)
	OS	0.046 $\pm$ 0.090	0.007 $\pm$ 0.028	0.154(1)
Angle of Exotropia (PD)at distance	Mean $\pm$ SD	14.64 $\pm$ 4.22	16.1 $\pm$ 3.94	0.349 (1)
	Range	10-25	10-25	
BLR in previous surgery (mm)	Mean $\pm$ SD	7.00 $\pm$ 1.18	6.88 $\pm$ 1.2	1.00(1)
	Range	5-9	5-9	

SD: standard deviation, BCVA: best corrected visual acuity, MR: medial rectus, PD: Prism diopters, BLR: bilateral lateral rectus recession, (1): Independent sample T test, (2): Chi-square test (χ)

Table 3: Comparison between the two groups as regards the postoperative residual angle

	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	P- value (t-test)
Residual angle 3 m. postop. (PD)	2.29 $\pm$ 4.57	1.50 $\pm$ 5.96	0.692

SD: standard deviation, PD: prism diopter, 3m. postop.: 3 months postoperative

Table 4: Comparison between the two groups as regards the successful outcome:

	Group I N (%)	Group II N (%)	P- value (Chi-square test(χ_{mc}))
Successful	13 (92.9%)	14 (87.5%)	1.000
Under correction	1 (7.1%)	1 (6.3%)	
Over correction	0 (0%)	1 (6.3%)	

Table 5: Amount of MR strengthening and its dose response; Comparison between the two groups.

	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	P- value (t-test)
MR strengthening (mm)	5.07 $\pm$ 1.27	5.38 $\pm$ 1.2	0.507
MR dose response (PD/mm)	2.87 $\pm$ 0.19	2.98 $\pm$ 0.23	0.176

SD: standard deviation, MR: medial rectus, PD: prism diopter, PD/mm: prism diopter per millimeter

Table 6: Postoperative limitation of abduction; comparison between the two groups.

Abduction	Group I	Group II	P- value (Chi-square test(χ^2 mc))
0	13 (92.9%)	12 (75.0%)	1.000
-1	1 (7.1%)	2 (12.5%)	
-2	0	1 (6.3%)	
-3	0	1 (6.3%)	

4. Discussion

In our study the success rate 3 months postoperatively was 87.5% for resected group II. Similar results were reported by the studies conducted on patients who underwent UMRR for correcting recurrent or under corrected exotropia [9,10,11] Olitsky et al. [9], who reported 95% success rate in 21 patients, at 6 months follow-up. Also, Kim and Kim [10] reported 84.1% success rate at a follow-up more than 6 months, in 70 patients. Mims [11] reported 82% success rate in 45 patients, during the follow-up of 2 years. Few studies were conducted to verify the success of MR plication in patients with residual exotropia [12]. In our study the success rates at 3 months after surgery were 92.9% for plicated group I, and 87.5% for resected group II, with no statistically significant difference ($p=1.000$), there were 2 cases of under correction (1 cases in each group) and only one case of overcorrection esotropia (10 PD) in group II.

In the studies we reviewed that comparing MR resection vs plication, the success rate varied. Zhale et al. [12] reported success

rate 87% for MR plication and 89.3% for MR resection in patients with XT, they included patients with residual XT after uni- or bilateral LR recession or R&R. Kimura et al. [13] compared plication-recession (PR) with resection-recession (RR) in patients with X(T) and had no history of previous strabismus surgery, the success rate was 67% for PR and 60% for RR. Wang et al. [14] compared bilateral MRP with bilateral MRR in patients with convergence insufficiency-type X (T) and had no history of previous strabismus surgery, their success rates were 64% for plication and 62% for resection. Sukhija et al. [8] compared PR with RR in patients with large-angle XT (30-50 PD) with no previous strabismus surgery, they had 100% success rate in both groups. Kamlesh et al. [15] compared PR with RR in patients with basic type X(T) and with no history of previous strabismus surgery, their success rates were 66.67% in the plicated group and 76.67% in the resected group. Elbarawy et al. [16] compared PR with RR in patients with XT with no history of previous strabismus surgery; the success rates were 85% in both groups. Although the result varies between those

studies the difference was not statistically significant between MR plication and resection groups success rates. On the other hand Al-Kharashi et al. [17] found that success rate was 58% in the plicated group while it was 89% in the resected group which was significantly higher ($P=0.005$), they included patients with simple or complex strabismus (esotropia, exotropia or vertical strabismus), patients who underwent a rectus muscle resection or plication, with or without recession of the antagonist muscle which may explain this difference in effectiveness, as the type of strabismus and surgical procedure are factors that may affect the surgical results, also their study was retrospective and nonrandomized. Lee et al. [18] reported success rates of 55.3% in the RR group and 27.8% in the PR group in patients with X(T), this was statistically significant ($p<0.001$), their study was retrospective and non-randomized. Our study, however, is a prospective study that only includes patients with residual X(T) after BLR and underwent only UMRR or UMRP. That variation in results may attribute to that there is no clear definition of successful surgical outcome for X(T) surgeries in the literature as they differed on what counted as success, for example some studies defined success as postoperative distance angle of 0–10 PD [17], others defined it as esotropia ≤ 5 PD to exotropia ≤ 10 PD [12,13,15,18], others defined it as distance ocular alignment of ≤ 10 PD of under correction and ≤ 4 PD of overcorrection [19], others defined it as distance angle of deviation between 10 PD of exodeviation and esodeviation [14,16], while others defined it as angle of deviation ≤ 8 PD esodeviation and exodeviation [8], also, the time of reporting the results widely varied between studies [20]. In our study, the mean effect of MR plication was 2.87 ± 0.19 PD/mm, whereas that of MR resection was 2.98 ± 0.23 PD/mm, although there was no significant difference between the two surgeries ($p=0.176$). In Kamlesh study [15], the

meaning effect of MR plication was 5.91 PD/mm, and MR resection was 5.5 PD/mm ($p=0.877$), in Zhale et al. [12] study the MR plication dose response was 5.28 ± 2.31 PD/mm and MR resection was 5.36 ± 2.02 PD/mm with no statistical difference ($p=0.904$). Chaudhuri et al. [6] found that the initial correction by MR plication was 7.10 ± 1.65 PD/mm and MR resection was 7.26 ± 1.23 PD/mm, ($p>0.05$), initial and late effects were similar. Our response was lower than the previous mentioned studies, which may be explained that our patient underwent BLR recession previously. Suh et al. [4] reported the variable effect of MR resection in patients with recurrent XT after BLR that surgeons have to be aware of, it was 3.99 ± 1.02 PD/mm in patients with LR recession ≥ 7 mm and 4.15 ± 1.19 PD/mm in patients with LR recession < 7 mm. Olitsky et al. [9] stated that the muscle resection effect per millimeter varied and until now there is no standard nomogram according to strabismus angle, that may be due to the different resection techniques and the amount of previous strabismus surgeries. In our study the following degree was based on surgeon's experience. Our present study demonstrates plication response predictability and similarity to resection effect and adaption to the small-incision technique, other advantages of rectus plication over resection include its less invasiveness which decrease the chances of inflammation, hemorrhage and avoids muscle disinsertion complications as slipped or lost muscle, while there were no cases of over correction in plication group in our study, other authors reported its early reversibility by suture releasing that can be performed in the first postoperative days [6,8]. Kimura et al. [13] reported that in the early postoperative period overcorrection is more likely after resection than plication, this may be attributed to the tethering effect caused by the inflammation and adhesion between the muscle, connective tissue and sclera in the early period after

resection, at 12 months the plication and resection achieved comparable deviation and success rates. So, in their study plication had only a better success rate in early follow up period which may decrease chances of postoperative diplopia due to overcorrection particularly in adults. In our study other than limitation of abduction in some patients with no statistically significant difference between respected and plicated groups ($p= 1.000$), there was no other complication (intra-operative or post-operative).

There is no agreement whether plication is tightening or strengthening procedure, while some authors [7,8,15] believe it is a tightening procedure causing eye movement limitation, others [6,12,13] consider it as strengthening procedure and the plicated muscle part is inactive causing no eye movement limitation.

Like us Sukhija et al. [8] reported no significant difference between the resected and plicated groups as regard to the abduction limitation ($p= 1.000$), while Alkharashi et al. [17] reported significantly high rate of limitation in plication group.

Our study is prospective and has the same follow up period for both groups, also the demographics and clinical characteristics of the 2 groups are similar, but our study is limited by its short follow-up time and the small number of cases.

In conclusion, patients with residual X(T) after bilateral lateral rectus recession have better results after unilateral MR plication than unilateral MR resection surgeries at 3 months post operatively, but to verify these results it is recommended to have further studies with longer follow up time and a greater number of cases.

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