Al-Azhar International Medical Journal

Volume 4 | Issue 6 Article 4

2023
Section: Ophthalmology

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How to Cite This Article

Madbouly, Wafaa Ahmed; Hegazy, Hanan Saied Mohamed; and Ragab, Fatma Fakhry Abdel Khalek (2023) "Supermaximal Monocular Recession-Resection Versus Large Bilateral Lateral Rectus Recession in large Angle Exotropia," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 6, Article 4.
DOI: https://doi.org/10.58675/2682-339X.1840

ORIGINAL ARTICLE

Supermaximal Monocular Recession–Resection Versus Large Bilateral Lateral Rectus Recession in Large-angle Exotropia☆

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Abstract

Background: **Strabismus surgery aims to improve the ocular alignment of the visual axis and the cosmetic appearance of the studied cases with strabismus. The most common functional benefits are the restoration of binocular vision, with the elimination of diplopia and compensatory head posture. In cases of large-angle exotropia, many surgical methods have been performed. Bilateral lateral rectus recession and medial rectus resection with lateral rectus recession are the most frequently used.**

Aim: **To evaluate the outcome of supermaximal monocular recession–resection versus large bilateral lateral rectus recession in large-angle exotropia.**

Patients and methods: **This was a prospective, interventional, nonrandomized study. This study was conducted at the Ophthalmology Department AL-Zahraa University Hospital, Cairo, Egypt, in the duration from May 2021 to May 2022 and included (20) patients, who were divided into two groups: group A (10) who underwent monocular recession–resection operation in large-angle exotropia and group B (10) patients who underwent bilateral lateral rectus recession operation in large-angle exotropia.**

Results: **At the final examination, in the RR group, 7 of the 10 studied cases (70%) were successfully aligned and three (30%) had recurrence. In the BLR group, 8 (80%) of the 10 studied cases achieved successful alignment, and two (20%) had recurrence. Successful alignment and recurrence rates were not significantly different between the groups.**

Conclusion: **The successful alignment rate of the two-muscle surgery in patients with large-angle exotropia was 75% and the overall surgical results were comparable between BLR and RR groups.**

Keywords: Bilateral lateral rectus recession, Large-angle exotropia, Recession–resection, Supermaximal

1. Introduction

Exotropia is characterized by an outward deviation of the eyes. It is a common condition that affects about 1% of all children under the age of 11 years.[1]

Therapy is recommended in order to restore binocular function and normal ocular alignment. For symptomatic exotropias, surgery is the preferred therapy. Nonsurgical therapy may be recommended to improve sensory conditions before surgery.[1]

Numerous surgical methods have been used in cases of large-angle exodeviation, such as bilateral lateral rectus recession, one medial rectus resection with lateral rectus recession, three-muscle procedure, botulinum toxin injection combined with recession–resection procedures, botulinum toxin injection combined with augmented BLR recession,

☆ **Place of the study:** Ophthalmology Department AL-Zahraa University Hospital, Cairo, Egypt.

Accepted 27 December 2022.
Available online 23 August 2023

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https://doi.org/10.58675/2682-339X.1840

bilateral medial rectus resection, and rectus muscle recession combined with central tenectomy.[2]

In cases with large-angle exotropia, two-muscle surgery can save other rectus muscles in the event of reoperation and requires less duration in the operating room.[3]

Monocular procedure is usually preferred to avoid exposing the dominant eye to the risks of surgery. Moreover, if a repeat operation is required, monocular surgery may maintain some muscles and reduce the surgical time. Several studies have been done and have shown that it is safe to perform supermaximal amounts of recession without causing significant limitation of ocular movements or disfigurement.[4]

2. Patients and methods

This is a prospective, interventional, non-randomized research. This research was done at the Ophthalmology Department AL-Zahraa University Hospital, Cairo, Egypt from May 2021 to May 2022. In all, 20 patients were prospectively studied. They were separated into two groups. **Group A**: The 10 studied cases who underwent monocular recession–resection operation in large-angle exotropia. **Group B**: 10 patients who underwent bilateral lateral rectus recession in large-angle exotropia.

Inclusion criteria: Patients with large-angle exotropia, age >5 years old, and both sexes.

Exclusion criteria: Patients with an exodeviation angle of less than 40 Δ, history of botulinum toxin injections for strabismus, nystagmus, history of previous strabismus surgery, history of previous intraocular or refractive surgery, and patients with limitation of ocular rotation due to restrictive or paretic strabismus.

2.1. Methods

2.1.1. Preoperative examination

Full history taking: date of birth, history of incubation, the onset of exotropia, previous therapy such as glasses, occlusion or surgery and family history of strabismus. Visual acuity assessment was done by Snellen's chart and cycloplegic refraction. Extraocular motility was evaluated in nine cardinal positions. Anterior and posterior segment examination was done. Assessment of angle of exotropia by the following tests: the Hirschberg test, cover test, cover–uncover test, Krimsky test, and the modified Krimsky test.

2.1.2. Surgical technique

Group A: monocular recession–resection operation. **Group B:** bilateral lateral rectus recession operation and fornix incision was done in all patients.

2.1.3. Postoperative evaluation

Topical antibiotics and corticosteroid eye drops were given in the early postoperative period with gradual withdrawal. Evaluation of muscle alignment, conjunctival redness, and refractive error on 1st day, at 1 week, 1 month, and 3 months postoperatively.

Conjunctival redness was evaluated using (0–3) over each of the operated muscles by **Escardó-Paton and Harrad**.[5] A score of 3 (very red) was applied to the degree of redness on the first postoperative day, and score 2 showed moderate redness; one showed mild redness. Any degree of redness (1–3) was considered red while a score of 0 meant that conjunctiva over the operated muscle had returned to its preoperative color.

2.1.4. Statistical techniques

The data was analyzed using the software MedCalc v. 19. The Kolmogorov–Smirnov test of normality was used to examine the data for normality. Kolmogorov–Smirnov test outcomes showed that the majority of data were normally distributed (parametric data), so parametric exams were used for the majority of comparisons. Significance of outcomes was determined using the *P* value, which was classified as non-important when the *P* value was greater than 0.05. When the *P* value is less than 0.05, the outcome is important. When the *P* value is less than 0.01 it is considered greatly important.

3. Results

Twenty studied cases with large-angle XT who met the inclusion criteria were classified into two groups: **Group A:** 10 studied cases who underwent monocular recession–resection (RR) operation in large-angle exotropia. **Group B:** 10 patients who underwent bilateral lateral rectus recession (BLR) in large-angle exotropia. Table 1.

Group A mean age was 23.5 ± 11.3 years and ranged from 10 to 45 years, while group B mean years was 13.1 ± 6.9 and ranged from 6 to 23, with no variation among the two groups ($P > 0.05$). Table 2.

Table 1. Age of the study group.

Age (y)	Group A RR (n = ten)	Group B BLR (n = ten)	*P*-value
Mean ± SD	23.5 ± 11.3	13.1 ± 6.9	0.061
Range	10–45	6–23	

Table 2. Comparison among the two 2 groups regarding the age of onset of exotropia.

Variable	Group A (n = ten)		Group B (n = ten)		*P*-value
	Mean	SD	Mean	SD	
Age of onset (y)	6.4	10.1	7.4	5.5	0.786

Regarding the age of onset, there was no variation between the two groups ($P > 0.05$).

There was no variation among the two groups regarding BCVA measurements on both the right and left sides ($P > 0.05$), Table 3, pre- and postoperative SPH.EQ measurements and no variation between pre- and postoperative SPH.EQ within groups A and B ($P > 0.05$). Table 4.

In group (A), four (40%) patients had no complications; six (60%) patients had narrowing of the palpebral aperture; and one (10%) patient had limitation in abduction. In group (B), seven (70%) patients had no complications; two (20%) patients had narrowing of PA; and three (30%) patients had limitations in abduction. Table 5.

Regarding postoperative conjunctival redness, in group A, most of the cases had severe grade at day 1 (90%), moderate grade at 1 week (60%), mild grade at 1 month (40%), and no redness at 3 months (100%). In group B, most of the cases had moderate grade at day 1 (60%), mild grade at 1 week (80%), mild grade (20%), and 80% had no conjunctival redness at 1 month, and no redness at 3 months (100%). Table 6.

Postoperative alignment was divided into those with ≤10PD (ET), ≤10PD (XT), and >10PD (XT). Regarding the postoperative angle in group A, Figs. 1 and 2, 30% of cases had ET ≤ 10PD, 50% had XT ≤ 10PD at day 1, week 1, 1 month, and 40% at 3 months. 20% had XT > 10PD at day 1, week 1, one month, and 30% at 3 months, Regarding postoperative angle in group B, Figs. 3 and 4, 90% of cases had XT ≤ 10 PD at day 1, week 1, and 80% at 1 month, 3 months. 10% had XT > 10PD at day 1, week 1, and 20% at 1 month and 3 months, Table 7.

Table 3. Comparison between two groups regarding best corrected visual acuity (BCVA).

BCVA	Group A (*n* = ten)		Group B (*n* = ten)		*P*-value
	Mean	SD	Mean	SD	
Right	0.29	0.35	0.22	0.32	0.613
Left	0.26	0.33	0.09	0.14	0.133

Table 4. Comparing two groups: spherical equivalent (SPH.EQ) pre & postoperative.

SPH.EQ	Group A	Group B	*P*-value
	Mean ± SD	Mean ± SD	
Preoperative	−1.29 ± 2.57	0.01 ± 1.32	0.1633
Postoperative	−1.28 ± 2.71	−0.33 ± 1.59	0.3479
P-value	0.9932	0.6175	–

Table 5. Comparing two groups son postoperative complication.

Postoperative complication	Group A (R–R) (*n* = 10) NO (%)	Group B (BLR) (*n* = 10) NO (%)
NO	4 (40)	7 (70)
Narrowing of PA	6 (60)	2 (20)
Limitation of abduction	1 (10)	3 (30)

4. Discussion

Our study is a prospective, interventional, non-randomized study. This study was done at the Ophthalmology Department AL Zahraa University Hospital, Cairo, Egypt. All procedures in this study followed Al-Azhar University Hospital Ethics Committee regulations.

The goal of our study was to compare the outcomes of supermaximal monocular recession–resection with large bilateral lateral rectus recession in large-angle exotropia in terms of postoperative muscle alignment, conjunctival redness, and refractive error at day 1, week 1, 1 month, and 3 months postoperatively.

There is no difference among the two groups regarding gender, family history, near or far preoperative angle of deviation, years old at onset, years old at surgery, the interval between onset and surgery, and refraction. The preoperative difference in sex, family history, years old at onset, years old at surgery, the interval between onset and surgery, and refraction had no effect on the outcome of surgery for either group.

In our study, the preoperative angle of deviation is a significant reason in determining the successful outcome of surgery. This is in agreement with **Huda** et al.[6] and **Saleem** et al.,[1] who discovered that preoperative deviation was the best indicator of a favorable result.

However, **Yoo and Kim**[7] revealed that the postoperative surgical result was affected by the duration of misalignment, instead of years old at the surgery.

Conjunctival redness appeared in all patients in groups A and B on the 1st postoperative day and then decreased gradually and completely disappeared at 3 months postoperatively; this is in agreement with **Escardo-Paton and Harrad** and **Wan and Hunter.**[5,8]

In our study in group A, four (40%) patients had no complications, six (60%) patients had narrowing of PA, and one (10%) patient had limitation in

Table 6. Distribution of postoperative conjunctival redness in groups A and B.

Conjunctival redness	Group A (R–R) ($n = 10$)				Group B (BLR) ($n = 10$)			
	3 No. (%)	2 No. (%)	1 No. (%)	0 No. (%)	3 No. (%)	2 No. (%)	1 No. (%)	0 No. (%)
1 day	9 (90)	1 (10)	0 (0)	0 (0)	4 (40)	6 (60)	0 (0)	0 (0)
1 week	0 (0)	6 (60)	4 (40)	0 (0)	0 (0)	2 (20)	8 (80)	0 (0)
1 month	0 (0)	0 (0)	4 (40)	6 (60)	0 (0)	0 (0)	2 (20)	8 (80)
3 months	0 (0)	0 (0)	0 (0)	10 (100)	0 (0)	0 (0)	0 (0)	10 (100)

3: severe, **2:** moderate, **1:** mild, **0:** No conjunctival redness.

Case (1) group (A)

Fig. 1. Preoperative female patient with XT 50 PD for near and far.

Fig. 2. The same patient at 3-month postoperative follow-up showed orthotropia.

Case (2) group (B)

Fig. 3. Preoperative male patient with XT 65 PD for near and far.

Fig. 4. The same patient at 3-month postoperative follow-up showed orthotropia.

abduction. In group B, seven (70%) patients had no complications, two (20%) patients had narrowing of PA, and three (30%) patients had limitations in abduction. The narrowing of PA and limitation in abduction disappeared 2 weeks to 1 month postoperatively in both groups.

Phuljhele et al.[9] observed that palpebral aperture variations are known to occur following horizontal muscle strabismus surgery; resection reduces its height, the amount of change in PA may be associated with the amount of surgery performed on the rectus muscle. Also **Chang** et al.[10] stated that significant resistance to abduction, enophthalmos, and palpebral fissure narrowing can happen when more than 6 mm of the medial rectus is resected. Lateral rectus recession of more than 7 mm to 8 mm is said to decrease abduction.

Kim et al.[3] have reported that if alignment in the primary position was among 10 PD of exophoria/tropia and five PD of esophoria/tropia, the surgical result was considered satisfactory. Overcorrection was described as > five PD of esophoria/tropia and recurrence as more than 10 PD of exophoria/tropia.

In our study, the time of follow-up after surgery was 3 months, which was so short to detect surgical recurrence. **Jeoung** et al.[11] reported that the estimated mean time from surgery to failure in the BLR group was 23 ± 1.9 months and 28.3 ± 2.1 months in the R&R group. **Lee and Choi**[12] described that the mean follow-up duration point of surgical recurrence is 21.3 months.

In our study, in group A on the 1st postoperative day the angle of esodeviation ranged from 4- to 8 PD, which was found in three patients (30%). At 1 and 3 months postoperative follow-up, they were orthotropic.

In our study, in group B postoperative angle of exodeviation ranged from 4 to 16 PD. Only two subjects (20%) were undercorrected (>10PD) at 3 months postoperatively and eight subjects (80%) were orthotropic, and no patients were

Table 7. Distribution of postoperative angle in groups A and B.

Postoperative angle (PD)	Group A (R–R) ($n = 10$)			Group B (BLR) ($n = 10$)	
	≤10PD ET	≤10PD XT	>10PD XT	≤10PD XT	>10PD XT
1 day	3 (30%)	5 (50%)	2 (20%)	9 (90%)	1 (10%)
1 week	3 (30%)	5 (50%)	2 (20%)	9 (90%)	1 (10%)
1 month	3 (30%)	5 (50%)	2 (20%)	8 (80%)	2 (20%)
3 months	3 (30%)	4 (40%)	3 (30%)	8 (80%)	2 (20%)

(ET),- means esodeviation and **(XT)** means exodeviation.

overcorrected in group B. Our study disagrees with **Jeoung** et al.,[11] who discovered that the unilateral RR process leads to better results than BLR recession surgery in the studied cases with exotropia in the dominant eye; however, overcorrection rate was greater in the unilateral RR process.

In the RR group, 7 of the 10 studied cases (70%) were successfully aligned and three (30%) had a recurrence. In the BLR group, 8 (80%) of the 10 studied cases achieved successful alignment and two (20%) had recurrence. Rates of successful alignment and recurrence were not different between groups.

This study was a prospective research and has numerous limitations. The major limitation of this research was the few number of studied cases and the short-term follow-up, which does not allow determination of the long-term ocular stability of exotropia after BLR and unilateral lateral rectus recession and medial rectus resection.

4.1. Conclusion

The successful alignment rate of two-muscle surgery in patients with large-angle exotropia was 75%. The overall surgical results were comparable among BLR and RR groups and successful alignment and recurrence rates were not different among groups.

Sources of support

None.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

There are no conflicts of interest.

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