

Comparative Study Between Recession Versus Fenestration of the Lateral Rectus Muscle in Treating Intermittent Exotropia

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Abstract

Background: The most common form of exotropia, an outward deviation of the eyes, is intermittent exotropia. Surgically, this condition is treated by weakening the lateral rectus muscle, with recession with scleral suturing being the standard technique. However, there is an alternative weakening procedure called muscle fenestration that can avoid many of the complications that can occur with scleral suturing. About one percent of children under the age of eleven suffer from exotropia.

Aim and objectives: To compare the surgical outcome of bilateral lateral rectus fenestration versus the standard bilateral lateral rectus recession with scleral suturing using 6-0 Vicryl sutures in treating intermittent exotropia.

Subjects and methods: This randomized interventional comparative study was carried out on 40-patients of intermittent exotropia at Giza Memorial Institute of Ophthalmic Research, Kids Eye Center through the period from July 2021 till 2023. Two groups were formed from the patients: Twenty patients having prior scleral tunnel surgery for bilateral lateral rectus recession were included in the recession group. Twenty individuals who were part of the fenestration group had lateral rectus fenestration done on both sides.

Results: Both techniques were effective in treating intermittent exotropia, as orthotropia was achieved in 70% and 65% of patients for near and distant fixation, respectively, during the economic downturn. With both close and far fixation, half of the patients in the fenestration group were able to attain orthotropia.

Conclusion: Intermittent exotropia can be treated effectively by fenestration of the LR muscle with comparable results to the standard recession. One risk-free method for reducing the strength of muscles outside the eye is fenestration.

Keywords: Recession; Fenestration; Lateral rectus muscle; Intermittent exotropia

1. Introduction

When the eyes turn outward, it's called exotropia, and it's a condition of ocular alignment. It is a prevalent disorder that impacts around 1% of children younger than 11 years old.¹

Surgical correction of intermittent exotropia is the standard of care.² The effectiveness of bilateral lateral rectus recession in treating intermittent exotropia has been extensively studied and proven.³

The usual method to weaken the muscles outside of the eye is recession with scleral

suturing. Complications involving suturing and muscle disinsertion might still arise, even though this surgical method is the most prevalent. Furthermore, if many rectus muscles are dissected, the risk of anterior region ischemia increases because the vascular supply to the anterior segment of the eye is interrupted.⁴

Other weakening techniques include hang-back and adjustable sutures, as well as other sutureless techniques, such as marginal myotomy, graded tenotomy for small deviations, and muscle fenestration.⁵

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Muscle fenestration is different from previous weakening techniques because it decreases the force of the muscle by reducing the number of contracting fibers by removing a block of muscular belly close to its insertion. The peripheral poles of the muscle are left intact. Gradually reducing the length of the muscle block can be done to get the desired weakening effect.⁶

In order to treat intermittent exotropia, this study compared the surgical results of two methods: bilateral lateral rectus fenestration and the conventional method of bilateral lateral rectus recession with scleral suturing using 6-0 Vicryl sutures.

2. Patients and methods

This randomized interventional comparative study was carried out on 40 patients of intermittent exotropia at Giza Memorial Institute of Ophthalmic Research, Kids Eye Center, from July 2021 to 2023. The patients were divided into two groups: Recession group (20 patients): had undergone bilateral lateral rectus recession with the scleral tunnel technique; Fenestration group (20 patients): had undergone bilateral lateral rectus fenestration.

Every patient had a thorough medical history taken, and their visual acuity was measured in both monocular and binocular formats using Log Mar notation. The results were reported as uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA). The cyclopentolate 1% eye drops were administered three times within one hour for cycloplegic refraction, and the results were acquired using an autorefractometer. We recorded the refractive errors in spherical equivalent. To rule out the possibility of pathology in the anterior region, slit lamp biomicroscopy is used throughout the examination. The fundus examination is performed to rule out any pathology in the posterior segment by means of an indirect ophthalmoscope. The duction and version test is a tool for evaluating eye movement. Evaluation of Control: The Kushner control scale was utilized for the evaluation of control.

Measurement of the angle of deviation:

Using the alternate prism cover test, we measured the angle of deviation at a distance of 6 meters and close to 33 centimeters while the subjects wore corrective lenses for their spectacles. Overcorrection of the angle of deviation was achieved by placing base-in prisms over one eye and continuing dissociation with progressively increasing prism strength. The next step was to find the maximum prism strength that eliminated exodeviation by reducing the prism strength.

Inclusion criteria:

Age: greater than 4 years; indication for surgery: intermittent exotropia.

Exclusion criteria:

Sensory strabismus, paralytic strabismus, restrictive strabismus, previous strabismus surgery, and uncooperative patients.

Surgical technique:

Recession:

Placing an eye speculum after sterilising and wrapping the eyes. A fornix-based incision is used to expose and hook the muscle. The muscle tendon is carefully exposed and released through meticulous dissection. Each muscle edge is sutured with 6-0 Vicryl sutures utilizing partial and full-thickness bites to bind the muscle fibers. Next, a partial thickness scleral tunnel is used to resuture the tendon to the sclera at the required distance after a Wescott scissors is used to cut it near the insertion. After that, the incision made in the conjunctiva is stitched back into place.

Fenestration:

After the standard procedures of sterilisation and eye draping have been completed, a speculum will be placed. A fornix-based incision is used to expose and hook the muscle. The muscle edge is carefully defined by dissection before another muscular hook is put under it. The interfering muscle fibers are stretched using the two hooks. Then, using a small Stevens' tenotomy hook, two 1-mm-thick peripheral muscle strips are made. With the help of two little hooks, the outer layers of muscle are drawn away from the muscle's core. To what extent muscles are weakened is dependent on the length of the produced peripheral strips. Two millimeters more than the usual amount for a traditional recession was removed. The area that will be surgically removed has a visible diathermy burn. Using two little hooks on each side, the two muscle strips are separated. Then, the area in the middle is cut off with Wescott scissors, exposing the sclera. After that, the incision made in the conjunctiva is stitched back into place.



Figure 1. Lateral rectus muscle fenestration.

Postoperative:

Initial, one-week, one-month, three-month, and six-month postoperative assessments included the following procedures: All of these measurements were collected digitally, and they included best corrected visual acuity, inspection of the anterior segment, investigation of the fundus, study of

motility, measurement of the angle of deviation for far and near in primary position, and finally, an alternate prism cover test.

Ethical consideration:

All patients or their parents' agreement was secured before the study could begin, and the Institutional Review Board of the Faculty of Medicine, Al-Azhar University gave its approval.

Statistical analysis:

A computer was used to analyze the data, with the help of IBM SPSS software package version 20.0. (New York: IBM Corp., Armonk, 1994). Quantitative and qualitative data were characterized by percentages and counts. The distribution was checked for normalcy using the Shapiro-Wilk test. Standard deviation, median, interquartile range (IQR), range (minimum and maximum), and mean were used to characterize quantitative data. We used a 5% level of significance to evaluate the results.

To compare various groups using categorical variables, the chi-square test is used. When more than 20% of the cells have an anticipated count less than 5, Fisher's Exact Test corrects for chi-square. When comparing two groups, the student t-test is useful for quantitative variables that follow a normal distribution. When comparing two groups, the Mann Whitney test is useful for quantitative variables with an atypical distribution.

3. Results

When comparing the study groups' patients based on age and sex, no statistically significant differences were found, (table 1).

Table 1. Comparison between the two studied groups according to demographic data.

DEMOGRAPHIC DATA	RECESSION GROUP (N=20)		FENESTRATION GROUP (N=20)		TEST OF SIG.	P
	No.	%	No.	%		
SEX						
MALE	9	45.0	6	30.0	$\chi^2=0.960$	0.327
FEMALE	11	55.0	14	70.0		
AGE (YEARS)						
MIN-MAX.	4.0-22.0		5.0-23.0		U=190.0	0.799
MEAN±SD	10.20±5.23		10.10±4.22			
MEDIAN (IQR)	9.0 (6.50-13.0)		8.50 (7.50-12.0)			

IQR:Inter quartile range; SD:Standard deviation
 χ^2 : Chi square test; U:Mann Whitney test; p:p-value for comparing between the two studied groups.

Comparison between patients in studied groups according to preoperative angle revealed no statistically significant difference between the two groups, (table 2).

Table 2. Comparison between the two studied groups according to preoperative angle.

ANGLE (PREOPERATIVE)	RECESSION GROUP (N=20)	FENESTRATION GROUP (N=20)	U	P
NEAR				
MIN-MAX	18.0-46.0	18.0-50.0	147.0	0.157
MEAN±SD	33.85±7.63	31.30±9.61		
MEDIAN (IQR)	36.0(31.0-41.0)	30.0 (25.0-40.0)		
DISTANT				
MIN-MAX	20.0-50.0	20.0-50.0	139.0	0.096
MEAN±SD	32.65±8.59	30.0±8.58		
MEDIAN (IQR)	31.0(26.0-41.0)	25.0(25.0-35.0)		

IQR:Inter quartile range; SD:Standard deviation; U:Mann Whitney test p:p-value for comparing between the two studied groups

There was no significant statistical difference between the studied groups regarding the amount of recession and fenestration, (table 3).

Table 3. Comparison between the two studied groups according to recession.

RECESSION (MM)	RECESSION GROUP (N=20)	FENESTRATION GROUP (N=20)	T
MIN-MAX	6.0-10.50	7.0-11.50	0.804
MEAN±SD	8.68±1.0	9.0±1.50	
MEDIAN (IQR)	8.50(8.0-9.50)	9.0(8.0-10.0)	

IQR:Inter quartile range; SD:Standard deviation; t:Student t-test

p:p-value for comparing between the two studied groups; *:Statistically significant at $p \leq 0.05$

Orthotropia is considered when the horizontal deviation is less than 10 PD whether exo or esophoria. Both techniques were effective in reducing the preoperative angle of deviation at near and distant fixation with more reduction effect in the recession group. But the difference between the two groups was statistically insignificant, (table 4; figures 2&3).

Table 4. Comparison between the two studied groups according to angle at postoperative.

ANGLE	RECESSION GROUP (N=20)	FENESTRATION GROUP (N=20)	U	P
Pre				
Min-Max	18.0-46.0	18.0-50.0	147.0	0.157
Mean±SD.	33.85±7.63	31.30±9.61		
Median (IQR)	36.0(31.0-41.0)	30.0(25.0-40.0)		
1st day				
Min-Max	-5.0-16.0	-4.0-25.0	166.00	0.369
Mean±SD.	5.0±5.39	7.70±7.94		
Median(IQR)	5.0(0.0-9.0)	10.0(0.0-13.50)		
1st week				
Min-Max	-8.0-25.0	-10.0-30.0	157.00	0.253
Mean±SD	6.90±8.25	10.35±10.48		
Median (IQR)	5.0(0.0-12.0)	11.0(1.50-16.50)		
1st month				
Min-Max	-15.0-30.0	-8.0-45.0	148.00	0.165
Mean±SD	8.30±12.45	14.60±14.35		
Median (IQR)	5.50(0.0-15.0)	15.0(5.0-22.50)		
3rd months				
Min-Max	-20.0-35.0	-18.0-50.0	144.50	0.134
Mean±SD	8.25±12.95	14.50±15.77		
Median (IQR)	5.50(0.0-14.0)	14.0(4.50-20.0)		

DISTANT	6th months				
	Min-Max	-30.0-35.0	-18.0-45.0	153.50	0.211
	Mean±SD	7.75±14.73	13.40±15.47		
	Median (IQR)	6.0(0.0-14.0)	10.0(2.50-20.0)		
	Pre				
	Min-Max	20.0-50.0	20.0-50.0	139.00	0.102
	Mean±SD	32.65±8.59	30.0±8.58		
	Median (IQR)	31.0(26.0-41.0)	25.0(25.0-35.0)		
	1st day				
	Min-Max	-5.0-20.0	-4.0-25.0	169.00	0.414
	Mean±SD	5.30±6.40	7.60±7.68		
	Median (IQR)	5.0(0.0-10.0)	9.0(0.0-12.50)		
	1st week				
	Min-Max	-8.0-25.0	-10.0-25.0	142.50	0.121
	Mean±SD	5.90±9.60	10.15±9.96		
	Median (IQR)	4.0(0.0-11.0)	11.0(5.0-18.0)		
	1st month				
	Min-Max	-15.0-30.0	-12.0-45.0	130.00	0.060
	Mean±SD	6.80±11.82	14.50±15.19		
	Median (IQR)	4.0(0.0-12.0)	14.50(7.50-25.0)		
	3rd months				
	Min-Max	-20.0-35.0	-18.0-40.0	141.50	0.114
	Mean±SD	7.60±12.58	12.80±14.78		
	Median (IQR)	5.0(0.0-14.0)	15.0(7.0-19.0)		
	6th months				
	Min-Max	-30.0-30.0	-25.0-40.0	151.50	0.192
	Mean±SD	6.65±13.23	11.85±14.83		
	Median (IQR)	4.0(0.0-15.0)	10.0(6.50-19.0)		

IQR:Inter quartile range; SD:Standard deviation; U:Mann Whitney test p:p-value for comparing between the two studied groups; *:Statistically significant at $p \leq 0.05$

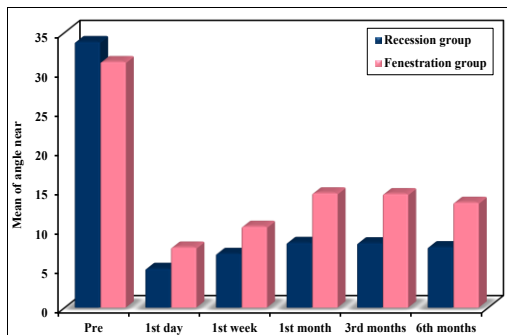


Figure 2. Comparison between the two studied groups according to angle near.

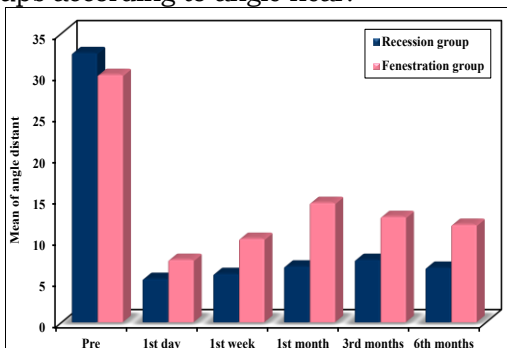


Figure 3. Comparison between the two studied groups according to angle distant.

In the recession group: Orthotropia was achieved in 70% for near fixation and in 65% for distant fixation with no significant difference between them. Residual exotropia was noticed in 5-cases for near and in 6-cases for distant fixation. Only 1-case had consecutive esotropia for near and distant fixation.

In the fenestration group: Orthotropia was achieved in 50% for near and distant fixation. Residual exotropia was noticed in 9-cases for near and distant fixation while only 1-case had consecutive esotropia for near and distant fixation, (table 5; figures 4&5).

Table 5. Comparison between the two studied groups according to angle at final follow up visit.

ANGLE	RECESSION GROUP (N=20)		FENESTRATION GROUP (N=20)		FET	P	
	No.	%	No.	%			
NEAR							
6TH MONTH							
SUCCESSFUL OUTCOME:10 TO ET 10	14	70.0	10	50.0	2.006	0.413	
RESIDUAL EXOTROPIA:> 10	5	25.0	9	45.0			
CONSECUTIVE ESOTROPIA:> ET 10	1	5.0	1	5.0			
DISTANT							
6TH MONTH							
SUCCESSFUL OUTCOME:10 TO ET 10	13	65.0	10	50.0	1.225	0.746	
RESIDUAL EXOTROPIA:>10	6	30.0	9	45.0			
CONSECUTIVE ESOTROPIA:>ET 10	1	5.0	1	5.0			

χ^2 :Chi square test; FET:Fisher Exact; p:p-value for comparing between the two studied groups

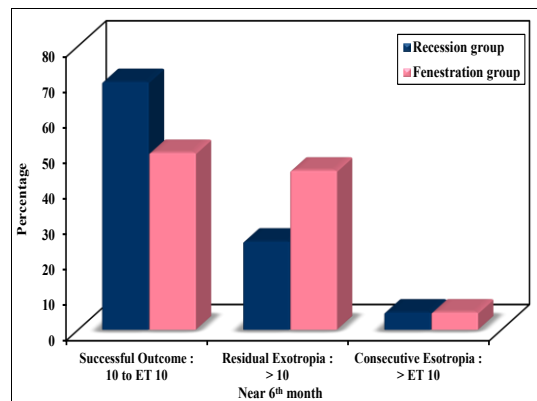


Figure 4. Comparison between the two studied groups according to angle near at final follow up visit.

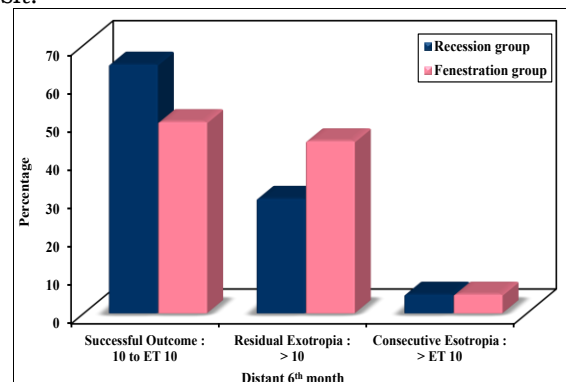


Figure 5. Comparison between the two studied groups according to angle distant at final follow up visit.

Case presentation:

Case one: (recession group)

Twenty-two years female with: Preoperative deviation: 50-PD for near and distant fixation. Operation: bilateral LR recession 10.5-mm. Final follow up at 6th month: orthotropic for near and



Figure 6. [A]:preoperative. [B]:early postoperative. [C]:1st month postoperative. [D]:3rd month postoperative. [E]:6th month postoperative.

Case two: (fenestration group):

Eight years female with Preoperative deviation: 35-PD for near and 30-PD for distant fixation. Operation: bilateral LR fenestration 9-mm. Final follow-up at 6th month: exophoric less than 10-PD for near and distant fixation.

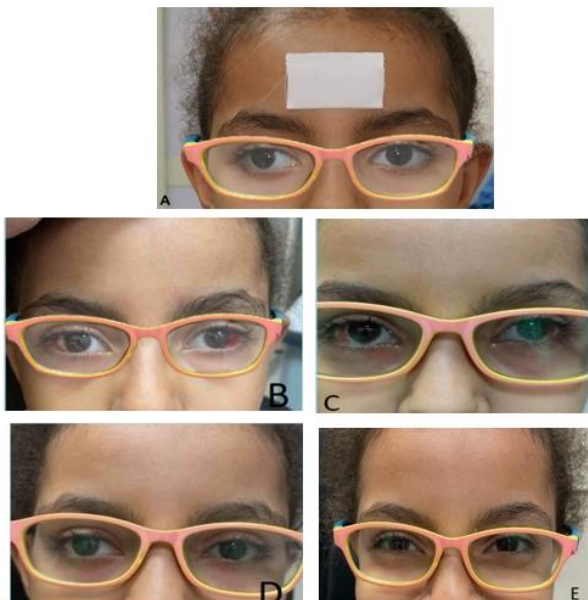


Figure 7. [A]: preoperative. [B]: early postoperative. [C]:1st month postoperative. [D]:3rd month postoperative. [E]:6th month postoperative.

4. Discussion

The majority of exodeviations are intermittent exotropia, which has both functional and social implications for the sufferer. Although X(T) can be treated with non-surgical methods as well, strabismus surgery remains the gold standard. When correcting intermittent exotropia, strabismus surgery aims to enhance binocular function while simultaneously improving cosmetics. Another ongoing demand is for sutureless surgery that requires fewer surgical procedures to accomplish the same goals as traditional surgery.

The usual method to weaken the muscles outside of the eye is recession with scleral suturing. Complications involving suturing and muscle disinsertion might still arise, even though this surgical method is the most prevalent. Furthermore, if many rectus muscles are dissected, the risk of anterior region ischemia increases because the vascular supply to the anterior segment of the eye is interrupted.⁴

One method for reducing the strength of the muscles around the eyes that has just recently been detailed is muscle fenestration. In patients with thin sclera or significant recession, the method helps prevent suture-related problems and allows for earlier patient rehabilitation. It is also reasonably uncomplicated. It also keeps muscle transposition, slippage, and stretched scars at bay, all of which can occur as a result of muscle disinsertion. The danger of anterior segment ischemia can be reduced with several eye muscle procedures since the muscular vessels can be retained.⁷

Orthotropia within 10 PD (exo or eso) with fixation on an accommodating target at 33 cm (near fixation) or 6 m (distance fixation) and the use of corrective spectacles six months after surgery was considered a successful motor alignment in this study.⁸

Previous research with different surgical approaches showed varying degrees of success in surgical procedures. In a statistical analysis conducted by Ing and colleagues, thirty-two patients, or 62% of the total, were found to be effectively aligned six months following BLR-rec for a mean preoperative deviation of 25 prism diopters (PD). Overcorrected patients accounted for 17% of the total, while undercorrected patients accounted for 21%.⁹

At 6 months post-op, Wang and colleagues found that 85.1% of 47 patients who underwent R&R were successful, compared to 65.8% of 38 patients who underwent BLR-rec. They also found that 10.5% of patients in the R&R group had overcorrection, while 23.7% of patients in the BLR-rec group had undercorrection.¹⁰

In a randomized trial done by Donahue and

colleagues, an optimal outcome was achieved in 54% of 101 patients who had BLR-rec, while that outcome was achieved in 63% of 96 patients who had R&R at a follow-up period of 3 years.¹¹

Contrarily, esotropia of more than 10 prism diopters (PD) that remains two months after exotropia surgery is considered successive esotropia.¹² An extremely uncommon consequence of surgical treatment of exotropia, the incidence of which ranges from zero to eleven percent, is persistent successive esotropia.¹⁰

In this study, the outcome was evaluated for near and distant fixation at 6 6-month follow-up period. There was no statistically significant difference in the results between the recession and fenestration groups, although there was a higher success rate in the recession group. Successful motor outcome was achieved in 14 and 13 patients [70% and 65%] for near and distant fixation, respectively, in the recession group. Residual exotropia was noticed in 5 and 6 patients [25% and 30%] for near and distant fixation, respectively, but consecutive esotropia happened in only one patient [5%] for both near and far in the recession group. These results were consistent with the results of the recession in the previously published reports.

Regarding the fenestration group, results were similar for near and distant fixation, as a successful outcome was achieved in 10 patients [50%] for both near and distant fixation. Residual exotropia was noticed in 9 patients [45%], while consecutive esotropia happened in only one patient [5%].

After looking over earlier fenestration reports, Rageh and colleagues, who first published the technique and coined the term fenestration, found that in three out of five cases of exotropia, or 60% of the cases, the patient was able to achieve alignment within eight postoperative days (PDS) of orthotropia with a surgical dose that was one mm longer than the conventional recession.⁹

In this study, we increased the surgical dose of fenestration to 2mm more than the numbers used in standard recession, based on a small, unpublished pilot study using only a 1mm increase in surgical dose, which showed a high residual rate of exotropia. That notice was consistent with what Elkhawaga and colleagues reported in their study, as they increased their surgical dose by 3mm more than the standard recession.¹³ Compared to our study, their success rate of 29 out of 36 patients (81% at 6 months) after bilateral lateral rectus muscle fenestration was greater. Despite increasing the surgical dose more than what we found in our study, they have not recorded a single case of successive esotropia.¹³

In this study, no significant complications were

encountered, which was consistent with what Elkhawaga and colleagues reported. Only 1-case of limited abduction was faced in the recession group in the case of consecutive esotropia. This case was treated successfully by bilateral lateral rectus advancement. There was also 1 case of consecutive esotropia in the fenestration group, but without any limitation of abduction. This case was treated by advancing the central part of the previously fenestrated LR to the original insertion, which was also successful in that case.

One patient experienced persistent subconjunctival hemorrhage that surfaced two hours following surgery; this complication required a return to the operating room to cauterize the bleeding tiny vessels; fortunately, there were no long-term effects from this procedure.¹⁴ In our study, the site of excision was marked with cautery prior to cutting, so no excessive bleeding was encountered.

4. Conclusion

Intermittent exotropia can be treated effectively by fenestration of the LR muscle with comparable results to the standard recession. One risk-free method for reducing the strength of muscles outside the eye is fenestration.

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

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Conflicts of interest

There are no conflicts of interest.

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