Early versus late postoperative ocular alignment following bilateral lateral rectus recession in children with intermittent exotropia

Sara Elhomosany, Tamer Massoud, Amgad Dwidar, Ahmed Elmassry

Ophthalmology Department, Faculty of Medicine, Alexandria University, Alexandria, Egypt

Correspondence to Sara Elhomossany, MD, Department of Ophthalmology, Faculty of Medicine, Alexandria University, Alexandria, Egypt. Tel: +01020885845; e-mail: sarahelhomossany@gmail.com

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Purpose
The aim of this study was to determine the relationship between early and late postoperative motor outcomes in pediatric patients operated for intermittent exotropia.
Patients and methods
A prospective interventional study was performed on 50 consecutive pediatric patients with intermittent exotropia. All patients were treated with bilateral lateral rectus recession. Distance alignment was analyzed in all patients before and after surgery at week 1 and 6 months postoperatively. Successful results were defined as ocular alignment with exodeviation (tropia/phoria) equal to or less than 10Δ, or esodeviation (tropia/phoria) equal to or less than 5Δ.
Results
A total of 50 patients, 30 (60%) female and 20 (40%) male, were included in this study with a mean age of 5.27±2.92 (0.8–10) years. Mean preoperative angle of deviation was 33.8±5.63Δ (20–45Δ). Bilateral lateral rectus recession was performed in all patients. Regarding the late outcomes analyzed at 6 months postoperatively, it is reported that 33 (66%) patients had favorable outcomes, 12 (24%) patients were undercorrected, and five (10%) cases were overcorrected. A good late outcome had initial alignment of 4.52±7.43 PD of esotropia, whereas patients with late postoperative undercorrection had an average initial postoperative alignment of –2.36±4.18 PD. The differences in average initial alignments were statistically significant between each of the groups ($P<0.01$). However, the average initial postoperative alignment in the overcorrected group was 7±9.9, which was statistically nonsignificant ($P=0.655$).
Conclusion
Initial postoperative overcorrection (0–9Δ) esotropia is desirable in the treatment of patients with intermittent exotropia; however, longer duration of follow-up is required to emphasize this relationship.

Keywords:
exotropia, intermittent, lateral recutus recession, squint, strabismus

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Introduction

Intermittent exotropia is the most common form of childhood exodeviations with incidence ranging from 50 to 90% [1]), and the second most common squint in children [2]. Several surgical interventions are used for management; however, bilateral lateral rectus recession is the most widespread as a primary intervention [3].

The aim of treatment is usually to obtain satisfactory ocular alignment and good binocular vision with least interventions. Many surgeons have reported the rates of postoperative recurrence, which varied widely, owing to variable length of follow-up, loss to follow-up, and different criteria of successful outcomes [4–7]. Although initial overcorrection often has a favorable outcome [8,9], it does not always ensure long-term satisfying results. We investigated the relation between early and late postoperative alignment in the pediatric population through a prospective interventional study.

Patients and methods

The study protocol was approved by the ethical committee of the Faculty of Medicine, and data collection conformed to all local laws and complied with the principles of the Declaration of Helsinki. A prospective, interventional study was performed on 50 consecutive children with intermittent exotropia. Informed consent was obtained from the parents or the patient's legal guardian including a possible second surgical procedure.

It was conducted in the Pediatric Unit of the Ophthalmology Department of the Alexandria Main

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University Hospital. Patients below 10 years with intermittent exotropia were included in the study. Excluded were children who had associated vertical deviation; those with a history of previous surgery for a horizontal deviation; those with nystagmus because of the difficulty of interpreting the success rate in terms of alignment of the eyes; children with amblyopia and/or other ocular abnormalities; or those with neurological disorders – e.g. cerebral palsy. A follow-up duration of 6 months was planned. Preoperatively, a thorough history was taken including the age of presentation. Complete ophthalmological examination, with cycloplejic refraction performed after administration of cyclopentolate hydrochloride 1% and refraction, was prescribed only if hyperopia more than 2.5 D, myopia greater than –1 D, astigmatism greater than or equal to 2 D, and myopic overcorrection was not used in any patient.

Ocular deviation was measured with correction in place, in all gazes for near (1/3 m) and far (6 m) with prism and alternate cover test, at least at two occasions; Krimsky test was used in few instances when children were uncooperative enough. Distance deviation was taken as the angle of deviation. Surgery was decided when exotropia approached poor control as observed by the parents and by examination at the clinic.

Surgeries were performed under general anesthesia by one surgeon (S.E.). Patients underwent bilateral lateral rectus muscle surgery using fornix approach, as described by Parks [10] using classical tables for muscle recession, also based on the surgeon experience, and the variation in amount of recession was based on the patient's age, where the younger the age the smaller the amount of recession performed (Table 1).

Goals of surgery were to leave the patients overcorrected (esotropic) for distance by 3–6Δ. The patient's alignment was checked with prism and alternate cover testing; postoperatively, patients were examined and the alignment of the eyes in primary gaze at distance fixation was assessed, at week 1 and then at 6 months after surgery. On the basis of initial measurement at week 1, patients were enrolled to one of the following groups: group A – those who were orthophoric; group B – those with undercorrection (residual exotropia); group C – those with small overcorrection (esotropia 0–10Δ); and group D – those with large overcorrection (>10Δ esotropia) in week 1 postoperatively.

Table 1 Surgical dosage used for intermittent exotropia in this study

Prism diopters	BLR (mm)
20	4
25	4.5–5 (according to the age)
30	6
35	6.5–7
40	7.5–8
45	8.5

The surgical doses used for the treatment of intermittent exotropia in this study were based on the surgeon's experience. BLR, bilateral lateral rectus muscle recession.

Successful outcomes were defined as exodeviation less than 10Δ or esodeviation of less than 5Δ; poor outcomes were defined as either undercorrection (≥10Δ exodeviation) or overcorrection (≥5Δ). Reoperation was planned for patients with recurrent exodeviation more than 15Δ, who showed poor fusional control over the deviation as noticed by the surgeon and the parents; also, reoperation was planned for patients who showed overcorrection more than 10Δ not controlled by glasses and prisms and persists for more than 2 months postoperatively.

The correlation between postoperative alignments at week 1 and 6 months was analyzed in all the groups with the analysis of variance. The correlation between age, sex, refractive errors, and late postoperative outcomes was also analyzed. *P* values less than 0.05 were considered statistically significant. All analyses were performed with statistical package for the social sciences software for Windows (SPSS; SPSS Inc., Chicago, Illinois, USA).

Results

A total of 50 patients with intermittent exotropia were included in this study: 30 (60%) female and 20 (40%) male; the mean age at which strabismus was diagnosed was 5.27±2.92 years (0.8–10 years) by parental report, whereas the age at which surgery was performed had a mean of 5.59±2.82 years, ranging from 1.5 to 10 years. Preoperative angle of deviation had a mean of 33.8±5.63Δ, ranging from 20 to 45Δ. Of all the patients who underwent surgery, 71.15% showed poor fusional control; the mean of their spherical equivalent was 0.63±1.88, ranging from –5.0 to +4.0 and median of +1.0. At week 1 postoperatively, 27 (56%) patients were orthophoric, five (10%) patients showed undercorrection (residual exotropia), 13 (26%) patients had small overcorrection (esotropia 0–10Δ),

and five (12%) patients showed large overcorrection (>10 Δesotropia) (Table 4).

Among the four groups, there was no significant correlation between age at presentation, sex, refractive errors, and long-term outcomes (Tables 2 and 3). The recurrence rate in this study was 16%; it was 19% in group A, 80% in group B, 10% in group C, and 0% in group D, which, however, showed late overcorrection that required reoperation. Second intervention was performed in nine (18%) cases of the study: seven (14%) cases in groups A and B together, two (4%) cases in group D, and none (0%) in group C.

The mean postoperative deviations in groups A and C show statistically significant differences, (Table 4); however, the surgical results at each postoperative time in each group demonstrate that there is a tendency for decline in overcorrection and a tendency for undercorrection and recurrence with time after surgery.

Regarding the late outcomes analyzed at 6 months postoperatively, it is reported that 33 (66%) patients had favorable outcomes, 12 (24%) patients were undercorrected, and five (10%) cases were overcorrected. The average initial postoperative alignment for the group with a good outcome was 4.52±7.43 PD of esotropia, whereas patients with late postoperative undercorrection had an average initial postoperative alignment of −2.36±4.18 PD. The differences in average initial alignments were statistically significant between each of the groups (two-tailed Student's *t*-test; $P<0.01$).

However, the average initial postoperative alignment in the overcorrected group was 7±9.9, which was statistically nonsignificant ($P=0.655$) (Table 5).

Table 2 Correlation between age, spherical equivalent, and late outcomes

	Mean±SD (range)		
	Age at diagnosis	SE (OD)	SE (OS)
Good outcome	5.15±2.81 (0.8 to 14)	0.7±1 (−5 to 4)	0.63±1 (−5 to 4)
Poor outcome (undercorrection and overcorrection)	6.05±3.83 (2 to 12)	0.5±1 (−5 to 2)	0.83±1 (−3.5 to 4.5)
P value	0.725	0.34	0.665

Proper alignment includes patients with orthophoria to exodeviation less than 10 prism diopters. OD, right eye; OS, left eye; SE, spherical equivalent.

Table 3 Correlation between sex and late ocular alignment

	Group 2		Total	*P* value
	Proper alignment	Misalignment		
Sex				
Male				
Count	18	4	22	
% within sex	81.8	18.2	100.0	
Female				
Count	23	8	31	
% within sex	74.2	25.8	100.0	
Total				
Count	41	12	53	0.74

Table 4 Postoperative angle of deviation for distant fixation at 1 week and 6 months postoperatively in each group

Groups	*N* (1 week/6 months)	Angle of deviation in prism diopters [mean±SD (range)]		Asymptotic significance (two tailed)[a]
		Time after surgery		
		1 week	6 months	
Group A	28/25	0	−5.68±8.73 (−20 to 12)	0.007
Group B	5/4	−12.6±7.26 (−25 to −6)	−14.5±5 (−20 to −8)	0.144
Group C	13/12	6.76±2.65 (4 to 10)	−1.166±3.24 (−8 to 2)	0.002
Group D	6/5	20±4.51 (14 to 25)	8±7.15 (−8 to 12)	0.042

Group A, those who were orthophoric; group B, those with undercorrection (residual exotropia); group C, those with small overcorrection (esotropia 0–10Δ); and group D, those with large overcorrection (>10Δ esotropia) at day 1 postoperatively. Positive numbers represent exodeviation; negative numbers represent esodeviation. [a]Based on positive ranks, Wilcoxon's signed ranks test.

Table 5 Initial postoperative deviation in patients with favorable and unfavorable outcomes

Groups	Angle of deviation in prism diopters [mean±SD (range)]		
	1 week	6 months	Tests of significance
Undercorrected (6 months: >10Δ exotropia) (*n*=12)	−2.36±4.18 (−10 to 0)	−16.73±2.57 (−20 to −14)	Wilcoxon's signed ranks test Z=−2.943 *P*=0.003*
Corrected (6 months: −10 to +4) (*n*=33)	4.52±7.43 (−12 to 25)	−1.47±3.42 (−10 to 2)	Wilcoxon's signed ranks test Z=−3.683 *P*<0.001*
Overcorrected (6 months: >+4) (*n*=4)	7±9.9 (0 to 14)	12±12 (12 to 20)	Wilcoxon's signed ranks test Z=−0.447 *P*=0.655

*Statistically significant.

Discussion

Although there is a large pool of studies that have reported the success rate following treatment of intermittent exotropia, there is no uniformity in the criteria of success, surgeries performed, and length of follow-up. In this prospective study on 50 children with intermittent exotropia, we found that 66% of patients had favorable outcome, ranging from esotropia or esophoria of less than 5Δ to exotropia or exophoria of less than 10Δ; this figure is comparable to previous studies reporting the success rate following bilateral lateral rectus recession (42.2–63%) [6,11]; to our knowledge, this range of postoperative alignment is acceptable both in terms of good sensory outcomes and stereopsis, also being unnoticeable and satisfactory to the patients and their parents. Because of the importance of fusional control on our decision to reoperate or not, there is a discrepancy between the rate of recurrence and reoperation.

We noticed that there is a general tendency for exodrift to occur with time, with significant correlation between good outcomes and initial postoperative small overcorrection (0–10 esodeviation at week 1), and although some surgeons agree to the importance of initial overcorrection on good final results [11], Oh and Hwang [8] suggested that the initial postoperative deviation was the only factor found to determine the outcome of exotropia – a finding that is similar to our results. Ruttum [12], however, found that initial overcorrection between orthotropia and 9Δ of esotropia did not guarantee a good long-term outcome; this discrepancy may be attributed to the length of follow-up and the surgical procedures used. Age, sex, and refractive errors according to our results have no significant correlation to long-term outcomes, although they may have indirect influence on late surgical outcomes as proved by others; in a study carried out by Gordon and Bachar [13] response to surgery was determined by the magnitude of preoperative deviation, anisometropia, and spherical equivalent. In another study conducted by Scott *et al.* [14], patient age at the time of surgery, refractive state, and degree of anisometropia had significant predictive values.

This study is a prospective one carried out on a population of the same age group; also, we tried to uniform the surgical intervention done in all the patients by performing bilateral lateral rectus recession by the same surgeon. However, this study has some limitations: first, it has a follow-up duration of only 6 months, which seems to affect recurrence rate, which is 16%, whereas other surgeons reported a recurrence rate of 49% with an average 51-month follow-up. Also, the preoperative and postoperative sensory statuses were not evaluated in this study, which may be because of the difficulty to assess stereopsis in this young hardly cooperative age group even though sensory status may influence the surgical results.

In conclusion, initial postoperative small overcorrection (0–9Δ) esotropia is desirable in the management of intermittent exotropia. Patients with this overcorrection were less likely to develop recurrence than those with undercorrection or even orthophoria; however, longer duration of follow-up is needed to emphasize this relation, and other factors may participate in long-term motor outcomes.

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Conflicts of interest

None declared.

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