

Surgical Management of Residual or Recurrent Esotropia Following Maximal Bilateral Medial Rectus Recession

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Objective: To describe the effect of graded unilateral vs bilateral lateral rectus resection in the treatment of residual or recurrent esotropia after maximal medial rectus muscle recession.

Methods: Retrospective case series of children with residual or recurrent esotropia. All children underwent initial eye muscle surgery for angles of 40 to 60 prism diopters (medial rectus recession of 5.5-6.5 mm; 11.0-11.5 mm from surgical limbus). If significant esotropia persisted or recurred, surgical results from graded lateral rectus resection were recorded.

Results: Thirty-eight children were identified for the study. Unilateral lateral rectus resection ranging from 4

to 7 mm resulted in mean esotropic corrections of 10.5 to 14.9 prism diopters. Differences in surgical response per millimeter of unilateral lateral rectus resection were not significant. Bilateral lateral rectus resection of 5, 6, and 7 mm resulted in a mean correction of 19.75, 28.75, and 33.5 prism diopters, respectively.

Conclusions: Graded lateral rectus resection can produce highly variable results on a case-to-case basis, but mean values trend in the expected direction. Residual deviations larger than 15 prism diopters need to be addressed with bilateral surgery.

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INFANTILE AND NONACCOMMODATIVE esotropia are common in pediatric ophthalmic practice.¹ Surgical correction by bilateral medial rectus recession for strabismic angles up to 60 prism diopters is a standard initial therapy.² Nevertheless, undercorrection is common and can be difficult to manage.³ If this occurs, varying strategies exist for the second surgery. Some authors have advocated recession of the medial rectus muscle.^{1,3} However, this practice may result in a late consecutive exotropia in many cases.⁴ It is now recognized that placement of the medial rectus muscle to a point greater than 1.5 mm behind the equator results in medial rectus muscle underaction and a greater risk of a consecutive exodeviation.⁵ Thus, residual or recurrent esodeviations after maximal medial rectus recession to about 11.5 mm from the surgical limbus are more commonly treated with lateral rectus resection.^{6,7}

Many practitioners use their training and prior experience to determine surgical dose, but little objective data exist on the amount of correction obtained with each millimeter of lateral rectus muscle re-

section.⁶⁻⁸ This study reviews our experience measuring the esotropic correction obtained with varying amounts of lateral rectus resection after the medial rectus muscles have been maximally weakened during a prior surgery.

METHODS

Institutional review was obtained prior to initiating this study. A retrospective case series was performed of all pediatric patients seen at a single institution by 2 strabismus surgeons (D.G.M. and S.P.D.) between 2004 and 2008 and evaluated for residual or recurrent esotropia after maximal medial rectus recession for a diagnosis of infantile or large-angle nonaccommodative esotropia. Patients with significant structural disorders of the eye, severe developmental delay, restrictive or paralytic strabismus, or untreated amblyopia were excluded from the study.

Inclusion criteria in this study necessitated initial eye muscle surgery for angles of 40 to 60 prism diopters (medial rectus recession of 5.5-6.5 mm; 11.0-11.5 mm from the surgical limbus). Measurements were performed by means of the prism alternate cover test at near while fixated on an accommodative target preoperatively and at 2 months after sur-

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Table 1. Unilateral and Bilateral Lateral Rectus Resection Results

Children, No.	Length of Resection, mm	Mean (SD) [Range] Correction, Prism Diopters
Unilateral		
2	4	12.0 ^a
6	5	13.3 (5.3) [8-22]
12	6	14.9 (6.7) [6-30]
4	7	10.5 (5.0) [8-18]
Bilateral		
4	5	19.75 (2.1) [17-22]
8	6	28.75 (5.6) [16-35]
2	7	33.5 (5.0) [30-37]

^aBoth children had a correction of 12.0 prism diopters.

gery. Near measurements were used to calculate changes in preoperative and postoperative strabismic angles for consistency. In all children, preoperative evaluation involved a cycloplegic refraction. For children with infantile strabismus and hypermetropia greater than 3 diopters (D), or anisometropia greater than 1.5 D, spectacles were dispensed and worn for 2 to 3 months prior to strabismic measurements. For children who experienced a period of orthotropia after the first surgery and then had a recurrence of the esotropia, cycloplegic refraction was again obtained, and the children were required to wear glasses for hypermetropia greater than 2 D.

RESULTS

Thirty-eight children were identified who underwent a second surgery for residual esotropia greater than 10 prism diopters. Unilateral lateral rectus resection was performed in 24 children, and bilateral surgery was performed in 14 children. Mean age at initial surgery (bilateral medial rectus recession) was 26 months (range, 6-72 months). Mean time between medial rectus recession and subsequent lateral rectus resection surgery was 23.9 months (range, 2-120 months). Mean age at the second surgery was 49.3 months (range, 14-144 months). Eight children had inferior oblique surgery at the time of lateral rectus resection, and 2 children had lateral rectus offset combined with resection for pattern strabismus.

Unilateral lateral rectus resection resulted in a mean correction of 12.0, 13.3, 14.9, and 10.5 prism diopters for 4-, 5-, 6-, and 7-mm resection, respectively (**Table 1**). The difference in the amount of correction obtained with each millimeter of unilateral lateral rectus resection was not statistically significant. Bilateral lateral rectus resection resulted in a mean correction of 19.75, 28.75, and 33.5 prism diopters for bilateral resections of 5, 6, and 7 mm, respectively (**Table 1**). Bilateral lateral rectus resection did provide a larger effect than unilateral surgery ($P < .001$ by *t* test). Simple linear regression also reveals that a significant slope of 7.3 prism diopters per millimeter of bilateral lateral rectus resection was present ($P = .003$).

COMMENT

Our study demonstrates that mean values for esotropic correction increase with larger amounts of lateral rectus

resection, although these differences in results were not significant for unilateral lateral rectus surgery. It is possible that the sample sizes were too small to detect an incremental change in dose response for each millimeter of unilateral lateral rectus resection. Alternatively, unilateral surgery may be inherently more variable, as evidenced by the fact that a 7-mm resection yielded less correction, on average, than a resection in the range of 4 to 6 mm. Our data indicate that, on average, unilateral surgery produces less than 15 prism diopters of correction. We believe that residual or recurrent deviations larger than 15 prism diopters should be addressed with bilateral surgery.

Our study has several limitations. It is retrospective in its design. The follow-up period was brief, and the long-term effects of lateral rectus surgery for this condition were not studied. We did not evaluate the influence that surgery had on near-distance disparity. Additionally, children with an immediate undercorrection and children with later recurrence of esotropia (presumably up to 10 years later) were studied together. The argument can be made that these 2 groups are not comparable because of the significant changes in orbital anatomy that occur as a result of growth during this duration of time. Additionally, these 2 groups may have a differing sensory status associated with their strabismus. It is unknown whether children with infantile esotropia and children with later-onset, large-angle, nonaccommodative strabismus respond differently to surgery. Finally, lateral incomitance and the effect of pattern strabismus were not independently evaluated regarding their effect on correction in this small sample group.

Previous studies have evaluated surgical dosage for second surgery for residual or recurrent esotropia after initial medial rectus recession. Biedner and Yassar⁶ tried to determine the surgical success of lateral rectus resection but did not specifically study dose response. King et al⁷ compared re-recession of medial rectus muscles to lateral rectus resection. Mims and Wood⁸ developed a formula for calculating the expected effect of bilateral lateral rectus resection for residual esotropia: $[2.39 + 0.26 (\text{mm medial rectus recession})^2 + 0.41 (\text{mm lateral resection}) = \text{prism diopters effect}]$. Their numbers are similar to ours, although they had a slightly smaller observed effect for bilateral surgery than we did. Although very useful for bilateral surgery, the Mims and Wood formula does not specifically address unilateral resection. Their study also included children in whom the medial rectus muscle was not maximally recessed. It is our practice pattern to re-recess the medial rectus muscle in these cases (with or without combined lateral rectus resection) rather than to pursue lateral rectus resection alone.

Our study is unique in that it provides simple data on unilateral and bilateral surgery that can be used by practitioners as a starting point for surgical decision making (**Table 1**). Interestingly, our average correction with bilateral lateral rectus resection can be easily remembered with standard surgical tables. For instance, a recess-resect procedure for 20 prism diopters calls for a lateral rectus resection of 5 mm. Using **Table 1**, we find that a bilateral lateral rectus resection of 5 mm for a residual deviation corrects about 20 prism diopters. This holds

Table 2. Recommended Surgical Dose for Residual or Recurrent Esotropia After Maximal Medial Rectus Recession

Lateral Rectus Resection, mm	Residual Esotropia, Prism Diopters
For 1 eye	
4-6	12-15
For both eyes	
5	20
6	25
7	30

roughly true for 25 and 30 prism diopter corrections as well. Thus, an idealized table can be created (**Table 2**).

In conclusion, individual responses to lateral rectus resection surgery for residual or recurrent esotropia after maximal medial rectus recession can be highly variable. However, we believe that our data provide support that unilateral surgery can be appropriate for residual esotropia of up to 15 prism diopters. Larger deviations should likely be addressed with bilateral surgery.

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