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Adjustable small-incision selective tenotomy and plication for correction of incomitant vertical strabismus and torsion

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Abstract

PURPOSE—To evaluate the effectiveness of adjustable small-incision selective tenotomy and plication of vertical rectus muscles in correcting vertical strabismus incomitant in horizontal gaze positions and cyclotorsion.

METHODS—The medical records of all patients who underwent adjustable small-incision selective tenotomy or plication of a vertical rectus muscle for correction of horizontally incomitant vertical strabismus or cyclotorsion by a single surgeon at a single eye institute from July 2013 to September 2014 were retrospectively reviewed. Selective tenotomy and plication were performed on either the nasal or temporal side of vertical rectus muscles, based on the direction of cyclotorsion and incomitance of vertical strabismus.

RESULTS—Of 9 patients identified, 8 (89%) had successful correction of horizontally incomitant vertical strabismus, with postoperative vertical alignment within 4° of orthotropia in primary position, lateral gazes, and downgaze. Of the 8 patients with preoperative cyclotorsion, 4 (50%) were successfully corrected, with <5° of cyclotorsion postoperatively. Of the 4 patients in whom cyclotorsion did not improve, 3 had undergone prior strabismus surgery, and 2 had restrictive strabismus. Eight of the 9 patients (89%) reported postoperative resolution of diplopia.

CONCLUSIONS—Adjustable small-incision selective tenotomy and plication effectively treat horizontally incomitant vertical strabismus. These surgeries may be less effective for correcting cyclotorsion in patients with restriction or prior strabismus surgery. Advantages are that they may be performed in an adjustable manner and, in some cases, under topical anesthesia.

Incomitant vertical strabismus and cyclotorsion remain two of the most challenging problems faced by strabismologists. Causes may include restrictive strabismus, oculomotor and trochlear nerve palsies, oblique overaction, orbital anatomical abnormalities, and neurologic disorders such as skew deviation.¹ Surgical options for vertical strabismus incomitant in horizontal gaze positions include surgery on vertical rectus and oblique muscles with or without posterior fixation sutures. Surgical options for cyclotorsion include

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the Harada Ito procedure,² horizontal transposition of vertical rectus muscles,^{3,4} superior oblique anterior tenectomy,⁵ and inferior oblique procedures. We have developed an alternative procedure for correction of vertical strabismus incomitant in lateral gaze positions and/or cyclotorsion involving selective plication or tenotomy of vertical rectus muscles that can be performed with adjustable sutures and in select cases under topical anesthesia.

Studies by Demer and colleagues⁶ and da Silva Costa and colleagues⁷ have shown that some extraocular muscles exhibit compartmental innervation, and different compartments of the same extraocular muscle may function independently. This suggests that surgery limited to one portion of an extraocular muscle may be corrective. Partial tenotomy of vertical rectus muscles is a minimally invasive procedure that was first described by Scott to treat small degrees of hypertropia.^{8,9} In this procedure, successive small cuts are made in the tendon of the rectus muscle at the insertion until the desired effect is achieved. A related surgery has been described by Wright,¹⁰ in which the central portion of the tendon of horizontal or vertical rectus muscles is cut through the conjunctiva under topical anesthesia in the office. We describe a novel modification of the procedure developed by Scott in which the nasal or temporal fibers of the vertical rectus muscles are selectively tenotomized and placed on an adjustable suture for the purpose of correcting cyclotorsion or horizontally incomitant vertical strabismus.

Miniplication of the central muscle belly of rectus muscles has similarly been described by Leenheer and Wright¹¹ as a minimally invasive procedure that can be performed in the office under topical anesthesia. Plication has multiple advantages over resection, including sparing of anterior ciliary blood supply,¹² reversibility, and avoiding risk of a lost muscle. We describe a new technique of selective plication in which only one pole of a vertical rectus muscle is plicated. By selectively strengthening the medial or lateral half of a vertical rectus muscle, this procedure can potentially be used to correct both vertical strabismus incomitant in horizontal gaze positions and cyclotorsion.

This study evaluated the effect of adjustable small-incision selective tenotomy and plication on correction of vertical strabismus incomitant in horizontal gaze positions and cyclotorsion. We considered correction of horizontally incomitant vertical strabismus to be successful if patients had $<4^\circ$ of vertical deviation in primary gaze, lateral gaze, and downgaze postoperatively. Correction of cyclotorsion was considered successful if postoperative torsion by double Maddox rod testing was $<5^\circ$. These cutoff values were chosen because 4° is the upper limit of the normal vertical fusion amplitude,¹³ and cyclotorsion of $>4^\circ$ to 6° may degrade horizontal fusion amplitude and stereopsis.¹⁴

Subjects and Methods

This study was approved by the University of California–Los Angeles (UCLA) Institutional Review Board; informed consent was obtained in compliance with the US Health Insurance Portability and Accountability Act of 1996. The medical records of consecutive patients who underwent adjustable small-incision selective tenotomy or plication of a vertical rectus muscle to correct vertical strabismus incomitant in horizontal gaze positions or cyclotorsion

were reviewed retrospectively. All patients were operated on by the same surgeon (FGV) at the Stein Eye Institute, UCLA, between December 2013 and July 2014. Patients who underwent these procedures without adjustable sutures were excluded, as were patients with <6 weeks' follow-up.

Each subject underwent complete ophthalmic examination, including visual acuity testing, cycloplegic refraction, slit-lamp examination, and dilated fundus examination.

Ocular versions, ocular alignment, and sensorial status as measured by the Titmus Fly-Animals-Circles Stereo Test (Stereo Optical Company Inc, Chicago, IL) were evaluated at pre- and postoperative visits. The presence of diplopia was also assessed pre- and postoperatively. Patients were asked to report diplopia in primary gaze, downgaze, and lateral gaze positions. Motor alignment was assessed by alternate prism cover testing at 20 feet. Ocular alignment was measured in primary and secondary gaze positions and at near.

Subjective torsion was measured with the double Maddox rod test. Two Maddox rod lenses, one red and one green, were placed in a trial frame over the patient's face with the calibration mark at 0° on the left eye and 180° on the right eye. All room lights were turned off. The patient was asked to rotate each knob on the trial frame until the red line and the green line were both horizontal. If the subject was not able to distinguish the 2 lines, a 6 base-down prism was placed in front of one eye to create vertical displacement of the lines. The amount of cyclotorsional deviation was determined in degrees directly from the axis scale on the trial frame after the patient made the necessary adjustment. The process was repeated after switching the red and green lenses to the opposite eyes.

Selective tenotomies and plications were performed on either the nasal or temporal side of vertical rectus muscles, based on the direction of incomitance of vertical strabismus and cyclotorsion. For each direction of horizontally incomitant vertical strabismus or cyclotorsion, there are four procedures to choose from. Figure 1 shows the list of possible procedures for each clinical scenario in patients who are primarily symptomatic from vertical strabismus incomitant in lateral gaze positions. Figure 2 identifies the possible procedures for patients who are primarily symptomatic from excyclotorsion or incyclotorsion. One procedure was chosen from the four choices based on forced duction testing, patient preference, and other concomitant procedures planned during the surgery. In cases of restriction, a selective tenotomy of the restricted muscle was the preferred procedure. In patients with both horizontally incomitant vertical strabismus and cyclotorsion, an effort was made to choose a procedure that would correct both. Finally, in patients with alternating hypertropia or >10° of cyclotorsion, which were thought to be unlikely to resolve with a single partial tenotomy or plication, two of these procedures were performed at the same surgery.

Adjustable small-incision selective tenotomy was performed in a similar fashion in all patients. A fornix, or in some cases a paralimbal, conjunctival incision was made. The muscle to undergo tenotomy was isolated on a muscle hook and cleaned from surrounding connective tissue. A single-armed 6-0 polyglactin 910 suture was woven in the nasal or temporal corner of the insertion of the muscle and the sclera adjacent to the insertion (Figure

3A). The nasal or temporal half of the muscle was then disinserted using Westcott scissors (Figure 3B). The suture was tied in an adjustable fashion using a slip knot (Figure 3C). The conjunctiva was closed with 8-0 polyglactin 910 sutures.

Adjustable small-incision selective plication was also performed in a similar manner in all patients. A fornix, or in some cases a paralimbal, conjunctival incision was made. The muscle to be plicated was isolated on a muscle hook and cleaned from surrounding connective tissue. A single armed 6-0 polyglactin 910 suture was woven in the nasal or temporal half of the muscle at the desired distance posterior to the insertion. The suture was secured and passed through the sclera just anterior to the nasal or temporal insertion of the muscle. The muscle was plicated and the suture was tied in a slip knot. The conjunctiva was closed with 8-0 polyglactin 910 sutures.

Patients underwent adjustment in the clinic on postoperative day one. The goal of adjustment was to eliminate diplopia in primary and lateral gaze positions. The target angle was 1 to 2 of undercorrection of the vertical deviation in primary gaze. If the patient was orthotropic in primary position preoperatively, the goal was to eliminate diplopia in lateral gaze positions without inducing diplopia in primary gaze.

Results

A total of 9 patients (5 females) were included. The mean age at presentation was 64 years (range, 28–78 years). Mean follow-up time was 4.5 months (range, 6 weeks to 10 months). Selective plications were performed on 4 patients, all of whom had horizontally incomitant vertical strabismus and 3 of whom had cyclotorsion measured preoperatively. Selective tenotomies were performed on 5 patients, who had both horizontally incomitant vertical strabismus and cyclotorsion. Two patients underwent surgery with monitored anesthesia care; 7 patients elected to receive general anesthesia. One patient was adjusted postoperatively.

Overall, horizontally incomitant vertical strabismus was successfully corrected in 8 patients (89%), with postoperative vertical alignment within 4 of orthotropia in primary gaze, lateral gaze, and downgaze. Of 8 patients with preoperative cyclotorsion, 4 (50%) were successfully corrected, with $<5^\circ$ of cyclotorsion postoperatively. Of the total 9 patients, 8 (89%) reported resolution of diplopia postoperatively.

Of the 4 patients who underwent selective plication, 3 (75%) had successful correction of horizontally incomitant vertical strabismus. Three of the 4 patients had preoperative cyclotorsion measurements. Of these, 1 patient (33%) had successful correction of cyclotorsion. One patient experienced only slight decrease (2) in cyclotorsion, and 1 patient had worsening of cyclotorsion postoperatively. Diplopia resolved in 3 of the 4 patients (75%).

Five patients underwent selective tenotomy, and all had horizontally incomitant vertical strabismus and cyclotorsion preoperatively. Postoperatively, all 5 patients had successful correction of horizontally incomitant vertical strabismus. Three of 5 patients (60%)

experienced resolution of cyclotorsion, and 2 patients had no change in cyclotorsion postoperatively. All 5 patients (100%) reported resolution of diplopia postoperatively.

Table 1 shows the patient diagnosis, surgery, pre- and postoperative measurements, and presence of diplopia in the 4 patients who underwent adjustable small-incision selective plication. Table 2 lists the same information for the 5 patients who underwent adjustable small incision selective tenotomy.

Discussion

We describe, for the first time, a novel procedure involving selective plication of the nasal or temporal pole of vertical rectus muscles for correction of vertical strabismus incomitant in horizontal gaze positions and cyclotorsion. Additionally, we evaluate the use of selective tenotomy of vertical rectus muscles for the same two indications. Overall, horizontally incomitant vertical strabismus was successfully corrected in 89% of cases, and cyclotorsion was successfully corrected in 50% of cases; 89% of patients reported postoperative resolution of diplopia.

Surgery on one pole of an extraocular muscle may be effective, in part, because of the compartmental nature of some extraocular muscles.^{6,7,15} Demer and colleagues⁶ showed that horizontal rectus muscles exhibit differential innervation to the superior and inferior portions, and selective palsy of the superior compartment of the lateral rectus does not significantly affect contraction of the inferior compartment.¹⁶ Compartmentalization also occurred in the inferior rectus muscle but was not as distinct as for horizontal muscles.⁷ Nonetheless, the independent functioning of extraocular muscle compartments suggests that surgery on one part of the muscle may minimally affect functioning of the rest of the muscle.

Partial tenotomy of vertical rectus muscles was first described by Scott for the correction of small degrees of hypertropia.⁸ Yim and colleagues⁹ showed that partial tenotomy of vertical rectus muscles effectively reduces small degrees of hypertropia in primary position and in the field of action of the tenotomized muscle. Van der Meulen-Schot and colleagues¹⁷ described partial tenotomy of horizontal rectus muscles to correct A and V pattern strabismus. The present study describes for the first time a modification of the procedure involving selective tenotomy of the nasal or temporal fibers of vertical rectus muscles on an adjustable suture and shows that it can be effective in correcting horizontally incomitant vertical strabismus and cyclotorsion in some cases.

Both selective plications and tenotomies proved to be effective in reducing horizontally incomitant vertical strabismus. Vertical deviation was reduced to $<4^\circ$ in primary gaze, lateral gaze, and downgaze positions in all but 1 patient, who had wall-eyed bilateral internuclear ophthalmoplegia (WEBINO) and bilateral oculomotor nerve palsy (case 4 in Table 1). By selectively strengthening (plication) or weakening (tenotomy) the medial or lateral aspect of a vertical rectus muscle, these procedures virtually eliminated incomitance up to 10° . This can have a major functional benefit for strabismic patients, whose quality of

life may be impacted by diplopia in horizontal gaze positions, which can interfere with activities such as driving.

Selective plications and tenotomies successfully corrected cyclotorsion to $<5^\circ$ in 4 of 8 cases (50%) with preoperative cyclotorsion. In 3 of the 4 successful cases, there was no measurable cyclotorsion postoperatively; however, among the unsuccessful cases, there was minimal correction of cyclotorsion, with an average change in cyclotorsion of $<1^\circ$. Thus, the procedures either corrected all or none of the cyclotorsion. Of the 4 patients in whom cyclotorsion was not successfully corrected, 2 had restriction (1 from thyroid eye disease and 1 from prior blepharoplasty), and 1 had severely limited ocular motility from bilateral internuclear ophthalmoplegia and bilateral oculomotor nerve palsy. Additionally, 3 of the 4 patients with no improvement in cyclotorsion had prior strabismus surgery, whereas only 1 of the 4 patients in whom cyclotorsion was corrected had undergone surgery previously. Therefore, it is possible that failure of these procedures to correct cyclotorsion may be related to scar tissue or restriction, either from prior surgeries or a restrictive process such as thyroid eye disease.

There are several well-described procedures to correct cyclotorsion. The most commonly used is the Harada-Ito procedure to correct exocyclotorsion, in which the anterior fibers of the superior oblique are advanced.² This procedure may be modified by placing the tendon on an adjustable suture.¹⁸ Incyclotorsion may be corrected by selective tenectomy of the anterior fibers of the superior oblique.⁵ Horizontal transposition of vertical recti may also be used to correct cyclotorsion.^{3,4} However, surgery on the superior oblique may not be possible in some cases of congenitally absent or anomalous superior oblique tendons. Transposition of vertical rectus muscles is not generally performed in an adjustable manner and may induce changes in horizontal alignment, resulting in A- or V-pattern strabismus. Surgery on multiple rectus muscles may risk anterior segment ischemia, whereas anterior ciliary circulation may be partially spared with selective tenotomy or plication.¹² For these reasons, it may be desirable in some situations to consider selective tenotomy or plication for correction of cyclotorsion as these procedures can be performed with adjustable sutures, less risk of anterior segment ischemia, and under topical anesthesia, in some cases.

This study has the limitations of a retrospective review. A single surgical technique was used in a small sample of patients with a limited follow-up time. Some patients underwent concomitant procedures on vertical rectus or oblique muscles, which could affect postoperative vertical deviation and cyclotorsion measurements. Additionally, there was no control group.

In conclusion, we describe the use of adjustable small incision selective plication and tenotomy for vertical strabismus incomitant in horizontal gaze positions and cyclotorsion. Both procedures were effective in eliminating horizontally incomitant vertical strabismus. There was an all-or-nothing effect on cyclotorsion, and patients with prior strabismus surgery or restrictive strabismus were more likely to experience no improvement in cyclotorsion. Advantages of these surgeries include ciliary vessel sparing and the ability to perform them in an adjustable manner, and in some cases, under topical anesthesia. Further

studies with more patients and longer follow-up are necessary to evaluate the long-term effectiveness of these surgeries.

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FIG 1.

Flowchart for surgical planning of adjustable small incision selective tenotomy or plication in patients primarily symptomatic from vertical strabismus incomitant in lateral gaze positions. *LIR*, left inferior rectus; *LSR*, left superior rectus; *RIR*, right inferior rectus; *RSR*, right superior rectus.

FIG 2.

Flowchart for surgical planning of adjustable small incision selective tenotomy or plication in patients primarily symptomatic from cyclotorsion. *LIR*, left inferior rectus; *LSR*, left superior rectus; *RIR*, right inferior rectus; *RSR*, right superior rectus.

FIG 3.

Adjustable small-incision selective tenotomy performed on the temporal side of the inferior rectus muscle. A, The inferior rectus muscle was isolated on a muscle hook and a single-armed 6-0 polyglactin 910 suture was woven in the temporal corner of the insertion and secured (arrow). The suture was then passed through the sclera adjacent to the insertion. B, The temporal half of the muscle was disinserted (arrow). C, The suture was tied in an adjustable fashion using a slip knot.

Characteristics and pre- and postoperative measurements of 4 patients who underwent small-incision selective plication^a

Table 1

Diagnosis	Case 1 (F, 71 years)		Case 2 (F, 78 years)		Case 3 (F, 60 years)		Case 4 (M, 70 years)	
	Asymmetric sagging eye syndrome	Parkinson disease with right inferior rectus underaction	Thyroid eye disease	WEBINO, bilateral CN 3 palsy				
Preoperative alignment								
Primary position	3 PD RHT	25 PD RHT 4 PD XT	8 to 12 PD LHT	8 PD LHT				
Lateral gaze positions	Right 1 PD RHT 2 PD ET Ortho	Right 25 PD RHT 6 PD XT 18 PD RHT 4 PD XT	Left 14 PD RHT 4 PD XT 22 PD LHT 2 PD ET	Right 6 PD LHT 4–6 PD XT Unable	Left 20 PD LHT 2 PD ET	Right 5 PD LHT 2 PD ET	Left 6 PD LHT 2 PD ET	
Downgaze								
Preop torsion	DMR testing not performed; no objective cyclotorsion	5 deg incyclotorsion	8 deg excyclotorsion	11 deg incyclotorsion				
Preop stereopsis, arcsec	50	50 in upgaze	50	400				
Preop diplopia	Yes	Yes	Yes	Yes				
Surgery	LSR 3 mm temporal plication on adjustable	1 RSR recession 5.5 mm on adjustable 2 RIR 3.5 mm temporal plication on adjustable	1 LIR 3 mm nasal plication on adjustable 2 RIR recession 4 mm on adjustable	1 LIR 7 mm temporal plication 2 RIR 5 mm temporal plication 3 bilateral SO anterior tenectomy				
Postoperative alignment								
Primary position	Ortho	3 PD RHT 6 PD X	Ortho	5 PD LHT, 6 PD X(T)				
Lateral gaze positions	Right Ortho	Right 4 PD RHT 6 PD X	Left 3 PD RHT 6 PD X	Right RXT 18 PD 16 PD LHT 14 PD X(T) 25 PD RXT	Left 2 PD LHT 2 PD ET Ortho	Right RXT 18 PD 16 PD LHT 14 PD X(T) 25 PD RXT	Left 6 PD LHT 2 PD ET Ortho	
Downgaze	Ortho	3 PD RHT 6 PD X	Ortho					
Postop torsion	Not measured	3 deg excyclotorsion	6 deg excyclotorsion	15 deg excyclotorsion				
Postop stereopsis, arcsec	40	50 in primary position	40	800				

Diagnosis	Case 1 (F, 71 years)		Case 2 (F, 78 years)		Case 3 (F, 60 years)		Case 4 (M, 70 years)	
	Asymmetric sagging eye syndrome	Parkinson disease with right inferior rectus underaction	Thyroid eye disease	WEBINO, bilateral CN 3 palsy				
Successful correction								
Horizontally incomitant vertical strabismus	Yes	Yes	Yes	No				
Cyclotorsion	N/A	Yes	No	No				
Postop diplopia	No	No	No	Yes				
Follow-up time	6 weeks	8 months	2 months	10 months				

CN, cranial nerve; Deg, degrees; DMR, double Maddox rod; ET, esotropia; LHT, left hypertropia; LIR, left inferior rectus; LSR, left superior rectus; Ortho, orthotropic; PD, prism diopter; Postop, postoperative; Preop, preoperative; RHT, right hypertropia; RIR, right inferior rectus; RSR, right superior rectus; SO, superior oblique; WEBINO, wall-based internuclear ophthalmoplegia; X, exophoria; XT, exotropia; X(T), intermittent exotropia.

^a Successful correction of horizontally incomitant vertical strabismus defined as postoperative vertical deviation within 4 PD of orthotropia in primary gaze, lateral gazes, and downgaze; Successful correction of cyclotorsion defined as <5 deg of torsion by double Maddox rod testing postoperatively.

Characteristics and pre- and postoperative measurements of 5 patients who underwent adjustable small incision selective tenotomy^d

Table 2

Diagnosis	Case 6 (M, 72 years)		Case 7 (F, 75 years)		Case 8 (F, 60 years)		Case 9 (M, 28 years)		Case 10 (M, 58 years)	
	Bilateral CN 4 palsy		Asymmetric sagging eye syndrome		Asymmetric sagging eye syndrome		Left CN 4 palsy		Right eye upgaze restriction after blepharoplasty	
Preoperative alignment										
Primary position	2 PD RHT 4 PD ET		3 PD RHT 10 PD ET		2 PD LHT 6 PD ET		Ortho		2 PD LHT 2 PD ET	
Lateral gaze positions	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
	2 PD LHT	2 PD RHT	12 PD ET	4 PD RHT	3 PD LHT	1 PD LHT	5 PD LHT	Ortho	3 PD LHT	12 PD LHT
	flick ET	flick ET		14 PD ET	6 PD ET	8 PD ET			4 PD ET	4 PD ET
Downgaze	Flick ET		3 PD RHT 14 PD ET		Flick LHT 10 PD ET		Ortho		2 PD E	
Preoptorsion	5 deg excyclotorsion		10 deg excyclotorsion		9 deg excyclotorsion		5 deg excyclotorsion		7.5 deg excyclotorsion	
Preop stereopsis, arcsec	400		100		80		40		3000	
Preop diplopia	Yes		Yes		Yes		Yes		Yes	
Surgery	Bilateral IR 50% temporal tenotomy on adjustable		1 LIR 50% temporal tenotomy on adjustable 2 LLR resection 5 mm		1 RIR 50% temporal tenotomy on adjustable 2 BLR resection 2.5 mm		RIR 50% temporal tenotomy on adjustable		1 RIR 50% temporal tenotomy on adjustable 2 LSR resection 4.0 mm with temporal transposition 3 LLR 3.5 mm plication	
Postoperative alignment										
Primary position	8 PD E(T)		Ortho		Ortho		Ortho		Ortho	
Lateral gaze positions	Right	Left	Right	Right	Right	Left	Right	Left	Right	Left
	4 PD E(T)	4 PD E(T)	2 PD ET	Ortho	Ortho	Ortho	Ortho	Ortho	1 PD LHT	1 PD LHT
Downgaze	2 PD E		2 PD ET		Ortho		Ortho		2 PD E Flick E	
Postop torsion	0 deg		10 deg excyclotorsion		0 deg		0 deg		8 deg excyclotorsion	
Postop stereopsis, arcsec	200		100		200		40		200	

	Case 6 (M, 72 years)	Case 7 (F, 75 years)	Case 8 (F, 60 years)	Case 9 (M, 28 years)	Case 10 (M, 58 years)
Diagnosis	Bilateral CN 4 palsy	Asymmetric sagging eye syndrome	Asymmetric sagging eye syndrome	Left CN 4 palsy	Right eye upgaze restriction after blepharoplasty
Successful correction					
Horizontally incomitant vertical strabismus	Yes	Yes	Yes	Yes	Yes
Cyclotorsion	Yes	No	Yes	Yes	No
Postoperative diplopia	No	No	No	No	No
Follow-up time, months	10	7	2	4	2

BLR, bilateral lateral rectus; *CN*, cranial nerve; *Deg*, degrees; *E*, esophoria; *ET*, esotropia; *E(T)*, intermittent esotropia; *IR*, inferior rectus; *LHT*, left hypertropia; *LIR*, left inferior rectus; *LLR*, left lateral rectus; *LSR*, left superior rectus; *Ortho*, orthotropic; *PD*, prism diopter; *Postop*, postoperative; *Preop*, preoperative; *RIR*, right inferior rectus.

^aSuccessful correction of horizontally incomitant vertical strabismus defined as postoperative vertical deviation within 4 PD of orthotropia in primary gaze, lateral gazes, and downgaze; successful correction of cyclotorsion defined as <5 deg of torsion by double Maddox rod testing postoperatively.