

Augmented Lateral Rectus Muscle Recession for treatment of Infantile Exotropia

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Research Article

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Abstract

Background: For the majority of the patients, surgical treatment of primary infantile exotropia (PIE) with large exodeviation angles of more than 50 prism diopters (PD) is not satisfactory. We evaluate the effectiveness of augmented lateral rectus (LR) muscle recession in treatment of congenital exotropia with large deviation angles.

Methods: A retrospective analysis was performed for 25 patients with congenital exotropia who had at least 60 prism diopters (PD). Augmented LR recession was performed using a hemi hang-back technique. The ocular alignment, ocular motility and binocular vision were evaluated pre- and postoperatively.

Results: There were 14 male and 11 female affected individuals with congenital exotropia included in this study, with a mean age of (3.92±2.02) years (range, 1 - 7 years). The average exodeviation angle was (68.0±8.78) PD (range, 60 - 80 PD) preoperatively. All patients underwent bilateral LR recession, of whom 3 patients underwent bilateral inferior oblique muscle transposition in the same operation. The mean surgical dosage was (11.08±1.19) mm for each lateral rectus muscle. All patients did not have abduction deficiency after a large amount of lateral rectus recession. 21 of 25 patients (84.0%) acquired orthophoria at the primary gaze position at the final visit. 13 patients obtained binocular vision.

Conclusions: Augmented bilateral LR recession is an effective and safe surgical procedure for treatment of congenital exotropia with large deviation angles.

Introduction

Congenital exotropia refers to the onset of exodeviation within 1 year after birth, and it is broadly classified as intermittent and constant strabismus based on the clinical features[1]. Constant exotropia is associated with neurological, ocular, or craniofacial anomalies, but may also present in healthy infants, a condition referred to as primary infantile exotropia (PIE) [2–4].

The prevalence of PIE is reported to be lower, affecting 1 in 30,000 infants in the general population[5]. PIE is characterized by a large exodeviation in the primary eye position, and is usually combined with oblique muscle overaction, A-V pattern, and disassociated vertical deviation (DVD). Patients with PIE may fixate alternatively with each eye and have very poor fusions.

For the majority of the patients, surgical treatment significantly improves ocular alignment, by providing an opportunity to establish the binocular vision and improve the cosmetic appearance of the patient. However, the surgical outcome is not satisfactory, especially for patients with large exodeviation angles of more than 50 prism diopters (PD) [6, 7]. Therefore, in this study, we evaluate the effectiveness of augmented bilateral lateral rectus muscle recessions for the treatment of PIE \geq 60 PD.

Materials And Methods

The medical records of PIE patients who underwent strabismus surgery between July 2015 to September 2019 were retrospectively reviewed. For eligibility, the patients had to meet the following criteria: 1) onset of exotropia within 1 year after birth; 2) constant exotropia at distance and near; 3) ≥ 60 PD exodeviation angles at distance and/or near measured by the prism and alternate cover test (PACT) or by the Krimsky test; 4) normal anterior segment and fundus; (5) at least 18 months' follow-up following surgery. Patients were excluded if there had any congenital anomalies, neurologic disorders, restrictive or paralytic strabismus, intermittent exotropia, or prior strabismus surgery.

This study was approved by the Ethics Committee of Beijing Children's Hospital, and adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained from all the children's parents.

Ocular Examination

All patients underwent anterior segment and fundus examinations. Visual acuity was evaluated using the Teller Card for younger children and the Snellen chart for older children. Refractive status was evaluated using a cycloplegic retinoscopy with 1% tropicamide. Spherical equivalents (SE) were determined through a handheld autorefractor (Welch Allyn VS100, China) and measured in diopters (D).

Ocular movement and ocular alignment were evaluated pre- and post-operatively. The deviation angle was measured using the prism and alternate cover tests at near (33cm) and distance (6m) on accommodative target for children who cooperated very well. The Krimsky method was used as an alternative for patients whom PACT could not be accurately used. The preferred dominant eye was assessed with a hole-in-the-card test. Binocular sensory status was evaluated with the Worth 4 dot test or the Bagolini striated glasses at near and distance, and by stereoacuity assessment at near using the Randot Preschool Stereoacuity test (Stereo Optical Co., Inc., Chicago, IL).

Surgical procedures and postoperative management

A large amount of recession was performed for bilateral lateral rectus (LR) using a Hemi hang-back technique[8]. Surgical dosage was calculated according to a 9 mm recession for 50 PD and augmented 1mm recession bilaterally for every 10 PD increments in the basement of 50 PD. If the patient still had an exotropia of more than 15° (≈ 25 PD -30PD) estimated by the Hisberg light reflex method under general anesthesia, the amount of LR recessions was augmented further by 1 ~ 2 mm bilaterally. Besides, myectomy was performed for the overacted inferior oblique muscles, and anterior transposition of the muscles was used for the DVD during the operation. All surgeries were performed under general anesthesia by the same surgeon.

The follow-up was scheduled regularly at postoperative day 1, 1 week, 1 month, and followed by two-month intervals until 18 months. Ocular alignment and binocular sensory status were examined at each visit. Surgical success was defined as the distance deviation in the primary gaze to be between esophoria/tropia of < 6 PD and exophoria/tropia of < 10 PD. Recurrence was defined as ≥ 10 exotropia

and overcorrection was defined as ≥ 6 PD esotropia. Stereoacuity of ≤ 100 seconds of arc was considered as good. Alternate full-time patching was used for postoperative overcorrection. Orthoptic treatment was performed postoperatively for patients with exophoria or residual exotropia. Re-operation was considered for patients with consecutive esotropia or recurrent exotropia ≥ 20 PD persisting for more than half a year postoperatively.

Results

Twenty-five patients met the inclusion criteria, 14 males (56%) and 11 females (44%) (Table 1). The mean age at the time of surgery was 3.92 ± 2.02 years (range, 1 - 7 years). The mean exodeviation angle was 68.0 ± 8.78 PD (range, 60 - 80 PD) preoperatively. None of the patients had binocular vision and stereoacuity. All patients underwent bilateral LR recession, out of which 3 patients underwent bilateral inferior oblique muscle transposition in the same operation. The mean surgical dosage was 11.08 ± 1.19 mm for each lateral rectus muscle.

Out of the 25 patients, 20 patients achieved an orthotropia at the primary gaze position, 3 patients had an exophoria of less than 8 PD, and 2 patients had a residual exotropia of more than 15 PD on a postoperative day 1. All five patients with exophoria or residual exotropia accepted orthoptic treatment from postoperative 1 month. At the final visit (18 months postoperatively), twenty-one patients had achieved successful motor alignment. The surgical success rate was 84.0% (21/25) based on the previously described motor criteria. Four patients with recurrent exodeviation achieved a cosmetic appearance change. All patients' sensory status was improved, 13 patients acquired binocular vision, and two patients had a stereoacuity of 200 seconds of arc. None of the patients experienced abduction deficiency after a sufficient amount of lateral rectus recession.

Discussion

Surgical treatment for congenital or primary infantile exotropia is the most difficult challenge for strabismus surgeons. The main challenge is to precisely evaluate the infants' ocular alignment, ocular movement, as well as deviation angles (especially at distance) before the operation since the majority of the infants, are not cooperative. Since the difference between the near and distance deviation angles is not easily determined, the surgical procedure, based on the traditional exotropia classification, is also difficult to choose. Besides, the effectiveness of the adjustable suture technique is also limited due to the infants' noncompliance.

Von Noorden suggested a surgical dosage of bilateral 7 mm LR recession and resection of one medial rectus for exotropia ≥ 50 PD and found adjustable sutures to be helpful in patients with large-angle exotropia [9, 10]. However, cooperation is a prerequisite for the adjustable suture technique. For a majority of infants above the age of 2-years, compliance is the main problem. Besides, abduction deficiency and incomitance are very common after a sufficient amount of MR resection.

In this study, an augmented LR recession was used for all patients with a large deviation angle of more than 60 PD. The mean surgical dosage used was 11.08 ± 1.19 mm for each lateral rectus muscle. No patients reported abduction deficiency after a large amount of LR recession. The surgical success rate was 84.0%, and some patients acquired binocular single vision postoperatively. All patients had their appearance cosmetically improved.

Compared with the traditional method, an augmented LR recession was found to spare at least one horizontal muscle in the treatment of large exodeviation. Therefore, augmented LR recession is beneficial for patients with DVD undergoing vertical rectus muscle surgery since it prevents the occurrence of anterior ischemia on an eye with a history of two horizontal recti surgery. Although we cannot exclude the possibility of the occurrence of consecutive esotropia due to the limited number of cases included in this study, based on the current findings, there is minimal chance of developing consecutive esotropia after bilateral augmented LR recession. Therefore, augmented LR recession is an important strategy which prevents amblyopia from developing and establishing of binocular vision. There were some under-corrective or recurrent exotropia cases reported in this study, however, more than 80% of the patients achieved ocular alignment. Besides, the success rate of the augmented LR recession was higher than previously reported [11–13]. Conversely, even with the recurrence of exotropia, there is an opportunity to operate using the two untouched medial rectus muscles.

Conclusions

The effectiveness of augmented LR recession on the surgical treatment of PIE remains to be further elucidated. Probably it is similar to surgical treatment for infantile esotropia, large recession of the tight muscles would be more effective than the recession-resection procedure[14]. Compared with the medial rectus muscle, LR has a longer arc of contact and more connective fascia with the surrounding tissues such as inferior oblique. Besides, a simple large recession results in abduction deficiency even though the recession of more than 10 mm according to our observations. In summary, the augmented bilateral LR recession is an effective and safe surgical procedure for the treatment of congenital exotropia with a large deviation angle of more than 60 PD.

Declarations

Conflicts of interest: none

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Author contributions:

Lijuan Huang : Formal analysis and investigation; Writing - original draft preparation.

Ningdong Li: Conceptualization; Methodology; Writing - review and editing; Funding acquisition; Supervision.

All authors read and approved the final manuscript.

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Tables

Table 1 Clinical data

Case (#)	Age (years)	D/N PR (PD)	BV PR	Dosage (BLR,mm)	D/N PO (PD)	BV/S PO
1	5	-65/-70	-	11	-12/-14	+/-
2	1	/-70	NA	13	+4/+2	NA
3	4	-60/-60	-	10	-4/-6	+/-
4	7	-60/-70	-	10	-2/-8	-/-
5	3	-60/-65	-	10	-2/-4	+ /800"
6	2	-70/-70	NA	11	0/-4	+ /200"
7	5	-60/-65	-	11	+2/-2	+ /800"
8	3	-65/-70	NA	11	0/-6	+ /600"
9	2	/-80	NA	13	-2/-8	+/-
10	7	-60/-70	-	10	+4/-6	-/-
11	7	-60/-65	-	10	+2/-6	+/-
12	1	/-70	NA	13	+2/0	NA
13	3	-80/-80	NA	13	-15/-15	+ /200"
14	2	-60/-70	NA	10	+2/-8	NA
15	5	-60/-70	-	10	-6/-8	-/-
16	7	-80/-80	-	13	-10/-10	-/-
17	6	-70/-70	-	11	-10/-14	-/-
18	1	/-80	NA	12	+2/-8	NA
19	2	-60/-65	NA	10	0/-6	+ /400"
20	4	-60/-70	-	10	-2/-8	+/-
21	4	-60/-70	-	10	-4/-8	-/-
22	4	-60/-70	-	11	0/-4	+/-
23	2	-60/-65	NA	10	-2/-6	NA
24	6	-70/-80	-	13	+2/-4	+/-
25	5	-78/-60	-	13	-6/0	-/-

PD: Prism diopters; BLR: Bilateral lateral rectus recession; NA: Not applicable;

Age: Age of operation; D/N PR: Preoperative deviation angles at distance/near;

D/N PO: Postoperative deviation angles at distance/near at final visit; BV PR: Preoperative binocular vision; BV/S PO: Postoperative binocular vision/ stereoacuity at final visit; Dosage: Surgical dosage; +: Yes; - : No.