



## Long-term outcomes of three-muscles surgery for very large-angle constant exotropia ( $\geq 5$ years of follow-up)

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### To the Editor:

Very large-angle exotropia severely affects the patient's binocular vision and appearance [1]. We tracked the results of very large-angle constant exotropia ( $\geq 120$  PD) with only three muscles procedure for more than 5 years after surgery in order to evaluate the long-term efficacy.

This study was approved by Shanxi Province Eye Hospital Ethics Committee and followed up the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants. 21 patients (10 males and 11 females) with constant exotropia ( $\geq 120$  PD) were collected in Shanxi Province Eye Hospital in China from May 2011 to December 2013. Patients with paralytic strabismus, a history of prior strabismus surgery were excluded. All patients had best-corrected visual acuity 6/9 in each eye. The measurement method is the same as the one we used before [2]. The mean age at surgery was 33.57 years old (range 20–58, SD 9.69 years old). The mean preoperative exodeviation was 133.10 PD (SD 13.08 PD) at near and 131.67 PD (SD 12.78 PD) at distance. The mean follow-up period was 74.67 months (range 61–104, SD 12.61 months).

All operations were performed under topical anaesthesia by one surgeon (JHL). The detailed surgical method has been mentioned in our previous article [2]. The mean surgical dosage is shown in the following table (Table 1).

The distance from the temporal limbus to the lateral canthus (mm) was used to assess the patient's postoperative abduction limit (mm) when the patient reached the maximum abduction.

Surgery consisted of mean lateral rectus recession of 13.19 mm (range 10–15 mm, SD 1.69 mm) on fixing eye

and mean lateral rectus recession of 11.29 mm (range 10–13 mm, SD 1.10 mm) combined with mean medial rectus resection of 7.90 mm (range 6–9 mm, SD 0.62 mm) on nonfixing eye. On the last visit, the mean residual exodeviation was 5.71 PD (range 3–20 PD, SD 6.13 PD) at near and 2.38 PD (range 3–15 PD, SD 4.12 PD) at distance. 18 of the 21 cases (85.71%) were successfully aligned. Three patients with residual exodeviations (10–20 PD) were satisfied with their current cosmetic appearances and did not undergo the secondary surgery. The mean deficit of lateral rectus abduction was  $-0.79$  mm (SD 0.96 mm) in the fixing eye and  $-1.64$  mm (SD 1.13 mm) in the nonfixing eye at the last follow-up. No patient complained of limited symptoms of abduction. None of the patients had diplopia in primary gaze postoperatively. Three patients had side diplopia on extreme lateral gazes. The side diplopia resolved in 3 weeks after surgery.

The main problem of large lateral rectus recession is abduction deficit [3, 4]. The limitation of abduction resulting from the lateral rectus supramaximal recession procedure was notable immediately after surgery but improved quickly (Fig. 1). We suppose that postoperative abduction is related to two oblique muscles, the connective tissue (including pulley) around the lateral rectus muscle and the recessed lateral rectus muscle that was overaction preoperatively. The corneal diameter minus the distance from the nasal limbus to the lateral canthus (mm) was used to assess the patient's preoperative maximum abduction magnitude (mm) when the patient reached the maximum abduction. We found six patients' maximum abduction magnitude were +3 to +4 mm, which means that the lateral rectus was overaction preoperatively. We did not examine the preoperative maximum abduction magnitude for all patients in our group since we didn't focus on lateral rectus muscle overaction until the last six patients. This is the limit of our study.

In conclusion, the three-muscle surgery has a good long-term result for patients with very large-angle exotropia. More than 85% of patients successfully restored long-term

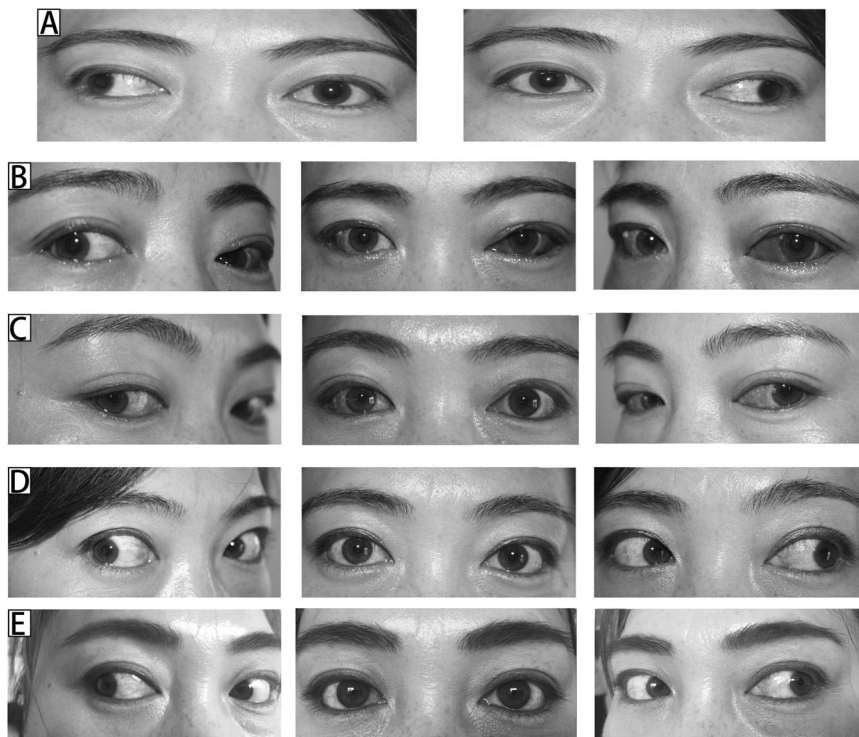
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**Table 1** Surgery dose and average preoperative and postoperative results for patients with very large-angle exotropia.

Pre-op dev, PD	Number of cases	Surgery in fixing eye, mm		Surgery in nonfixing eye, mm		Post-op dev, PD		Abduction deficit, mm		Follow-up, months
		LR recession		LR recession	MR resection	Near	Distance	Fixing eye	Nonfixing eye	
-155	1	15.00		13.00	8.00	-9.00	-3.00	0.00	-1.00	86.00
-150	4	15.00		12.50	8.50	-6.00	-4.25	-0.38	-1.13	78.75
-140	5	14.40		12.00	7.60	-4.40	-1.80	-0.40	-1.20	68.60
-130	3	12.33		10.67	8.00	-9.00	-3.33	-1.67	-2.67	70.67
-120	8	11.63		10.25	7.75	-4.75	-1.38	-1.00	-1.88	76.50

*Pre-op dev* preoperative deviation, *Post-op dev* postoperative deviation, *LR* lateral rectus muscle, *MR* medial rectus muscle, *PD* prism Dioptre.



**Fig. 1 Pre- and post-operative photos of a patient with 150PD constant exotropia.** **A** Preoperative photos: Clinical photographs of 43-year-old female patient with exodeviation of 150 PD before surgery. Right lateral rectus recession of 15 mm, left lateral rectus recession of 12 mm and left medial rectus resection of 8 mm were performed. **B** Photos taken 1 day after surgery: Alignment in primary position alignment was successfully restored; the deficit of lateral rectus muscle was 2 mm in right eye and 3 mm in left eye at day 1 after surgery.

**C** Photos taken 3 weeks after surgery: The lateral rectus was almost full on right eye and the deficit of lateral rectus was 1 mm in left eye in 3 weeks after surgery. **D** Photos taken 7 months after surgery: The lateral rectus muscle was almost full bilaterally in 7 months after surgery. **E** Photos taken 93 months after surgery: The lateral rectus muscle was almost full bilaterally in 93 months after surgery. Panels A–D were published in JAAPOS 2013 (J AAPOS 2013;17:578–581).

alignment at primary gaze, and none of the patients cause clinical symptoms of abduction deficit.

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### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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