



Clinical investigation of surgery for intermittent exotropia*

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Received Dec. 12, 2007; revision accepted Mar. 4, 2008

Abstract: Objective: To investigate the time and postoperative binocular vision of strabismus surgery for children with intermittent exotropia (X(T)). Methods: A retrospective investigation was conducted in 80 child patients with intermittent exotropia. Pre- and postoperative angles of deviation fixating at near (33 cm) and distant targets (6 m) were measured with the prolonged alternate cover testing. The binocular function was assessed with synoptophore. Twenty-one patients took the postoperative synoptophore exercise. Results: (1) A week after surgery, 96.2% of the 80 patients had binocular normotopia, while a year after surgery, 91.3% of the 80 patients had binocular normotopia; (2) Preoperatively, 58 patients had near stereoacuity, while postoperatively, 72 patients achieved near stereoacuity ($P<0.05$); (3) Preoperatively, 64 patients had Grade I for the synoptophore evaluation and postoperatively, 76 patients achieved Grade I. Meanwhile, 55 patients had Grade II preoperatively and 72 achieved Grade II postoperatively. For Grade III, there were 49 patients preoperatively and 64 patients postoperatively ($P<0.05$); (4) Patients of 5~8 years old had a significantly better recovery rate of binocular vision than those of 9~18 years old ($P<0.05$); (5) Patients taking postoperative synoptophore exercise had a better binocular vision than those taking no exercise ($P<0.05$). Conclusions: (1) Strabismus surgery can help to preserve or restore the binocular vision for intermittent exotropia; (2) Receiving the surgery at young ages may develop better postoperative binocular vision; (3) The postoperative synoptophore exercise can help to restore the binocular vision.

Key words: Intermittent exotropia (X(T)), Surgery, Binocular vision

doi:10.1631/jzus.B0720007

Document code: A

CLC number: R77

INTRODUCTION

Intermittent exotropia (X(T)) is a common form of childhood exotropia, accounting for about 50%~90% of all the exotropia and affecting about 1% of the general population (Govindan *et al.*, 2005; Mohny and Huffaker, 2003; Yu *et al.*, 2002; Nusz *et al.*, 2006). Although common, the natural history of intermittent exotropia remains obscure due to lack of longitudinal prospective studies and only a few retrospective studies of untreated intermittent exotropia (von Noorden and Campos, 2002; Chia *et al.*, 2005). It is usually preceded by a stage of exophoria, and the deviation is most noticeable when children are tired, sick or after long time near reading task. Intermittent

exotropia is an exodeviation intermittently controlled by fusional mechanisms. Patients may exhibit normal retinal correspondence when both eyes are aligned, but abnormal retinal correspondence on sensory testing if one eye is deviated. Strabismus surgery is thought to be an effective method for the treatment of intermittent exotropia (Maruo *et al.*, 2001). The goal of the surgery for intermittent exotropia is to restore alignment and preserve or restore binocular function. In this study, we carried out a follow-up investigation of postoperative binocular function in 80 children with intermittent exotropia.

PATIENTS AND METHODS

Cases

A retrospective study was conducted in 80 patients with intermittent exotropia (37 males and 43

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* Project supported by the National Natural Science Foundation of China (No. 30600693) and Department of Education of Zhejiang Province (No. 20030236), China

females) recruited from the clinic of the Department of Ophthalmology, the First Affiliated Hospital, School of Medicine, Zhejiang University, China. The patients had an average age of 8.9 years (ranging 5~18 years) at the time of surgery and completed one-year follow-up. The entry criteria were normotopia with scattered outward deviation (more than 20 prism diopter (PD) or 20 Δ) for some time every day. Informed consent was obtained from their guardians. The baseline demographics of the patients are listed in Table 1.

Table 1 Baseline demographics of 80 patients

		Values*
Age (years)		8.9 (5~18)
Gender	Male	n=37
	Female	n=43
BCVA		0.78 (0.5~1.0)
MSE (diopter)		+0.50 (-2.25~+3.00)
Deviation angle (Δ)	At near targets	52.6 (20~90)
	At distant targets	59.7 (20~95)

BCVA: Best corrected visual; MSE: Mean spherical equivalent;

* Data are expressed as mean (range)

Examination

All patients received detailed enquiry regarding the disease history and completed ophthalmologic examination before operation. Pre- and postoperative angles of deviation fixating at near (33 cm) and distant targets (6 m) were measured by the prolonged alternate cover testing. If significant angle variability or a significant distant/near discrepancy was observed after prolonged alternate cover testing, a patch test (patching the eye for 30 min) would be indicated. Bifixation was examined with synoptophore and near stereoacuity was assessed with Titmus chart.

Operation

According to the Duane classification system, divergence excess type was treated with bilateral lateral rectus muscle recessions. Simulated divergence excess and basic types were treated with unilateral lateral rectus muscle recession and medial rectus muscle resection, and convergence insufficiency type was treated with bilateral medial rectus muscle resections. Concomitant A- and V-patterns

would also be corrected. The surgery was performed for the largest deviation that can be documented consistently.

Synoptophore exercise

Twenty-one patients took the daily synoptophore exercise at least for 4 weeks postoperatively. Every week all patients underwent the daily exercise for 5 d.

RESULTS

1. Among the 80 patients, 49 had Grade III visual function (61.3%), whereas 31 did not have complete function (38.7%).

2. A week after surgery, 77 out of 80 patients had binocular normotopia, including 65 within the range of 0~+5 Δ and 12 ranging -2 Δ ~-6 Δ being of under-correction, and the remaining 3 ranging -10 Δ ~-14 Δ were of under-correction. At the end of one-year follow-up after surgery, 73 patients had binocular normotopia (91.3%), of whom 28 ranged 0~+5 Δ and 45 ranged -2 Δ ~-6 Δ , and the remaining 7 of more than -10 Δ had under-correction.

3. Preoperatively, 58 patients had near stereoacuity, while postoperatively, 72 achieved near stereoacuity. The surgery enhanced near stereoacuity significantly ($P<0.05$).

4. Preoperatively, 64 patients had Grade I synoptophore function, while postoperatively, 76 achieved Grade I ($P<0.05$). Fifty-five patients had preoperative Grade II synoptophore evaluation and 72 achieved Grade II postoperatively ($P<0.05$). Forty-nine patients had Grade III, whereas 64 achieved Grade III postoperatively ($P<0.05$).

5. Pre- and postoperative bifixation results for different age stages are listed in Table 2. There was statistically significant difference for the recovery rate of binocular function between the two groups of different age stages ($P<0.05$), suggesting that earlier surgery could improve the recovery of bifixation.

6. Among the 21 patients without complete Grade III function and taking the synoptophore exercise postoperatively, 15 achieved bifixation (71.4%), whereas only 4 out of 10 (40%) who did not take the synoptophore exercise postoperatively achieved bifixation ($P>0.05$).

Table 2 Pre- and postoperative bifixation results of different age stages

Subject group		Number of the patients			
		None	GI	GII	GIII
5~8 years (n=45)	Preoperative	4	41	38	37
	Postoperative	1	44	43	42
9~18 years (n=35)	Preoperative	12	23	17	12
	Postoperative	3	32	29	22

GI, GII, GIII: Grade I, Grade II, Grade III

DISCUSSION

Intermittent exotropia is the most common type of exodeviation and usually first observed in early childhood by parents. The deviation is noticeable when the child is tired, sick, sleepy or scatterbrained. Adult patients may manifest exodeviation after imbibing alcoholic beverages or taking sedatives. In some cases, an exophoria can progress to an intermittent exotropia that eventually become constant exotropia. Such deviation usually occurs first at distance, but later at near fixation.

As the onset period (when patients are 3~6 years old) of intermittent exotropia is the period of visual function maturing for children, the binocular function is hence often influenced. As a rule during the phoric phase of intermittent exotropia, the eyes are perfectly aligned and the patient will have bifoveal fusion with excellent stereoacuity ranging between 40 and 60 arc second. During the tropia phase when the exotropia is manifest, most patients will show large regional suppression of the temporal retina and anomalous retinal correspondence. A minority of patients with intermittent exotropia may have the monofixation syndrome and do not develop normal bifoveal fixation with high grade of stereopsis. Rarely, some patients may even have a significant amblyopia. Patients with late onset exotropia after ages of 6~7 years may experience diplopia because the exotropia occurs after the loss of plasticity that allows suppression. One symptom that deserves a special comment is closure of one eye in bright sunlight. Bright sunlight dazzles the retina so that fusion is somehow disrupted, causing the deviation to become manifest, and resulting in the closure of one eye in order to avoid diplopia and confusion.

Without any appropriate intervention, few in-

termittent exotropia can be improved by itself. Intermittent exotropia could progress to constant exotropia or keep stable (Rutstein and Corliss, 2003). The main etiology is explained to be abnormal anatomy, fusional control lost and/or convergence insufficiency. It is generally considered that the lens therapy is insufficient for myopia with intermittent exotropia. Strabismus affects stereoacuity development most, as its onset period is just around the key phase of bifixation development. The earlier the strabismus happens, the worse the prognosis of stereoacuity becomes. Timely surgical therapy can help to restore and enhance binocular function (Figueira and Hing, 2006). The goal of strabismus surgery for intermittent exotropia is both appearance and binocular function.

However, the optimal time of surgery for intermittent exotropia remains unclear. The critical point is the postoperative stereoacuity establishment. Currently, most ophthalmological workers believe that early surgery for children is indicated to prevent progressing to constant exotropia and restore the bifixation, whereas for most adult patients, surgery can only help to achieve normotopia, but not bifixation. Abroms *et al.*(2001) and Lou *et al.*(2005) have proposed that patients may achieve superior sensory outcome with motor realignment before age 7 or less than 5 years of strabismus duration. Others hold that the surgery needs to be postponed for several years because intermittent exotropia patients can still keep intermittent normotopia and bifixation could hence be obtained; not all intermittent exotropia is progressive. In some cases, the deviation may remain stable for many years, whereas in a few cases, it may even be improved. Nevertheless, some researchers (Simmon *et al.*, 2002; Hutchinson, 2001) thought that patients might easily achieve binocular function if operated after age 7 and over 5 years of strabismus duration. In our study, fusional control loss evaluated by preoperative synoptophore was found to appear early and significantly. In intermittent exotropia, one important indication for therapeutic intervention is the increasing tropia phase, since this indicates deteriorating fusional control. The increasing frequency or duration of the tropia phase indicates the diminished fusional control and potential binocular function lost. Progression should be monitored by documenting the size of the deviation, duration of manifest deviation

and ease of regaining fusion after dissociation from the cover to uncover test. Stathacopoulos *et al.* (1993) also proposed that distance stereoacuity could be both an objective measurement and a surgical indicator. Normal distance stereoacuity indicates good control with little or no suppression.

In order to avoid diplopia and aliasing symptoms, patients with intermittent exotropia may form anomalous retinal correspondence or suppression. Postoperatively, positive correcting exercise should be taken to restore normal retinal correspondence and enhance binocular function, such as the synoptophore exercise, which could help to re-establish bifixation through consecutive stimulus to the retinal correspondence part (mainly macula lutea). Our results demonstrate that patients taking postoperative synoptophore exercise had a better binocular vision than those taking no exercise ($P < 0.05$).

CONCLUSION

Our study demonstrates that strabismus surgery can help to preserve or restore the binocular vision for intermittent exotropia. Children receiving the surgery at young ages might develop better postoperative binocular vision, and the postoperative synoptophore exercise can help to restore the binocular vision.

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