

Consecutive Esodeviation After Exotropia Surgery in Patients Older than 15 Years: Comparison with Younger Patients

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Purpose: The purpose of this study was to investigate the clinical course of esodeviation after exotropia surgery in older patients (older than 15 years) and to compare it with that in younger patients (15 years or younger).

Methods: The medical records of all surgeries for exodeviation from December 2004 to February 2007 were reviewed and 82 patients were found with consecutive esodeviation. The patients were divided into two groups according to their age: Group A (patients older than 15 years) and Group B (patients age 15 or younger). The clinical course of esodeviation in Group A was compared to that in Group B by means of survival analysis.

Results: The median survival times of the esodeviation were 2.0 ± 0.1 months in Group A and 1.0 ± 0.1 months in Group B ($p=0.40$). The prevalence of consecutive esotropia at six months was 0% in Group A and 6.1% in Group B ($p=0.32$). The myopic refractive error, worse sensory condition, and a larger preoperative exodeviation in Group A did not affect the clinical course of the two groups differently.

Conclusions: The postoperative esodeviation of patients older than 15 years after exotropia surgery tended to persist longer during the early postoperative period than that of patients 15 years or younger, however, the difference did not persist at postoperative six months.

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The aim of surgery for exodeviation is to align the eyes as straight as possible, and it is widely agreed that an initial overcorrection is desirable because of a tendency toward postoperative exotropic drift.^{1,2} Many investigators have proposed that an overcorrection of 8 to 10 PD is desirable, and Oh and Hwang³ demonstrated that early postoperative overcorrection is the only predictor of a successful long-term outcome after exotropia surgery. However, the overcorrection of exodeviation can be harmful in some cases.^{4,5} Children may develop nasal suppression and amblyopia, and their binocular function can be deteriorated as a result of overcorrection after exodeviation surgery. Adults have a risk of permanent diplopia if the overcorrection does not

resolve.⁶⁻⁸ In general, a consecutive esotropia is defined as continued esodeviation for six months following surgery for exotropia, and Edelman et al. reported a 27% incidence of reduced or lost stereoacuity and a 14% incidence of amblyopia in children with six years of age or younger at surgery for consecutive esotropia.⁶

To the best of our knowledge, most studies related to exotropia surgery have been limited to children. Abraham and Richard provided reviews of exotropia surgery in adults older than 15 years,⁹ yet there has been few reports on comparing consecutive esodeviation after exotropia surgery in patients older than 15 years with that of patients younger than 15. In this study, we investigated the time course of the consecutive esodeviation after exotropia surgery in patients older than 15 years, compared their clinical courses with those of patients 15 years or younger, and tried to identify the factors influencing the differences in clinical courses between the two groups.

Material and Methods

The medical records of all patients who received surgery for exodeviation (constant and intermittent exotropia)

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performed by one surgeon (S. Baek) at the division of strabismus in Kim's Eye Hospital from December 2004 to February 2007 were reviewed and cases that showed esodeviation at any time during the follow-up were identified. Exclusion criteria included prior strabismus surgery, sensory exotropia occurring from unilateral visual impairment, patients with limitation of extraocular movement, patients who had neurologic disorders and cases with a follow-up period of less than six months postoperatively.

Refraction was conducted under cycloplegia using a 1% cyclogyl ophthalmic solution, and corrected vision was measured whenever possible. The ocular deviation angle was measured with near and far distance fixation by an alternate prism cover test. Sensory function was evaluated using the Titmus stereoacuity test and the Worth 4-dot test, and normal sensory function was defined as 120 seconds of arc or less in the Titmus test and no suppression at all in the Worth 4-dot test. The presence of amblyopia was defined as a difference of two or more lines in Snellen visual acuity charts between the best corrected visual acuity of each eye or a best corrected visual acuity lower than 20/30. Unilateral lateral rectus recession and medial rectus resection procedures on the non-dominant eye were performed on all patients. The operative extent was determined on the basis of the deviation angle at distant fixation according to the method devised by Parks¹⁰ and was irrespective of age.

All patients received follow-up examinations at three days, one week, one month, two months, three months, four months and six months postoperatively, and at each exam the ocular alignments at distant and near distance fixations were recorded.

The patients with postoperative esotropia were managed with alternating full-time patching until the postoperative esotropia reduced and disappeared for up to about one to two months after surgery. If the esotropia did not resolve with alternate patching for four to eight weeks, cycloplegic refraction was performed again, and a hyperopia of +1.00 diopters or more was fully corrected with hyperopic glasses.

The patients who showed esodeviation even after correction with hyperopic glasses were prescribed base-out Fresnel press-on prism or bifocal lenses regardless of the presence of postoperative diplopia to allow for constant fusion.

The postoperative esodeviation cases were divided into two age groups: Group A (patients older than 15 years) and Group B (patients 15 years of age or younger). The two groups were compared with regard to clinical characteristics, time course of esodeviation and potential factors influencing differences in the clinical courses between the two groups.

In the analysis for factors influencing the course of postoperative esodeviation, patient groups were stratified according to each factor of interest and the survival curves of each stratum were compared: median survival times are shown for comparison. For survival analysis, the event was defined as a disappearance of esodeviation at both near and distant fixation, and difference in the survival curves of the two age groups were compared. The consecutive esotropia was defined as residual esodeviation over 10 PD found at six months postoperatively so as to determine its incidence.

The Chi-square test, Fisher's exact test and Student *t*-test were used to compare variables between the two groups. The Kaplan-Meier method and the Log Rank test were used for survival analysis. Probability values <0.05 were considered statistically significant, and all analyses were performed with SPSS software for Windows (version 13.0, SPSS Inc, Chicago, IL, USA).

Results

Out of 325 eligible exotropia operation cases (244 childhood cases and 81 adult cases), 82 consecutive esodeviation cases were found and divided into two groups: Group A (24 cases older than 15 years) and Group B (58 cases 15 years or younger).

The mean age of the patients was 28.7±11.2 years in Group A and 8.4±2.4 years in Group B. Overall, Group A showed a larger preoperative mean exodeviation, more myopic mean refractive error, and worse sensory function

Table 1. Patient demographics

	Group A (n=24)	Group B (n=58)	<i>p</i> -value
Sex			
Male (n=38)	15 (62.5%)	23 (40%)	0.06 [‡]
Female (n=44)	9 (37.5%)	35 (60%)	
Age (years)	28.7±11.2	8.4±2.4	
Refraction (SE, * D)	-2.1±2.4	-1.0±1.7	0.05 [§]
Amblyopia	3 (12.5%)	8 (14%)	0.88 [‡]
Sensory dysfunction	17 (70.5%)	24 (41.4%)	0.02 [‡]
Preop. deviation at far distance (PD [†])	34.3±9.0	27.4±6.3	0.01 [§]
Preop. deviation at near distance (PD)	34.8±9.7	26.9±7.5	0.02 [§]
Follow-up period (months)	6.3±2.8	7.1±3.2	0.39 [§]

Values are expressed as mean±SD; Group A=Older age group with esodeviation after surgery for exotropia; Group B=Younger age group with esodeviation after surgery for exotropia; * Spherical equivalent; Preop.: preoperative; [†] Prism diopter; [‡] *p*-value by Chi-square test; [§] *p*-value by Student *t*-test.

than those of Group B, whereas there was no significant difference between the two groups in sex ratio and preoperative amblyopia history (Table 1).

The average prism diopters at each follow-up time in each group are listed in Table 2. Group A shifted to exodeviation faster than Group B.

In view of the changes in postoperative esodeviation, the maximum esodeviation angle and the mean amount of postoperative exodrift during the follow-up period was smaller in Group A than in Group B; however, the difference could not reach statistical difference. The incidence of consecutive esotropia at postoperative 6 months in Groups A and B was 0% and 8.3%, respectively, which indicates that the older patient group showed a lower frequency of consecutive esotropia incidence at six months postoperatively than did the younger age group, even though the difference was not statistically significant (Table 3).

According to Kaplan-Meier's survival analysis, the median survival times of esodeviation in Groups A and B were 2.0±0.1 and 1.0±0.1 months, respectively: Group A showed a longer survival of postoperative esodeviation; however, the difference did not reach statistical significance ($p=0.4$ by Log Rank test, Fig. 1).

The stratified analyses to determine the possible factors influencing survival of esodeviation differently between the two age groups revealed no significant difference in survival curves between Groups A and B based upon sex, sensory conditions and amblyopia history. The median survival times

of each group according to the strata of preoperative refractive error, preoperative angle of horizontal deviation,

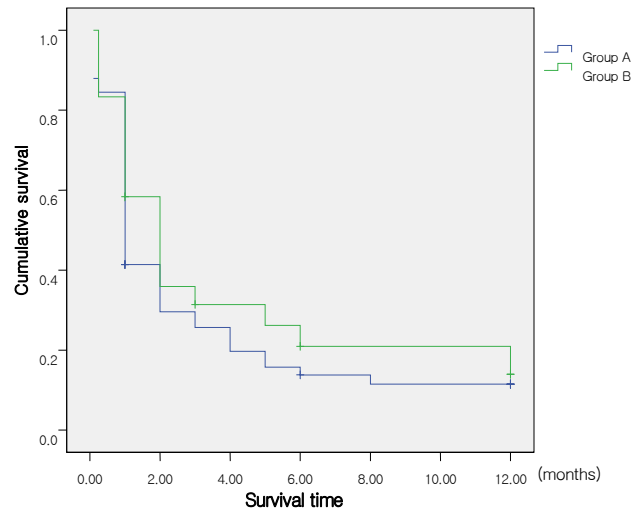


Fig. 1. Kaplan-Meier survival curves of Group A (older age group with esodeviation after surgery for exotropia; green line) and Group B (younger age group with esodeviation after surgery for exotropia blue line). These survival curves indicated that the estimated median survival times were 2.0±0.1 months in group A and 1.0±0.1 months in group B. Their difference was not statistically significant even though the median survival time seemed larger in Group A than in Group B ($p=0.40$, Log Rank test).

Table 2. The average angles of horizontal deviation after operation according to age groups

Postoperative days	Postoperative esodeviations (PD*)		p-value [†]
	Group A (n=24)	Group B (n=58)	
1 week	6.7±6.4	8.3±5.9	0.29
1 month	3.5±7.9	4.2±7.9	0.71
2 months	1.8±4.6	2.2±5.9	0.79
3 months	0.8±3.9	0.8±5.5	0.69
4 months	0.3±3.5	-1.2±6.5	0.71
6 months	-0.1±2.7	-2.2±6.8	0.06

Values are expressed as mean±SD; Group A=Older age group with esodeviation after surgery for exotropia; Group B=Younger age group with esodeviation after surgery for exotropia; * Prism diopter; (-) means exodeviation; [†] p-value by Student t-test.

Table 3. The changes of horizontal deviation after surgery

	Group A (n=24)	Group B (n=58)	p-value
Median survival time (months)	2.0±0.1	1.0±0.1	0.40 [†]
Maximum esodeviation (PD*)	11.4±6.1	13.2±6.3	0.77 [‡]
Consecutive esotropia [#]	0 (0%)	5 (8.3%)	0.32 ^{II}
Amount of exodrift (PD)	8.9±6.2	14.8±8.7	0.12 [‡]

Values are expressed as mean±SD; Group A=Older age group with esodeviation after surgery for exotropia; Group B=Younger age group with esodeviation after surgery for exotropia; * Prism diopter; [†] p-value by Log Rank test; [‡] p-value by Student t-test; ^{II} p-value by Fisher's exact test; [#] Consecutive esotropia is defined as >10 PD esodeviation at 6-month follow-up.

Table 4. Factors affecting the change of esodeviation after exotropia surgery

		Median survival time (months; median±SD)		
		Group A (n=24)	Group B (n=58)	p-value [†]
Sex	Male (n=41)	2.0±0.5	1.0±0.2	0.30
	Female (n=44)	2.0±0.7	1.0±0.3	0.30
Refraction (SE*)	SE ≤ -2 D (n=27)	2.0±0.3	2.0±0.2	0.97
	-2 D < SE < 0 D (n=18)	2.0±1.5	1.0±1.3	0.62
Sensory staus	Abnormal (n=41)	2.0±0.4	1.0±0.1	0.65
	Normal (n=41)	2.0±0.7	2.0±0.3	0.20
Amblyopia	(-) (n=71)	2.0±0.5	1.0±0.1	0.41
	(+) (n=11)	2.0±1.0	2.0±0.1	0.91
Preoperative far PD [‡]	≤ 30 PD (n=43)	2.0±0.5	1.0±1.2	0.18
	> 30 PD (n=39)	2.0±1.1	1.0±1.3	0.11
Postoperative 1 wk PD	< 10 PD (n=46)	1.0±0.3	1.0±0.9	0.57
	≥ 10 PD (n=36)	2.0±0.5	3.0±0.8	0.59
Postoperative 1 mo PD	< 10 PD (n=58)	2.0±0.3	1.0±0.1	0.40
	≥ 10 PD (n=24)	12.0±3.7	6.0±3.0	0.68

Values are expressed as median±SD; Group A=Older age group with esodeviation after surgery for exotropia; Group B=Younger age group with esodeviation after surgery for exotropia; * Spherical equivalent; [†] p-value by Log Rank test; [‡] Prism diopter.

and postoperative angle of horizontal deviation are also shown in Table 4. There was no significant difference in survival curves between Groups A and B based on these factors.

Discussion

This study reports that the clinical course of postoperative esodeviation in patients older than 15 years was not significantly different than that observed in patients 15 years or younger and that the preoperative refractive error, sensory condition, preoperative deviation angle, and postoperative esodeviation angle at one week and one month did not affect the course of postoperative esodeviation differently in the two age groups.

Many authors have studied postoperative exodrift. It has been reported that out of 159 total exotropia cases, 32% of postoperative orthoposition or residual low exotropia cases showed an under-correction of 10 PD no later than eight weeks postoperatively,² while it has also been reported that exodrift became stabilized six weeks or later following surgery and was sustained during two-year monitoring.¹

To the best of our knowledge, this is the first report with a survival analysis of postoperative esodeviation after exotropia surgery in patients older than 15 years. Sensory adaptation in response to strabismus is different between the mature visual system and the immature visual system: therefore, we expected that the clinical course of consecutive esodeviation could be different in the older age group compared to that of the younger age group. In this study, postoperative esodeviation cases (after exotropia surgery) were divided into two groups (patients older than 15 years

and patients 15 or younger) and compared by survival analysis. Esodeviation after exotropia surgery in patients older than 15 years showed a larger median survival time than that of patients 15 years or younger: however, the overall survival curves did not differ significantly between the two age groups.

It has been reported thus far that the prevalence of consecutive esotropia ranged from 6% to 20%.¹¹⁻¹³ We reported that the incidence of consecutive esotropia of patients older than 15 years and patients 15 years or younger was 0% and 8.3%, respectively, which means that all esodeviations in the older group improved within six months following surgery. Postoperative esodeviation was mostly alleviated through conservative treatment in both groups. This study indicated that in spite of the longer median survival time of postoperative esodeviation, patients older than 15 years showed a lower incidence of consecutive esotropia at six months postoperatively than did younger patients. Nevertheless, none of the differences reached statistical significance, which is in agreement with the report by Dunlap et al.¹⁴ They found that the age at surgery had no significant effects on the incidence of overcorrection after exotropia surgery. In contrast, Keech and Stewart reported that patients aged 20 years or older accounted for a higher percentage of continuous over-correction cases (≥3 PD) than patients younger than 10 years, which indicates a significant correlations between the age at operation and incidence of overcorrection.¹⁵ The discrepancy may be partly due to the differences in the definition of overcorrection as a residual esodeviation over 3 PD found in mean postoperative follow-up period of two years.

It has been reported that amblyopia history and high

myopia are associated with a higher incidence of overcorrection after exotropia surgery, and patients with higher ametropia of 2.5 D greater showed a significant tendency for a higher incidence of overcorrection than patients with lower ametropia or emmetropia.¹⁶ In this study, we could not demonstrate a significant effect of amblyopia history, sensory dysfunction or differences in refractive error on the clinical course of postoperative esodeviation in both the older and younger groups.

In conclusion, esodeviation after exodeviation surgery seems to persist longer in patients older than 15 years than in patients 15 years or younger in the earlier phase after surgery: however, the difference is not significant. Older age, more myopic refractive error, larger preoperative exodeviation, and poor sensory function in the older age group do not influence the clinical course of esodeviation differently between the two age groups.

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