Consecutive Esotropia in Intermittent Exotropia Patients with Immediate Postoperative Overcorrection More Than 17 Prism Diopeters

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Purpose: To report the incidence and the factors of consecutive esotropia (ET) in patients with immediate postoperative overcorrection of at least 17 prism diopeters (PD) after surgery for intermittent exotropia (X(T)).

Methods: Four-hundred-five patients under the age of 18 were included in this study. They underwent bilateral lateral rectus recession (LROU-rec) or unilateral recession-resection (R&R) for X(T). On postoperative day one, the patients with at least 17 PD overcorrection were classified as group 1 and those with less than 17 PD as group 2. Age, refractive error, type of surgery, lateral incomitancy, and the incidence of consecutive ET were analyzed for each group.

Results: Group 1 consisted of 116 patients (28.6%) and group 2 consisted of 289 (71.4%). At the six-month follow-up visit, consecutive ET had developed in 16 patients (13.8%) in group 1 and in five patients (1.7%) in group 2 (p<0.001). The occurrence of consecutive ET was not related to age at the time of surgery (p=0.46 in group 1; p=0.54 in group 2), refractive error (p=0.18 in group 1; p=0.08 in group 2), or the type of surgery (p=0.69 in group 1; p=1.00 in group 2). The incidence in group 1 was 23.8% in patients with lateral incomitancy and 8.1% in patients without lateral incomitancy (p<0.05). In group 2, the incidence was 4.4% in patients with lateral incomitancy and 0.5% in patients without lateral incomitancy (p=0.04).

Conclusions: Consecutive ET developed in 13.8% of patients with immediate overcorrection of at least 17 PD. Lateral incomitancy was the most important risk factor.

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Key Words: Consecutive esotropia, Intermittent exotropia, Lateral incomitancy, Overcorrection

While intermittent exotropia (X(T)) recurs in 20~30% of patients after surgery,1-11 consecutive esotropia (ET) arises in 2~20% because of overcorrection.12-16 Once consecutive ET has occurred, the patient can suffer from cosmetic problems and diplopia. Moreover, suppression, amblyopia, and deterioration of stereovision may occur later.17 Lateral incomitancy, medial rectus muscle contracture, and overcorrection of at least 20 prism diopeters (PD) immediately after surgery have been reported as risk factors for consecutive ET.11,15,18,19 Many studies reported that overcorrection of 11~20 PD immediately after surgery was optimal for the prevention of consecutive ET.6,9,11,16 Raab and Parks4 suggested that in cases of overcorrection that exceeds 17 PD, the occurrence of consecutive ET increased. Kim and Hwang20 reported that 6% of patients who have had overcorrection over 20 PD developed consecutive ET. The purpose of this study was to investigate the incidence and factors in the development of consecutive ET in patients with immediate postoperative overcorrection of at least 17 PD after surgery for X(T).

Materials and Methods

Medical records were reviewed for 405 X(T) patients who underwent LROU-rec or R&R performed by one surgeon at Anam Hospital at Korea University between January 1998 and December 2004. Patients who met the following criteria were excluded in the study: those with previous strabismus surgery, a combination of vertical or oblique muscle surgery,
postoperative follow-up less than six months, and no overcorrection (undercorrection or orthotropia) immediately after surgery.

Preoperative examination involved assessing visual acuity, the amount of exodeviation, version and duction, stereovision, and fundus examination. The amount of surgery performed was based on the degree of exotropic deviation at distant gaze and, was measured using the prism cover test. In cases involving uncooperative children, the Krimsky method with angle kappa correction was used.

Patients were grouped into two categories: group 1 contained those with an overcorrection of at least 17 PD immediately after surgery, while group 2 contained those with an overcorrection, less than 17 PD. Consecutive ET was defined as esodeviation over 10 PD at six months or more post-operatively. Alternate patching therapy or a Fresnel lens was used for consecutive ET. If ET could not be controlled by these therapies, patients underwent reoperation.

To determine the risk factors for consecutive ET, the patient’s age, refractive error, type of surgery, deviation angle, and lateral incomitancy were analyzed for each group. Lateral incomitancy was defined as a condition in which the angle of exotropia for lateral gaze was 20% or less than the angle for primary gaze.

Pearson’s chi-square test was used for statistical analysis.

**Results**

The results of 405 patients were analyzed for this study.

**Table 1.** Immediate postoperative esotropia in intermittent exotropia

| Esoangle at POD$^1$ | No. of patients (%) | Mean±SD$^2$ PD (Range) |
|---------------------|---------------------|------------------------|
|                     |                     | Postoperative esoangle | Preoperative esoangle |
| ≥ 17 PD             | 116 (28.6)          | 21.8±4.5 (17-35)       | 28.6±5.6 (20-55)      |
| < 17 PD             | 289 (71.4)          | 10.7±4.3 (1-16)        | 29.0±4.9 (16-43)      |

$^*SD$: standard deviation.

$^1$POD: postoperative day.

**Table 2.** Incidence of consecutive esotropia according to immediate postoperative esotropia

| Esoangle at POD | No. of patients | Incidence (%) |
|----------------|-----------------|---------------|
| Consecutive esotropia | Total |               |
| ≥ 17 PD | 16 | 116 | 13.8 |
| < 17 PD | 5 | 289 | 1.7 |
| Total | 21 | 405 | 5.2 |

p<0.001

**Table 3.** Incidence of consecutive esotropia according to age at surgery

| Esodeviation at POD | Age at surgery (years) | No. of patients | Incidence (%) | p-value |
|---------------------|------------------------|-----------------|---------------|---------|
|                     | Consecutive esotropia | Total |               |
| ≥ 17 PD             | ≤ 4 | 3 | 16 | 18.8 | 0.46 |
|                     | > 4 | 13 | 100 | 13.0 |
| < 17 PD             | ≤ 4 | 1 | 41 | 2.4 | 0.54 |
|                     | > 4 | 4 | 248 | 1.6 |         |
patients with refractive values at more than -1.00 D, as well as in 11.3% of emmetropic patients with refractive values between -1.00 D and +1.00 D, and in 8.7% of hyperopic patients with refractive values greater than +1.00 D. In group 2, consecutive ET developed in 5.3% of myopic patients with refractive values at more than -1.00 D, in 0.0% of emmetropic patients with refractive values between -1.00 D and +1.00 D, and in 1.5% of hyperopic patients with refractive values more than +1.00 D (Table 4).

Fourteen patients (24.1%) who underwent unilateral recession-resection (R&R) (n=58), and 102 patients (29.4%) who underwent bilateral lateral rectus recession (LROU-rec) comprised group 1 (n=347). Consecutive ET occurred in group 1 in 7.1% of patients who underwent R&R and in 14.7% who underwent LROU-rec. In group 2, no patients who underwent R&R developed consecutive ET, but 2.0% who underwent LROU-rec did (Table 5).

With regards to lateral incomitancy, overcorrection of at least 17PD occurred in 42 patients (31.8%) in the lateral incomitancy group (n=132), and in 74 patients (27.1%) in the other group (n=273). The incidence of consecutive ET was 23.8% in patients with lateral incomitancy and 8.1% in patients without lateral incomitancy in group 1 (p<0.05). In group 2, the incidence was 4.4% in patients with lateral incomitancy and 0.5% in patients without lateral incomitancy (p=0.04) (Table 6).

### Discussion

In prior studies, the incidences of consecutive ET after surgery for X(T) varied. Cho and Yoo\(^{13}\) reported that the incidence was 2.6%; in the Richard and Parks\(^{11}\) study, the incidence was 6%; in the von Noorden study,\(^{3} 11\%\); Pratt-Johnson et al.\(^{14} 15\%\); and in Park et al.\(^{15} 25\%\). In this study, consecutive ET developed in 21 (5.2%) of 405 patients who underwent X(T) surgery, with a minimum of six months of follow-up. Strict postoperative patching therapy may explain this relatively low rate of developing consecutive ET. Parks\(^{4}\) said that the overcorrection of at least 17 PD immediately after surgery was a risk factor for consecutive ET. Overcorrection inhibits the recurrence of exotropia and makes long-term maintenance of orthotropia possible. The optimal amount of overcorrection differs from investigator to investigator, but it is known that the overcorrection must not generally exceed 20 PD.\(^{4,6,9,11,21}\) Kim and Hwang\(^{22}\) reported that consecutive ET arose in 16% of the overcorrected patients with over 20 PD. In this study, 21.1% of the overcorrected patients with over 20 PD developed consecutive ET.

We chose 17 PD as a criterion for this study according to Park's suggestion. The incidence of consecutive ET in 17 PD or more in the overcorrected group was significantly higher than that of overcorrection less than 17 PD.

| Table 4. Incidence of consecutive esotropia according to the refractive error |
|-----------------------------------------------|
| Esdeviation at POD 1 | Refractive error | No. of patients | Incidence (%) | p-value |
|-----------------------|-----------------|-----------------|---------------|---------|
|                       |                 | Consecutive     |               |         |
|                       |                 | esotropia       | Total         |         |
| ≥ 17 PD               |                | < -1.00D        | 7             | 51      | 22.6   |
|                       |                | -1.00~+1.00D    | 7             | 62      | 11.3   |
|                       |                | > +1.00D        | 2             | 23      | 8.7    |
|                       |                | < -1.00D        | 4             | 76      | 5.3    |
| < 17 PD               |                | -1.00~+1.00D    | 0             | 147     | 0.0    |
|                       |                | > +1.00D        | 1             | 66      | 1.5    |

| Table 5. Incidence of consecutive esotropia according to the type of surgery |
|-----------------------------------------------|
| Esdeviation at POD 1 | Type of surgery | No. of patients | Incidence (%) | p-value |
|-----------------------|-----------------|-----------------|---------------|---------|
|                       |                 | Consecutive     |               |         |
|                       |                 | esotropia       | Total         |         |
| ≥ 17 PD               | R & R\(^{+}\)   | 1               | 14            | 7.1     | 0.69   |
|                       | LROU recession  | 15              | 102           | 14.7    |         |
| < 17 PD               | R & R           | 0               | 44            | 0       | 1.00   |
|                       | LROU recession  | 5               | 243           | 2.0     |         |

\(^{+}\) R&R: recession and resection.

| Table 6. Incidence of consecutive esotropia according to lateral incomitancy |
|-----------------------------------------------|
| Esdeviation at POD 1 | Lateral incomitancy | No. of patients | Incidence (%) | p-value |
|-----------------------|---------------------|-----------------|---------------|---------|
|                       |                     | Consecutive     |               |         |
|                       |                     | esotropia       | Total         |         |
| ≥ 17 PD               | +                   | 10              | 42            | 23.8    | 0.05   |
|                       | -                   | 6               | 74            | 8.1     |         |
| < 17 PD               | +                   | 4               | 90            | 4.4     | 0.04   |
|                       | -                   | 1               | 199           | 0.5     |         |
Pratt-Johnson et al.\textsuperscript{14} and Knapp\textsuperscript{21} obtained higher success rates when surgery was performed in those under four years of age. Early surgery may inhibit amblyopia and reinforce the tendency to deviate. On the other hand, Jampolsky\textsuperscript{2} and von Noorden\textsuperscript{3} preferred late surgery (after seven years of age) for a better follow-up, precise measurement of deviation, and decreased incidence of amblyopia and suppression when an overcorrection occurred. Cho and Lee\textsuperscript{23} reported that the incidence of consecutive ET was 10.8% in those under four years of age, and that this was higher than that of patients whose age was over five years. Richard and Parks\textsuperscript{11} and Dunlop\textsuperscript{24} found that age at the time of surgery was independent of the development of consecutive ET, as was demonstrated in this study. However, in our study the age distribution was not equal, so a larger study will be needed.

Some investigators believed that amblyopia or a high refractive error could be a risk factor for consecutive ET.\textsuperscript{15,25} In this study, myopic patients over -1.00D had an increased tendency to develop consecutive ET, but it was not statistically significant.

While Keech and Stewart\textsuperscript{26} concluded that the incidence of consecutive ET was not related to the type of surgery, Park et al.\textsuperscript{15} reported that the incidence was higher in the LROU-rec group than in the R&R group. In this study, there was no relation between the incidence of consecutive ET and the type of surgery.

Moore\textsuperscript{27} reported that consecutive ET rate eight times higher in the lateral incomitancy group than the other group, and Parks\textsuperscript{28} reduced the amount of recession or resection in cases with lateral incomitancy. In our study, the incidence of consecutive ET in group 1 was 23.8% in patients with lateral incomitancy and 8.1% in patients without lateral incomitancy. The incidence in group 2 was 4.4% in patients with lateral incomitancy and 0.5% in patients without lateral incomitancy. These results were both statistically significant.

In conclusion, consecutive ET developed in 13.8% of patients with immediate overcorrection of at least 17PD after X(T) surgery. Lateral incomitancy was the most significant risk factor.

\section*{References}

1. Kim MM, Cho ST. Long-term surgical results of intermittent exotropia. \textit{J Korean Ophthalmol Soc} 1994;35:1321-6.
2. Jampolsky A. Pediatric Ophthalmology and Strabismus. New York: Raven Press, 1986;201-34
3. Von Noorden GK. \textit{Binocular Vision and Ocular Motility}. 5th ed. St. Louis: CV Mosby, 1996;352
4. Raab EL, Parks MM. Recession of the lateral recti. Early and late postoperative alignments. \textit{Arch Ophthalmol} 1969;82:203-8.
5. Gillies WE, Rivers MR, Brooks AM. Results of surgical correction of exodeviations. Changes during the first postoperative year. \textit{Binocul Vis Eye Muscle Surg Q} 1995;10:113-8.
6. Ruttim MS. Initial versus subsequent postoperative motor alignment in intermittent exotropia. \textit{J AAPOS} 1997;1:88-91.
7. McNeer KW. Observations on the surgical overcorrection of childhood intermittent exotropia. \textit{Am Orthop J} 1987;37:135-50.
8. Souza-Dias C, Uesugui CF. Postoperative evolution of the planned initial overcorrection in intermittent exotropia: 61 cases. \textit{Binocular Vision Strabismus Q} 1993;8:141-8.
9. Scott WE, Keech R, Mash AJ. The postoperative results and stability of exodeviations. \textit{Arch Ophthalmol} 1981;99:1814-8.
10. Clarke WN, Noel LP. Surgical results in intermittent exotropia. \textit{Can J Ophthalmol} 1991;16:66-9.
11. Richard JM, Parks MM. Intermittent exotropia. Surgical results in different age groups. \textit{Ophthalmology} 1983;90:1172-7.
12. Helen Lew, Lee JB, Han SH, Park HS. Clinical evaluation on the consecutive esotropia after exotropia surgery. \textit{J Korean Ophthalmol Soc} 1999;40:3482-90.
13. Cho YA, Yoo CK. Consecutive esotropia after surgical correction of intermittent exotropia. \textit{J Korean Ophthalmol Soc} 2001;42:335-41.
14. Pratt-Johnson JA, Barlow JM, Tillson G. Early surgical in intermittent exotropia. \textit{Am J Ophthalmol} 1977;84:689-94.
15. Park HS, Kim JB, Seo MS, Park YG. A study on the consecutive esotropia after intermittent exotropia surgery. \textit{J Korean Ophthalmol Soc} 1994;35:1327-34.
16. Hardesty HH, Boynton JR, Keenan IP. Treatment of intermittent exotropia. \textit{Arch Ophthalmol} 1978;96:268-74.
17. Edelman PM, Brown MI, Murphree AL, Wright KW. Consecutive esodeviation. Then what? \textit{Am Orthop J} 1988;38:111-6.
18. Moore S. The prognostic value of lateral gaze measurements in intermittent exotropia. \textit{Am Orthop J} 1969;19:69-71.
19. Jampolsky A. Surgical correction of overcorrection in strabismus. \textit{Am Orthop J} 1976;26:14-9.
20. Kim JH, Hwang JM. Initial overcorrection of 20PD or more after surgery of exotropia. \textit{J Korean Ophthalmol Soc} 2003;44:121-7.
21. Knapp P. \textit{Symposium on Strabismus}. St.Louis: CV Mosby, 1971;56-7.
22. Souza-Dias C, Uesugui CF. Postoperative evolution of the planned initial overcorrection In intermittent exotropia: 61 cases. \textit{Binocular Vision & Eye Muscle Surgery} 1993;8:141-8.
23. Cho YA, Lee JK. Early surgery before 4 years of age in intermittent exotropia. \textit{J Korean Ophthalmol Soc} 2004;45:620-5.
24. Dunlop EA. \textit{Symposium on horizontal ocular deviations}. St. Louis: CV Mosby, 1971;183-4
25. Son AN, Park SC, Lee WR. Clinical study of consecutive esotropia. \textit{J Korean Ophthalmol Soc} 1990;31:1321-8.
26. Keech RV, Stewart SA. The surgical overcorrection of intermittent exotropia. \textit{J Ped Ophthalmol and Strabismus} 1990;27:218-20.
27. Moore S. The prognostic value of lateral gaze measurements in intermittent exotropia. \textit{Am Orthop J} 1969;19:69-71.
28. Parks MM. \textit{Strabismus symposium of the New Orleans Academy of Ophthalmology}. St. Louis: CV Mosby, 1962;31-55