Long-Term Results of Surgery for Intermittent Exotropia

İntermitan Ekzotropya Cerrahisinin Uzun Vadeli Sonuçları

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ABSTRACT Objective: To evaluate the long-term surgical outcomes in a population with intermittent exotropia X(T) who were operated by the same surgeon. **Material and Methods:** The medical records from January 1991 to December 2008 were retrospectively reviewed. Patients were examined on postoperative day 1, in week 1 and week 6, at 6 months and 1 year, and then every year. Twenty four of 43 patients underwent bilateral lateral rectus recession and 19 patients underwent unilateral recession-resection for X(T). **Results:** Forty-three patients underwent surgery at a mean age of 11.2±4.6 years (range, 6 to 25 years). Eleven of the 43 children (25.6%) underwent a second surgical intervention (9 for recurrent exotropia and 2 for consecutive esotropia), and no patient received more than 2 interventions. Four patients were lost to follow-up after 2 years. Mean follow-up time was 9±5.2 years for 39 patients. Consecutive esotropia (ET) developed in 9 (21%) patients with immediate overcorrection of at least 20 prism diopters (PD). Only two cases of consecutive ET required second surgery. Postoperative esodeviation developed in almost all cases and it showed a tendency to progress to exodeviation with longer follow-up time. Nine cases required surgery for residual or recurrent exotropia. Finally, 28 of the 39 (71.8 %) were within 10 PD of orthotropia at distance and 18 of 39 (46.2%) had a stereopsis better than 60 seconds of arc. **Conclusion:** In this population with intermittent exotropia, although 11 cases underwent a second surgical intervention, after a mean follow-up of 9.8 years, approximately 3 out of 4 cases were successfully aligned and 46.2% had high-grade stereopsis.

Key Words: Exotropia; surgery; strabismus

ÖZET Amaç: Aynı cerrah tarafından ameliyat edilen intermitan ekzotropyalı [X(T)] hastaların uzun vadeli sonuçlarını değerlendirmek. **Gereç ve Yöntemler:** Ocak 1991 ile Aralık 2008 arasındaki tıbbi kayıtlar, geriye dönük olarak gözden geçirildi. Ameliyat sonrası değerlendirmeler sırasıyla ilk gün, 1 hafta, 6 hafta, 6 ay, 1 yıl sonra ve 1. yılın ardından her yıl yapıldı. Kırk üç hastanın 24'üne [X(T)] için iki taraflı lateral rektus geriletme ameliyatı ve 19 hastaya tek taraflı geriletme-kısaltma ameliyatı yapıldı. **Bulgular:** Kırk üç hasta ortalama 11,2±4,6 yaşında (6-25 yaş) ameliyat edildi. Kırk üç çocuğun 11'ine (%25,6) ikinci bir ameliyat yapıldı (Dokuzu rekürren ekzotropya için, ikisi ardıl ezotropya için). Hiçbir hastaya 2'den fazla ameliyat yapılmadı. Dört hasta ikinci yıldan sonra takip edilemedi. Otuz dokuz hastada ortalama takip süresi 9,8±4,9 yıldı. Ameliyattan hemen sonraki günlerde dokuz (%21) hastada aşırı miktarda [en az 20 prizma dioptrisi (PD)] ardıl ezotropya (ET) gelişti. Altı ay takipten sonra, ardıl ET gelişen hastalardan sadece ikisine ikinci bir ameliyat gerekti. Olguların hemen hepsinde postoperatif ezodeviasyon gözlendi ve bu durum, takip süresi arttıkça ekzodeviasyona ilerleme eğilimi gösterdi. Dokuz hastada rezidüel veya rekürren ekzotropya için ameliyat gerekti. Son olarak, 39 olgunun 28'i (%71,8) uzak bakışta 10 PD'lik ortotropya içindeydi ve 18'inin (%46,2) 60 saniyeden daha iyi stereopsisi vardı. **Sonuç:** İntermitan ekzotropyalı bu populasyonda, 11 olguya ikinci bir ameliyat yapılmış olmasına rağmen, ortalama 9,8 yıllık bir takip süresinden sonra 4 olgudan yaklaşık 3'ü başarılı şekilde düzeltildi ve %46,2'sinde üst düzeyde stereopsis vardı.

Anahtar Kelimeler: Ekzotropya; cerrahi; şaşılık

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Exodeviations are present in approximately 30% of patients with strabismus.[1] Intermittent exotropia [X(T)], the most prevalent form of childhood exotropia is an acquired, intermittent exodeviation in healthy children.[2] X(T) is known as a progressive condition resulting in irreversible binocular single vision problems, but some long term observations show that significant numbers improve within time.[3,4]

According to Knapp, the angle of deviation seen in patients with exotropia is basically present at birth as exodeviation, and the obvious deviation increases as dynamic factors like accommodative convergence change.[5] It has been suggested that exophoria and X(T) usually arise in infancy and become obvious over time, not only in degree but also in the frequency of deviation.[6,7]

There is still no broad consensus on surgical interventions for intermittent exotropia as the best treatment options.[8] The frequency of the manifest deviation (observed during >50% of waking hours) and its size are important in making a decision for surgery.[6] Good binocular control for near with ≥ 20 prism diopters (PD) exotropia is considered the threshold for surgical intervention.[9] Exophoria, the initial symptom for intermittent exotropia, may progress to constant exotropia with binocular vision loss.[4] Patients with intermittent or constant exotropia have been reported to achieve superior sensory outcome with motor realignment before age 7, before 5 years of strabismus duration, or while the deviation is intermittent.[10]

In this study, we investigated the long-term results of surgery for intermittent exotropia.

MATERIAL AND METHODS

Medical records were reviewed for 43 X(T) patients who underwent bilateral lateral rectus recession (BLRR) or unilateral recession-resection (R&R) performed by one surgeon (KHK) between January 1991 and December 2008. Intermittent exotropia was distinguished from other forms of exotropia and was defined as an intermittent distance exodeviation of at least 10 PD without an underlying or associated neurologic, paralytic, or ocular disorder.

Preoperative examination involved a detailed history, which included the parental observation of the deviation and the assessment of visual acuity, the amount of exodeviation, version and duction, stereoacuity, and fundus examination. Sensory testing was performed with the Titmus fly stereotest (Stereo Optical Co. Inc., Chicago, IL, USA) and the Worth 4-dot test (W4D). The ocular deviation was measured with an alternate cover test at 6 m and 33 cm to an accommodative target. In cases involving uncooperative children, the Krimsky method with angle kappa correction was used. This study was carried out in accordance with the Declaration of Helsinki.

The amount of surgery performed was based on the degree of exotropic deviation at distant gaze and measured using the prism cover test. Because of the variation of the deviation angle in intermittent X(T), the number of preoperative examinations related to the deviation angle was at least three. Twenty four patients underwent BLRR (Group 1) and 19 patients underwent R&R (Group 2) for X(T).

Patients were examined on postoperative day 1, in week 1 and week 6, at 6 months and 1 year, and then every year All subjects were offered minus lens therapy to control the exotropia, which was operated by adding the maximum tolerated minus lenses with a minimum of minus 1 diopter to a maximum of minus 3 diopters, to their full cycloplegic refraction. Hence, if the patients were hypermetropic, the prescription was reduced by a minimum of 1 diopter to a maximum of 3 diopters. An emmetropic individual for instance would be prescribed a minimum of minus 2 diopters and a maximum of minus 4 diopters. The strength prescribed depended on their ability to read the 20/20 with the equivalent minus lenses in place.

RESULTS

The mean age at diagnosis for the 43 patients was 5.3 years. Twenty-three patients (59%) were female, and 16 (41%) patients were male. Forty-three patients underwent surgery at a mean age of 11.2±4.6 years (range, 6 to 25 years). Twenty-three (53.4%) patients were between 5 and 8 years of age,

12 (27.9%) patients were between 9 and 12 years of age, and 8 (18.7%) patients were between 13 and 24 years of age. Characteristics of patients at the time of surgery were listed in Table 1.

The final postoperative measurements were recorded in 39 patients (91%) at a mean of 9.8 years (range, 3 to 19 years) after the first surgery. Four patients were lost to long-follow-up. The mean follow-up time was 9.8±4.9 years (range, three to nineteen years) (Table 2). Sixteen of the 21 (76.2%) children who underwent a BLRR were < 10 PD at distance from orthotropia versus 12 of 18 (66.7%) children who underwent an R&R procedure. Twenty-eight of the 39 (71.8%) were within 10 PD of orthotropia at distance, and 18 of 39 (46.2%) had stereopsis of better than 60 seconds of arc.

Mild amblyopia was found in 17 (Table 3), and the mean initial exotropic angle was 22.7±6.6 PD at distance and 15.6±4.8 PD at near. Postoperative esodeviation drift was observed almost in all cases and it showed a tendency to progress to exodeviation with longer follow up.

Eleven out of 39 children (28.2%) underwent a second surgical intervention (9 for recurrent exotropia and 2 for consecutive esotropia) and no patient received more than two surgeries during a mean follow-up of 9.8 years from the first surgery. Consecutive esotropia (ET) developed in 9 (23%) patients [Three (12.5%) in Group 1, and 6 (31.5%) in Group 2] with immediate overcorrection of at least 20 PD. During six months of follow-up seven cases improved and only two cases of consecutive ET (One from Group1 and 1 from Group 2) required second surgery. Nine cases required surgery for residual or recurrent XT (Seven from Group 1, and 2 from Group 2).

TABLE 1: Characteristics of intermittent exotropia patients at the time of surgery.

Characteristic	Mean ± SD
Age in years (range)	9.1±4.9 (5-24)
Age at surgery (range)	11.2±4.6 (5-25)
Distance deviation*	22.7±6.6
Near deviation*	15.6±4.8

* PD: Prism diopters.

TABLE 2: Follow-up time of patients.

No. of patients	Follow-up (years)
6	3
3	4
2	5
1	6
3	7
1	8
1	9
2	10
4	11
3	12
4	13
3	14
1	15
1	6
1	17
2	18
1	19
Total 39	**Mean (9.8± 4.9)**

TABLE 3: Pre and postoperative binocularity levels of patients.

Seconds of arc	Preoperative [n (%)]	Postoperative* [n (%)]
140-400	17 (39.5)	10 (25.6)
60-100	16 (37.2)	11 (28.2)
40-50	10 (23.3)	18 (46.2)
Total	**43**	**39**

* Four patients were lost to follow-up.

DISCUSSION

Intermittent exotropia shows many different clinical symptoms and mostly develops within the first four years of life. As children grow, the incidence of exodeviation increases or is maintained.[5,11] With regard to the changes in the angle of deviation associated with exotropia, Burian and Spivey reported that exuberant convergence in childhood could mask an exotropia and that convergence weakened with age, producing an increasingly divergent position of the eye.[12]

The outcome of strabismus surgery shows great variability among patients.[13] Although most patients with intermittent exotropia show a stable

exotropic angle with the repeated preoperative measurements, some patients show variable angles of exotropia. According to Pritchard, the simplest and most obvious potential explanation for a high rate of recurrence of intermittent exotropia is that we are not operating at the full angle of deviation.[14] Variability in the measurement of exotropia from one examination to the next supports this idea. In a population-based cohort study of children with intermittent exotropia, it was suggested that the distance exodeviation of 52.8% of patients would increase by 10 or more PD after 20 years of follow-up.[15] Operated children in this population were significantly more likely to have demonstrated an increase in their deviation during the median follow-up of 5.6 years. In that study, 74% of patients were expected to undergo surgical correction within 20 years of diagnosis. Kii and Nakagawa also observed a larger angle of exodeviation in their preoperative adult patients compared with their pediatric patients, thereby supporting the notion that the strabismic angle increases with time in intermittent exotropia.[16] Since the correct measurement of preoperative angles of deviation would be expected to influence the final results and as the preoperative deviation is presumed to be an important determinant for strabismus surgery in intermittent exotropia, surgery should be performed for the measured largest angle.[17-19] Von Noorden suggested that considerable variation in the degree of fusional control from one examination to another is not a surprising finding.[7] It is repeatedly performed by the same strabismologist at the same distance using the same accommodative targets.[19] Regarding these problems, we prefer to examine our patients at least three times before deciding the operation.

The study of Ekdawi et al. describes the long-term surgical outcomes of children diagnosed with intermittent exotropia during a 20-year period using a population-based medical record retrieval system.[20] In this population-based study of surgery in children with intermittent exotropia, although only 1 in 5 received a second surgical intervention, after a mean follow-up of 8 years, approximately half were successfully aligned and 45% had high-grade stereopsis. The estimated rate of developing ≥10 PD from orthotropia following initial surgery in this population was 54% by 5 years and 86% by 15 years.[20] No significant difference has been reported in terms of orthotropia (<10 PD) in children who underwent BLRR and R&R in this study. Maruo et al. found that 66.7% of BLRR and 32.8% of R&R were orthotropic or mini-microtropic at a mean of 4 years after surgery.[21] In a prospective randomized trial, Jeoung and co-authors reported that alignment of <10 PD of orthotropia was achieved in 48.3% of BLRR versus 83.3% of R&R in 113 patients after a mean follow-up of 15.8 months.[22] In our study, <10 PD of orthotropia was achieved in 76.2% and 66.7% of patients with bilateral and unilateral surgery respectively. Postoperative motor success rates of previous studies were listed in Table 4.[12,20,22-26] Stoller et al. and Richard and Parks reported that the patient's age at exotropia onset as well as age at surgery did not adversely affect long-term alignment.[25,27] Moreover, Stoller et al. concluded that the presence of symptoms, amblyopia, anisometropia, or incomitance before surgery were not predictive of success.[25] Wu et al. reported that 74% of their 34 patients with intermittent exotropia had better than or equal to 60 seconds of arc after one year of follow-up.[24] Similarly, in our study, almost half of our patients had gained a stereopsis of 60 seconds of arc or better.

Surgical technique and patient population should be carefully considered to decide for degrees of overcorrection for comitant intermittent exotropia. Initial overcorrection of up to 10 PD-20 PD in bilateral lateral rectus recessions has been recommended to prevent postoperative drift at long-term follow-up.[28] Postoperative drift varies from 0 PD to 10 PD in patients undergoing unilateral recession-resection procedures to 0 PD-20 PD in those undergoing bilateral lateral rectus recessions.[29-32] There may be less postoperative drift in these groups after unilateral than bilateral surgery for intermittent exotropia.[33] In our study, postoperative drift was present in almost all cases and it showed a tendency to progress.

Overcorrection inhibits the recurrence of exotropia and makes long-term maintenance of orthotropia possible. Some authors have suggested

TABLE 4: Patient number and postoperative success rates of previous studies.

Study	Number of patients	Success Rate (%)	Criteria for motor success	Mean follow-up (years)
Burian and Spivey[12]	200	50	<10Δ of deviation	2.5
Ekdawi et al.[20]	184	56	<10Δ of deviation	10.2
Jeoung et al.[22]	124	67	<10Δ of deviation	1.3
Hardesty et al.[23]	100	51	No tropia,some stereopsis	6.1
Wu et al.[24]	63	79	<8Δ of deviation	1
Stoller et al.[25]	57	58	<10Δ of deviation	1
Pineles et al.[26]	50	64	<9Δ of deviation	>10
Current study	39	72	<10Δ of deviation	9.8

that successful alignment is more likely when there is an initial overcorrection of the deviation.[30-34] The optimal amount of overcorrection differs among investigators, but it is well-established that the overcorrection must not generally exceed 20 PD.[27,29,35] Consecutive ET was known as esodeviation over 10 PD at six months or more after surgery. Alternate patching therapy or a Fresnel lens was used for consecutive ET. Reoperation should be considered if ET cannot be controlled with these therapies. Recurrence of X(T) was reported in 20~30% of patients after surgery, while consecutive ET frequency was 2~20% because of overcorrection.[7,23,28,30,32,35,36] Optimal overcorrection of 11~20 PD to prevent consecutive ET has been reported in many studies.[23,27,30,35] In our study, 21% of patients developed consecutive ET and patients who had unilateral surgery (12.5%) seemed to be better than those who had bilateral surgery (31.5%). All patients who required surgery for consecutive ET had six months of non-surgical period in our study.

The right time of surgery for intermittent exotropia is still a dilemma. Critical point is the establishment of postoperative stereoacuity. Most of the ophthalmologists prefer surgery for children to establish bifixation and prevent progressing to constant exotropia, but for adult patients, the benefit of surgery is orthophoria and better outlook. If the surgery is done before age 7 or before 5 years of strabismus duration, superior sensory outcome with motor realignment may be achieved.[11] According to Hutchinson, patients can easily restore binocular function even when operated after age 7 and over 5 years of strabismus duration.[37] If exotropia is well controlled, near fixation and normal stereoacuity can be achieved but again a significant number of patients will re-present with low binocular single vision and reduced stereoacuity, recognized to be characteristic of this disease.[38,39] After all the timing has great significance for surgery. Sharma et al. reported that, abnormal near fusional vergence amplitudes and steroacuity disorders were important parameters to decide for the time of surgery.[40] In our study, most of the patients with a mean age of 10 had indications of binocularity and almost half had developed high-grade stereopsis after surgery.

Retrospective study design and relatively small number of patients were the limitations of our study. Despite these limitations, this study gives outcomes of two different techniques of X(T) surgery performed by one experienced surgeon with a long-follow-up period.

In conclusion, almost 3 of 4 X(T) cases were successfully aligned and half of them had high-grade stereopsis with surgery. Sensory outcome seems to be less successful than motor and further prospective studies with a large number of patients are required to make a more reliable conclusion.

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