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Factors Influencing the Surgical Success in Patients with Intermittent Exotropia

İntermitan Ekzotropyada Cerrahi Başarıyı Etkileyen Faktörler

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Summary

Purpose: To determine the factors that influence surgical success in patients with intermittent exotropia.

Material and Method: We retrospectively evaluated the records of patients with intermittent exotropia who were diagnosed, operated, and followed up. Successful outcome was defined as alignment ≤10 prism diopters (PD) esophoria or exophoria at the last follow-up visit. The clinical findings, exodeviation types, surgical ages, operation types, preoperative and postoperative deviation amounts, presence of anisometropia and amblyopia, presence of A- or V-pattern, and presence of binocular vision and stereoacuity of patients were evaluated. We investigated the independent variables that affected the surgical success in intermittent exotropia patients.

Results: Among the 379 patients included in the study, 266 (70.18%) underwent surgery, and the success rate was 68.05% (181 patients). In this successful surgery group, mean deviation was 25.82±11.27 PD at near and 30.80±10.59 PD at distance versus 30.93±12.47 PD and 34.92±11.02 PD, respectively, in the unsuccessful surgery group. There was a statistically significant difference between the two groups. Preoperative factors, such as presence of binocular vision preoperatively, and postoperative factors, such as follow-up period and the patients' deviation amount in the 1st week and 6th month, were found to affect the surgical outcome.

Discussion: The success rate of surgical treatment of intermittent exotropia increases in the patients with presence of fusion and low preoperative deviation amounts. Also, in the early postoperative period, orthophoric or ≤10 PD esophoric patients have a higher final surgical success rate. *(Turk J Ophthalmol 2013; 43: 107-12)*

Key Words: Strabismus, exodeviation, exotropia, intermittent exotropia

Özet

Amaç: İntermitan ekzotropya tedavisinde cerrahi başarıyı etkileyen faktörleri incelemek.

Gereç ve Yöntem: Kliniğimizde tanı konulup, ameliyat edilen ve takibi yapılan intermitan ekzotropya tanılı hastaların kayıtları retrospektif olarak incelendi. Hastaların klinik bulguları, kayma tipleri, cerrahi geçirdikleri yaşları, uygulanan cerrahi yöntemler, operasyon öncesi ve sonrası kayma miktarları, anizometropi ve ambliyopi varlığı, A-V patern birlikteliği, binoküler görme düzeyleri değerlendirildi. Operasyon sonrası son kontrollerinde hastalarda kayma miktarı 10 prizm dioptri (PD) ve altında ezoforya veya ekzoforya olması başarılı sonuç olarak kabul edildi. İntermitan ekzotropyalı hastalarda cerrahi başarıyı etkileyen bağımsız değişkenler araştırıldı.

Sonuçlar: Çalışmaya dahil edilen 379 hastanın 266'sına (%70,18) cerrahi uygulandığı görüldü ve cerrahi başarı oranı %68,05 (181 hasta) idi. Cerrahi başarı grubunda operasyon öncesi ortalama kayma miktarı, yakında 25,82±11,27 PD, uzakta 30,80±10,59 PD iken başarısız cerrahi grubunda sırasıyla 30,93±12,47 PD ve 34,92±11,02 PD idi. İki grup arasında istatistiksel olarak anlamlı farklılık vardı. Preoperatif bir faktör olan binoküler görme varlığının ve postoperatif faktörler olan ortalama takip süresi ile cerrahiden sonraki 1. hafta ve 6. aydaki hastanın kayma miktarlarının cerrahi başarıyı etkilediği görüldü.

Tartışma: İntermitan ekzotropyanın cerrahi tedavi başarısı, füzyon varlığı olan ve cerrahi öncesi düşük kayma miktarı olan hastalarda artmaktadır. Ayrıca erken postoperatif dönemde ortoforik veya ≤10 PD ezoforik olan hastalarda sonuç cerrahi başarı oranı daha yüksektir. *(Turk J Ophthalmol 2013; 43: 107-12)*

Anahtar Kelimeler: Şaşılık, ekzodeviasyon, ekzotropya, intermitan ekzotropya

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Introduction

Intermittent exotropia, which sometimes begins as exophoria, is the most common form of exodeviation. Many researchers consider it a progressive disease that can transform into constant exotropia[1-4] and report that 75% of patients require surgical correction within 20 years of its diagnosis.[2,4] Many previous studies have reported many factors such as preoperative deviation amount, presence of refractive errors, presence of anisometropia, age at the time of surgery, presence of A- and V-pattern, age at onset of deviation, and esophoria rate 1 day and 1 week postoperative that affect the surgical success, whilst some studies have reported that there are no factors that affect the surgical success in patients with intermittent exotropia.[5-12] The present study aimed to determine the factors that affect the surgical success in patients with intermittent exotropia.

Material and Methods

We retrospectively evaluated the records of patients with intermittent exotropia who were diagnosed, treated, and followed up between 2000 and 2009. Patients who had been previously operated on once, were followed up at another hospital, had exotropia due to restrictive and paralytic causes, had <12 months follow-up period, or had another eye disease were excluded from the study.

The types of intermittent exotropia (basic, convergence insufficiency, true, and simulated divergence excess), age at onset of deviation, age at the time of surgery, types of surgery performed, preoperative and postoperative level of deviation at distance and near (at straight gaze position) according to the alternate prism cover test, presence of anisometropia and amblyopia, presence of binocular vision, and level of stereoacuity were evaluated. Visual acuity was determined using the Snellen chart. Children that were unable to participate in visual acuity testing during the initial visit were scheduled for a return visit and sent home with the E game in order to practice.

Patients with a difference in visual acuity ≥2 lines in each eye were considered to have amblyopia. Refractive errors were identified using streak retinoscopy 30 min after instillation of 3 drops of 1% cyclopentolate (Sikloplejin®) (1 drop every 5 min). Amblyogenic anisometropia was defined as ≥1.00 D spherical equivalent aniso-hyperopia, ≥3.00 D spherical equivalent aniso-myopia, and ≥1.50 D cylindrical equivalent aniso-astigmatism.[13] Binocular vision was evaluated at near and distance with Bagolini lenses. The level of stereoacuity was determined with the TNO test and in uncooperative children with the Titmus test.

After strabismus surgeons corrected the refractive errors in all patients, the level of deviation was measured at distance and near as PD. Hirschberg and Krimsky testing at near were used, respectively, when the unilateral and simultaneous cover and prism tests could not be performed.

Patients with deviation at distance ≥10 PD than at near were considered to have divergence excess type of exotropia. In contrast, when the degree of deviation at near was ≥10 PD, patients were considered to have convergence insufficiency exotropia. Basic exotropia was diagnosed in patients with a difference between distance and near deviation <10 PD. In divergence excess patients, we performed prolonged (60 min) occlusion testing. Deviation in these patients was again measured at near and distance. If the difference was >10 PD after this patch test, true divergence excess was diagnosed. If near deviation increased and became similar to distance deviation, simulated divergence excess was diagnosed. The aim of covering one eye was to dissipate tonic fusional convergence. Determining the type of intermittent exotropia is important, as it affects the choice of surgical procedure.[5,11,14-18]

When deterioration occurred in control patients with intermittent exotropia, surgery was suggested. Deterioration

Table 1. Patients' characteristics, type of intermittent exotropia, and clinical features

Patient characteristics	Mean±SD (range)
Age at the initial presentation (years)	12.06±8.85 (1-49)
Age at the time of surgery (years)	12.78±8.56 (2-49)
Follow-up period (months)	35.68±32.34 (12-168)
Type of intermittent exotropia	**n=266**
Basic exotropia	172 (64.66%)
Simulated divergence excess	47 (17.67%)
True divergence excess	42 (15.79%)
Convergence insufficiency	5 (1.88%)
Clinical features	**n=266**
Binocular vision	134 (50.38%)
Stereoacuity	82 (30.83%)
Amblyopia	44 (16.50%)
Anisometropia	15 (5.64%)
A- or V-pattern	77 (28.95%)

Table 2. Surgical procedures performed

	Recession resection	Bilateral recession	1 muscle	3 muscles	4 muscles
Basic exotropia	138 (80.2%)	19 (11.0%)	8 (4.7%)	5 (2.9%)	2 (1.2%)
Simulated divergence excess	39 (83.0%)	7 (14.9%)			1 (2.1%)
True divergence excess	10 (23.8%)	32 (76.2%)			
Convergence insufficiency	4 (80.0%)	-		1 (20.0%)	

criteria were as follows: increase in the level and frequency of deviation, presence of exotropia during >50% of waking hours, breakdown of the convergence mechanism, and decreased binocular vision and stereoacuity. Information about strabismus surgery and the likely complications were explained to the patients or patients' parents, and informed consent was obtained.

After surgery, the patients were evaluated and ophthalmic examinations were performed 1 day, 1 week, 1 month, 6 months, and 12 months post surgery. Successful outcome was defined as alignment ≤10 PD esophoria or exophoria at the last follow-up. More than 10 PD esotropia was defined as consecutive esotropia and >10 PD exotropia was defined as residual exotropia; these patients formed the unsuccessful surgery group.

To determine which factors affected the surgical success in intermittent patients, the chi-square and Mann-Whitney U tests were used. Preoperative and postoperative variables were used in these tests as follows:

1. Age at the time of surgery.
2. Follow-up period.
3. Exotropia type.
4. Type of surgery.
5. Level of deviation at near and distance.
6. Presence of anisometropia and amblyopia.
7. Presence of an A- or V-pattern.
8. Presence of binocular vision and stereoacuity.

Table 3. Independent variables that did not differ significantly

	Successful n=181	Unsuccessful n=85	P
Stereoacuity	60 (33.1%)	22 (25.9%)	0.231
Amblyopia	29 (16.0%)	16 (18.8%)	0.570
Anisometropia	9 (5.0%)	6 (7.1%)	0.570
A- or V-pattern	54 (29.8%)	23 (27.1%)	0.642
Mean age at the time of presentation	11.69±8.34	12.86±9.87	0.545
Mean age at the time of surgery	12.08±8.09	13.64±9.49	0.463

Approval of the study protocol was obtained from the institutional review board and all patients or patients' parents provided informed consent. The study and data collection protocols conformed to all local laws and complied with the principles of the Declaration of Helsinki.

Results

Among the 379 patients treated and followed up at our clinic, 220 were female (58.05%) and 159 were male (41.96%); surgery was indicated in 266 of the patients (70.18%). Among the patients that underwent surgery, 151 were female (56.77%) and 115 were male (43.23%). Mean age at presentation was 12.06±8.85 years (range: 1-49 years) and mean age at the time of surgery was 12.78±8.56 years (range: 2-49 years). The mean postoperative follow-up period was 35.68±32.34 months (range: 12-168 months) (Table 1).

Among the patients, 172 (64.66%) had basic intermittent exotropia, 47 (17.67%) had simulated divergence excess, 42 (15.79%) had true divergence excess, and 5 (1.88%) had convergence insufficiency (Table 1). Testing for the presence of binocular vision using Bagolini lenses showed that 134 patients (50.38%) had positive binocular single vision and 132 (49.62%) had negative binocular single vision. Testing for stereoacuity with the TNO or Titmus test showed that 82 patients (30.83%) had binocularite and 184 patients (69.17%) had not binocularite. Among the 266 patients included in the study, 44 patients (16.50%) had amblyopia, 15 (5.64%) had anisometropia, and 77 patients (28.95%) had an A- or V-pattern (Table 1).

In the present study, based on the last follow-up alignment, our success rate was 68.05% (181 patients). There were 80 orthophoric patients (30.07%) at near and distance. In all, a second surgery was indicated in 25 patients (9.40%), in which 23 (92.0%) patients' indication was residual exotropia and 2 (8.0%) patients' was consecutive esotropia. Among the 25 patients, 13 (52.0%) agreed to have the second surgery. The success rate of the second surgeries was 84.6% (11 patients), and the mean time between surgical procedures was 34.61±30.26 months (range: 5-96 months).

Table 4. Independent variables that differed significantly

	Successful n=181	Unsuccessful n=85	p
Mean Level of Deviation			
At near PD±SD (range)	25.82±11.27 (0-50)	30.93±12.47 (0-65)	0.003
At distance PD±SD (range)	30.80±10.59 (10-62)	34.92±11.02 (10-65)	0.007
Binocular vision			
Bagolini positive (n=134)	99 (54.70%)	35 (41.18%)	0.004
Bagolini negative (n=132)	82 (45.30%)	50 (58.82%)	
Mean follow-up period			
Month±SD (range)	32.22±29.02 (12-168)	43.04±37.61 (12-144)	0.047

The surgical procedures performed are summarized in Table 2. Unilateral recession of the lateral rectus muscle and resection of the medial rectus muscle were preferred in the patients that had basic exotropia, simulated divergence excess, and convergence insufficiency, whereas bilateral recession of the lateral rectus muscle was preferred in the patients that had true divergence excess. There weren't any unexpected complications during the perioperative and postoperative periods.

In the present study, preoperative factors such as level of deviation at near and distance, presence of binocular vision, and follow-up period affected the surgical outcome. Independent variables, such as the type of intermittent exotropia (p=0.294), surgery procedure performed (p=0.416), presence of stereoacuity (p=0.231), amblyopia (p=0.570), anisometropia (p=0.570), presence of an A- or V-pattern (p=0.642), age at the time of presentation (p=0.545), and age at the time of surgery (p=0.463), were not statistically different between the two groups (successful and unsuccessful surgery) (Table 3).

In the successful surgery group, the mean preoperative deviation was 25.82±11.28 PD at near and 30.80±10.60 PD at distance. In contrast, in the unsuccessful surgery group, the mean preoperative deviation was 30.93±12.47 PD at near and 34.92±11.02 PD at distance. There was a statistically significant difference in deviation at near (p=0.003) and distance (p=0.007) between the two groups (Table 4).

In the successful surgery group, there were 99 (54.7%) patients who had positive Bagolini test results versus 35 (41.2%) patients in the unsuccessful surgery group; the difference between the two groups was statistically significant (p=0.004) (Table 4). In the successful surgery group, the mean follow-up period was significantly shorter than in the unsuccessful surgery group (p=0.047) (Table 4).

Table 5 shows the number of patients in the successful and unsuccessful surgery groups who were orthophoric 1 week and 6 months post surgery. These results indicate that surgery in the patients orthophoric 1 week (p<0.001) and 6 months (p<0.001) post surgery were very likely to be successful. Table 5 also shows the number of successful and unsuccessful patients that had ≤10 PD esophoria 1 week and 6 months post surgery. These results indicate that the surgery in patients with ≤10 PD esophoria 1 week (p=0.009) and 6 months (p=0.042) post surgery was very likely to be successful. Moreover, Table 5 shows the number of successful and unsuccessful patients who had ≤10 PD exophoria 1 week and 6 months post surgery. These results indicate that the surgery in patients with ≤10 PD exophoria 1 week (p=0.538) post surgery was not likely to be successful, while the surgery in those who had ≤10 PD exophoria 6 months post surgery (p<0.001) was very likely to be successful.

Discussion

In the literature, surgical success rates of intermittent exotropia vary between 45% and 88%10-12. The main reason for the wide variation in success rates could be differences in the relationship between the level of deviation as a postoperative success criterion and differences in the follow-up period. For example, Pratt-Johnson et al. reported that during a mean 1-year follow-up of 100 intermittent exotropia cases, the success rate was 45.7% for all consecutive esotropia cases in the unsuccessful surgery group without taking into consideration the postoperative level of deviation;[19] however, many researchers agree that in the early post surgery period exodeviation is a desired result, because of the tendency for exodeviation after surgery.[20,21] Many other studies reported that another parameter affecting surgical success is the follow-up period.[22] Our study shows that the rate of surgical failure increased as the follow-up period increased. When we included the cases with exophoria and esophoria ≤10 PD in the successful surgery group, the surgical success rate, which was 81.95% 1 week post surgery and 73.79% 6 months post surgery, decreased to a mean of 68.05% 36 months post surgery. This shows that when long-term follow-up was performed, failure in exotropia cases and the need for a second surgery increased.

The present study results suggest that 3 main prognostic factors affected the surgical success in intermittent exotropia

Table 5. Successful and unsuccessful surgical results in orthophoric, <10 PD exophoric, and <10 PD esophoric patients 1 week and 6 months post surgery

	Successful n=181	Unsuccessful n=85	p
Orthophoric Patients			
1 week post surgery (n=86)	70 (38.7%)	16 (18.8%)	<0.001
6 months post surgery (n=60)	58 (32.0%)	2 (2.4%)	<0.001
<10 PD Esophoric Patients			
1 week post surgery (n=33)	29 (16%)	4 (4.7%)	0.009
6 months post surgery (n=14)	13 (7.2%)	1 (1.2%)	0.042
<10 PD Exophoric Patients			
1 week post surgery (n=101)	71 (39.2%)	30 (35.3%)	0.538
6 months post surgery (n=122)	98 (54.1%)	24 (28.2%)	<0.001

Table 6. Factors influencing the surgical success reported in the literature

Investigators	Factors influencing the surgical success
Scott et al. (1975)	Preoperative level of deviation
	Refractive errors
	Age at the time of surgery
	A- and V-pattern
Gordon and Bachar (1980)	Preoperative level of deviation
	Refractive errors
	Anisometropia
Kenan and Willshaw (1994)	Patients who perform overcorrection
	Preoperatively no factor influenced surgical success
Ko and Min (1996)	Preoperative level of deviation
	Age at onset of deviation
Abbasoglu et al. (1996)	Preoperative level of deviation is the most important factor in patients with esotropia but not in those with exotropia
Gezer et al. (2004)	Preoperative level of deviation
	Refractive errors
Koo et al. (2006)	Esophoria rate 1 day and 1 week post surgery
Preoperatively no factor influenced surgical success	
Kose et al. (2006)	Preoperatively no factor influenced surgical success

cases. The first was preoperative level of deviation at near and distance. We observed that the patients with higher levels of deviation had a lower success rate. These results suggest that it could be beneficial to review the surgery nomograph we use for exotropia with wide-angle and, if necessary, the values could be increased.

Binocular vision was the second prognostic factor that affected the success of surgery. Specifically, we observed that surgery carried out in the presence of fusion was more successful than in the other cases. Our findings regarding the relationship between binocular vision breakdown and the timing of surgery are consistent with other studies; e.g. Yildirim et al.[23] reported that good distance stereoacuity and fusion in exotropia patients are important in ensuring a high rate of surgical success.

The third prognostic factor in our study that affected the success of surgery was postoperative level of deviation. Our results suggest that the existence of deviation or consecutive esophoria (≤10 PD) 1 week post surgery was a good predictor of success, although overcorrection in children that have not finished visual development can increase the risk of amblyopia.[11] Other studies show that excessive correction <10 PD yielded better functional and cosmetic results.[11,16,24-26] Moreover, at the 6-month post-surgery follow-up, we observed that there were 2 measures that predicted success orthophoric and residual exodeviation ≤10 PD.

In a study on 225 exotropia patients, Gezer et al.[5] reported that preoperative level of deviation and the presence of high refractive errors affected the success of surgery. In another study, Scott et al.[6] reported that the level of preoperative deviation, age at the time of surgery, refractive error, presence of an A- or V-pattern, and the difference between the level of deviation at near and distance were the major factors influencing the outcome of surgery for exotropia. Gordon and Bachar identified the preoperative level of deviation, presence of anisometropia, and spherical refractive errors as the major determinants of surgical success.[7] In a study involving 199 intermittent exotropia patients, Koo et al.[10] concluded that postoperative deviation 1 day and 1 week post surgery was important indicator in predicting the success of surgery, while all other preoperative factors had no effect. Keenan and Willshaw reported that there are no factors that affect the success of surgery in exotropia. In the case of esotropia, however, they reported that preoperative level of deviation was the most important factor affecting the success of surgery.[27] Table 6 summarizes the factors that previous studies identified as important for surgical success.

Although many studies[10-12,28] reported that the age at onset of exotropia does not affect the surgical success, Ko and Min[29] obtained the highest success rate (92.9%) in patients who were between 4 and 7 years old. Richard and Parks divided 111 exotropia patients who underwent bilateral recession of the lateral rectus muscle into 3 groups: <3 years, 3-6 years, and >6 years. They reported that the age at onset of strabismus did not influence the surgical success.[12] The mean age in the successful surgery group in the present study was 12.38±8.094 years versus 13.64±9.487 years in the unsuccessful surgery group. This difference was not statistically significant (p=0.463).

Due to the retrospective nature of the present study, there are some limitations: surgical procedures were performed by multiple surgeons, and there were differences in the number of patients in the type of intermittent exotropia. It is surprising that only 33% of the patients had measurable stereoacuity based on TNO or Titmus tests, which is very unusual for intermittent exotropia. We thought that there were many childhood patients who are uncooperative during the stereoacuity tests. In the future, we think that the factors influencing the surgical success in patients with intermittent exotropia should be investigated in greater detail with prospective controlled trials.

In conclusion, surgical success in intermittent exotropia patients increased in the presence of fusion, when there was low-level preoperative deviation, when no deviation occurred in the early post-surgery period, and in the cases that had esophoria ≤10 PD. When surgery was performed prior to binocular vision breakdown, we observed that the level of deviation decreased and that preservation of binocular vision improved.

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