

Evaluation of the Main Factors in the Need for Reoperation in Horizontal Strabismus

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ABSTRACT

Strabismus surgery aims to correct the deviation in the visual axes and to achieve a good cosmetic appearance. This study, it was aimed to reveal the causes in patients with horizontal strabismus requiring reoperation. A total of 26 cases, including 22 esotropia and 4 exotropia who was operated on twice for horizontal deviation, were analyzed. The cases were evaluated according to the age of onset of strabismus, muscles involved, presence of amblyopia, and strabismus type. Twenty-two of 26 cases were operated on for esotropia and 4 for exotropia for the second time. Of the 22 patients who were operated on for esotropia, 95% were residual, while 5% were operated on for the second time for consecutive exotropia. One of the patients with exotropia had excessive divergence and the others were consistently exotropia. While amblyopia was detected in 53% of all cases at the beginning, amblyopia was detected in 58% of the group that failed after the second surgery. Amblyopia, high hyperopia and anisometropia, high age at the first operation, and a long interval between two operations may be risk factors for surgical failure. In conclusion, it was emphasized that early diagnosis, early surgical intervention and effective amblyopia treatment can increase the success rate.

Keywords: Etiology, re-operation, horizontal strabismus.

Yatay Şaşılıkta Yeniden Ameliyat İhtiyacındaki Temel Faktörlerin Değerlendirilmesi

ÖZET

Şaşılık ameliyatı, görme eksenlerindeki sapmayı düzeltmeyi ve kozmetik olarak iyi bir görünüm elde etmeyi amaçlar. Çalışmamızda, tekrar ameliyat gerektiren yatay şaşılık hastalarında nedenlerin ortaya konulması amaçlanmıştır. Çalışmamızda, yatay deviasyon nedeniyle iki kez şaşılık cerrahisi uygulanan 22 ezotropya (ET) ve 4 ekzotropya (XT) olmak üzere toplam 26 olgu incelendi. Olgular şaşılık başlangıç yaşı, müdahale edilen kaslar, ambliyopi varlığı ve şaşılık tipine göre değerlendirildi. Çalışmamızdaki ardışık şaşılık gelişen 26 olgunun 22'si ezotropya nedeniyle, 4'ü ekzotropya nedeniyle ikinci kez ameliyat edildi. ET nedeniyle ameliyat edilen 22 hastanın %95'i(21) rezidü iken, %5'i (1) ardışık XT nedeniyle ikinci kez ameliyat edildi. ET'li hastaların sekizinde (%36) infantil ET, 16'sında (%72) akomodatif olmayan ET, 5'inde (%22) kısmi akomodatif ET saptandı. XT'li hastaların birinde (%25) aşırı diverjans vardı ve diğerleri sürekli XT idi. Ambliyopi olguların %53'ünde (13) saptandı. İkinci ameliyattan sonra başarılı olamayan 12 olgunun 7'sinde (%58) de ambliyopi saptandı. İlk ameliyatlarında başarısız olan ET ve XT hastalarının sonraki ameliyatlarında başarı oranlarının farklı değildi. Her iki grupta da ambliyopi, yüksek hipermetrop ve anizometri, ilk ameliyat yaşının yüksek olması ve iki ameliyat süresi arasında geçen sürenin uzun olması cerrahi başarısızlık için risk faktörleri olabilir. Sonuçta, erken tanı,erken cerrahi müdahale ve etkin ambliyopi tedavisinin başarı oranını artırabileceği vurgulandı.

Anahtar Kelimeler: Etiyoloji, re-operasyon, yatay şaşılık.

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INTRODUCTION

Strabismus is the occurrence of functional sensory and motor impairments as a result of the distortion of the parallelism of the visual axis and leaves irreversible sequelae when not treated in a timely and adequate manner. Strabismus surgery aims to provide the best motor and functional recovery with as few operations as possible. However, the desired level of results cannot always be achieved, in patients with the same amount of surgery, quite different results can be obtained from the targeted result. Second surgery in strabismus involves difficult problems in terms of both indication and surgical techniques (Von Norden, 2000).

Slips that occur due to excessive correction of the deviation are called consecutive shifts, while those that develop due to under-correction are called residual shifts. Second operations in strabismus are aimed at the newly formed deviation and cause problems in terms of both indication, timing, and surgical techniques (Bryselbout et al., 2019). In addition, factors such as the presence of amblyopia, high refractive defects, and delay of the operation are stated as factors that can negatively affect the prognosis (Von Norden, 2000).

In this study, we evaluated the factors affecting the success and the results of the subsequent surgical intervention in strabismus cases, whose first surgery was unsuccessful and required reoperation and we aimed to present real-life data and compare them with the literature.

MATERIAL AND METHOD

Study Type

The type of the study is descriptive design.

Population and Sampling

Of 750 patients followed for 5 years at the Ministry of Health Haseki Training and Research Hospital Ophthalmology Clinic, 26 patients, (12 girls, and 14 boys) who had strabismus surgery due to horizontal deviation twice were included in the study.

Patients who had surgery due to vertical deviation, paralytic strabismus, post-traumatic fibrosis, various syndromes, who achieved partial success after the first surgery. They had significant cosmetic and functional improvement, did not follow up regularly for 6 months after the second operation were not included in the study. And also patients who did not have both surgeries in our clinic, who underwent adjustable suture surgery, and who underwent vertical transposition of their horizontal muscles in the first surgery due to the letter (A-V) pattern were excluded from the study. The same classical surgical approach was applied by different surgeons in all cases.

Data Collection Tools and Data Collection

A complete ophthalmic examination was performed at least 3 times postoperatively in all cases (1st month, 2nd month and 6th month). If there was amblyopia, it was followed up with occlusion therapy. The amount of surgical intervention to be performed in all patients was determined by taking the patient's most recent examination findings after the first operation. In the second operation, care was taken to intervene in the muscles that were not operated on before. In the postoperative period, the most recent examination findings were taken into account in our study. In the cases whose first and second operation protocols were examined; those with 10 Prism Diopter (PD) and below deviation after the second operation was considered to be surgically successful and those with more than 10 PD deviations were considered unsuccessful. In the surgical protocol, a maximum of 6 mm recession, 8 mm resection was applied to the inner rectus, and a maximum of 7 mm recession, 9 mm resection was applied to the external rectus. Patients with an incomplete corrected visual acuity and at least two lines of difference between the two eyes were accepted as amblyopia.

Data Analysis

The results were evaluated statistically using Chi-square tests such as Pearson independence and Fisher Exact tests in the computer environment.

Ethics Committee Approval

The study was initiated after the approval of the Ministry of Health Haseki Training and Research Hospital Local Ethics Committee. Written informed consent was obtained from the families (mother or father) of the patients who underwent surgery after necessary explanations regarding the study were made.

RESULTS

The mean age of the patients included in the study was 20.4 ± 26.21 months (1 to 84 months), while 26 of 14 (53.8%) were boys and 12 (46.2%) were girls ($p > 0.05$). The age of strabismus onset were summarized in Table 1. And also the first and second operation ages of the patients were summarized in Table 2. The mean second postoperative follow-up period of the cases was 18.11 ± 12.01 months which varied between 6 and 48 months.

When the distribution of the cases according to the fixation types was examined, it was found that 14 patients (53.8%) were monocular and 12 patients (46.2%) were alternan type. When esotropic cases according to strabismus types that were operated for residual ET was examined, a total of 21 cases. 16 of them were found to be non-accommodative ET (8 of them were infantile ET) and 5 cases were partial accommodative ET. One case that was reoperated with the diagnosis of consecutive XT was infantile ET. When the distribution of exotropic cases according to strabismus types was examined, 4 cases were residual XT; it was observed that one of them was intermittent XT in the excess divergence type and the other 3 were continuous XT.

While the mean age of strabismus onset was 20.4 ± 26.21 months; the mean age of cases with XT was 2.37 ± 0.75 years. The first and second operation ages in the esotropia group and exotropia group are given in Table 2.

Table 1. Distribution of the onset of strabismus by age groups

Strabismus Onset Age Groups	n (%)
1 year and under	10 (38.5)
1-3 year	14 (53.8)
4 years and older	2 (7.7)
Total	26 (100)

Table 2. Distribution of surgery ages of the cases

	1st Op. Age	2nd Op.age
ET Group	7.86 ± 6.40	9.45 ± 10.9
XT Group	5 ± 2.44	6.1 ± 2.80

*ET, Esotropia; XT, Exotropia

The amount of deviation and the amount of surgical recovery in all cases are summarized as before the first operation, after the first operation, and after the second operation in Table 3. No statistically significant difference was found between the success of the first and second operations ($p = 0.202$) (Table 3). In addition, no significant difference was found between the success of the first and success of the second operations whose first diagnosis was XT ($p = 0.512$) (Table 3).

Table 3. Preoperative and postoperative deviation and the amount of recovery due to surgery in all cases

Cases	Deviation (PD)			Improvement (PD)	
	Amount of Deviation Before the First Op.	Amount of Deviation After the First Op.	Amount of Deviation After the Second Op.	Amount of Surgical Recovery First operation	Amount of Surgical Recovery Second Operation
	Mean (Min.-Max.)			Mean (Min.-Max.)	
ET	50.7 (30-90)	26.60 (10-40)	10.8 (0-30)	25.60 (5-55)	18.18 (2-42)
XT	46.25 (45-60)	28.75 (20-40)	17.5 (0-25)	10 (15-20)	18.75 (10-25)

*ET, Esotropia; XT, Exotropia.; PD, Prizm Diopter.

In the second surgery, care was taken to intervene in the eyes and muscles that were not available before. Only one patient with residual ET who underwent recession and resection in a single eye in the first operation was intervened in the same eye in the second operation. Three muscle interventions were applied to none of the cases. In cases operated for XT, bilateral rectus recession was performed in all cases in the first operation. In the second operation; bimedial rectus resection was performed in one case and resection on single eye medial rectus was performed in 3 cases (Table 4).

Table 4. Residual Esotropia (n=21) and Consecutive Esotropia (n=1) Surgery Protocols for Cases

Protocols	First Operation	Second Operation
MRR	-	3
MRR+LRR	12	7
2 MRR	8	-
2MRR+LRR	2	-
LRR	-	8 (1) *
2LRR	-	3
LR	-	1**

MRR(Medial Rectus Recession); LRR,(Lateral Rectus Resection), (MR (medial rectus marginal myotomy),
 **Case developing consecutive XT after the 1st op.)

In the group with XT, two muscles were intervened for all cases in the first operation while one muscle was intervened in 3 cases and two muscles in 1 case in the second operation . Surgical success was achieved in 12 of 21 cases operated for the second time with the diagnosis of residual ET (postoperative deviations were between (+) 10 PD and (-) 10 PD). Hypocorrection was found in 8 cases and hypercorrection was found in one case (Table 5).

Table 5. Distribution by the Amount of Deviation and Postoperative Success in Patients with Esotropia After the Second Surgery

Deviation (PD)	Successful n (%)	Unsuccessful	
		Hypocorrection n (%)	Hypercorrection n (%)
20-40	3 (14.28)	5 (23.80)	1 (4.76)
41-60	8 (38.09)	1 (4.76)	-
61-90	1 (4.76)	2 (9.52)	-
Toplam	12 (57.14)	8 (38.09)	1 (4.76)

*PD, Prizm Diyoptri.

Surgical success was achieved in 2 of 4 cases that were operated on for the second time due to residual XT, while residual XT was found to continue to decrease in the other 2 cases. Both had 20 PD residues XT. Both two cases did not have an operation again (Table 6).

Table 6. The amount of deviation before and after the second operation in residual exotropia case

Operation	Deviation
Preoperative	35±7.07
Postoperative	20
Significance	p>0.05 (AD)

In the evaluation according to the amount of improvement in deviation; there was no significant difference between cases with ET and XT in terms of the success of the second operation (p = 0.747). Amblyopia was detected in 14 (53.86%) cases, 13 of whom were ET and one was XT, of 26 cases whose visual acuities could be determined before the first surgery. In the second postoperative evaluation, 7 (58.33%) of 12 cases who could not be surgically successful had amblyopia. When all cases were examined in terms of refractive error and anisometropia; 6 of the cases (23.07%) +2.50 Diopter (D) and more hyperopia, 12 (46.15%) refraction errors between -1.50 and +2.50 D, 3 (11.5%) myopia above -1.50 D, hypermetropic astigmatism was detected in 8 (3.8%), myopic astigmatism in 4 (15.4%) and anisometropia in 3 (11.5%) patients. When our cases are examined in terms of surgical complications; none of the patients developed

muscle loss or fiber rupture during surgery, and no hemorrhage or fat prolapse requiring excessive cauterization was observed.

DISCUSSION

One of the most important problems that may arise in strabismus surgery is deviations that require surgery again. Therefore, each patient should be examined in terms of factors that may affect the surgical outcome other than the amount of deviation angle (Reena et al.,2019; Von Norden, 2000). Schematically, the second operation is performed for the persistent strabismus angle, although ultimately changing, whether it is related to insufficient correction (residual deviation) or a hypercorrection (overcorrection or consecutive deviation) (Oğuz et al., 2002; Bryselbout et al., 2018; Roth et al., 2019). Although the operations are performed by different surgeons in our clinic, the same classical surgical methods have been used for all of the cases.

When the gender distribution of our cases was made, it was seen that there was no difference between the sexes. In our study, 26 of 14 (53.8%) patients were boys and 12 (46.2%) were girls ($p>0.05$). Our finding about gender is compatible with literature knowledge (Reena et al.2019; Oğuz et al., 2002; Bryselbout et al., 2018; Rajavi et al., 2013; Yurdakul et al., 2013).

It has been reported that the majority of strabismus cases requiring reoperation are residual esotropia, followed by residual exotropia, consecutive esotropia and exotropia. Altıntaş et al. (2000) reported that residual ET was detected in 33 (89.1%) of 37 cases whose first diagnosis was ET and required a second surgery, while 4 (10.8%) had consecutive XT, and residual XT was detected in 8 of 9 cases whose first diagnosis was XT (11). Morris et al. (1993) reported that 12 of 24 (%50) cases with congenital ET (onset before 6 months), one of 24 cases with congenital XT, and 1/24 cases with early acquired ET (onset between 6 months and 2 years) required a second operation (Morris,1993). In our study; 21 (95.45%) residual ET, one (4.54%) consecutive XT, 4 (% 15) residual XT has been determined. These findings found as compatible with the literature.

In similar studies in the literature, different rates were observed in each series (Oğuz et al, 2002; Bryselbout et al, 2018; Wang et al., 2014; Parks M. 2000; Christensen et al., 2018). When the success of the second surgery of our cases is examined; while surgical success was achieved in 12 (57.14%) of 21 patients with residual ET, ET decreased and continued in 8 cases (38.09%). Hypercorrection was observed in one case (4.76%). While success was achieved in two (50%) of 4 cases operated due to residual XT, it was found that XT decreased and continued in two of them. Surgical success was achieved as a result of the second operation in 14 (53.8%) of 26 cases. There was no significant difference between the success of the first and second operations in patients with ET ($p = 0.202$). No significant difference was also found between the success of the two operations in cases with XT ($p = 0.512$). When the success of the second operation in all cases is examined; there was no significant difference between ET and XT groups ($p = 0.747$). Since it may be misleading to evaluate the success of strabismus surgery within a short follow-up period, long-term follow-up is required. Our findings are consistent with the limits given in the literature according to strabismus type and deviation levels (Stack et al, 2003).

In our study, among all strabismus cases (26 in total) who had undergone one operation, the rate of consecutive XT developed at the end of the first operation was 1.03% (one case). 4.76% (1/21) of our patients who were operated on twice due to residual ET converted to XT (had consecutive XT). Considering all horizontal strabismus surgeries (once and/or more) in our clinic, the rate of consecutive XT development is 2.06% (2 cases). Generally, as it has been reported in different series of cases operated for ET, consecutive XT development is observed in 2-20% (Reena et al,2019; Oğuz et al, 2002; Rajavi et al., 2013; Parks, 2000).

In the first operations of the patients, two muscles were intervened in most of our ET cases and all of XT cases, while a single muscle was intervened in majority of the ET and XT cases in the second operations. The results are compatible with the literature (Yurdakul et al. 2013; Wang, 2010; Stack, 2003).

As the onset age of strabismus decreases, the effect of surgery increases, and it has been found that the rate of successive development decreases as this age gets older (Bradbury,1993). Most of the authors; (Reena et al.2019; Bradbury,1993; Fletcher,1966; Roth 2019) state that the younger child age, caused more effective intervention results. Since the globe diameter will be smaller in young children, the geometric effect of the same size surgical intervention will be increased. von Noorden and Campos (2000) reported

that the amount of surgery should be increased as the age progressed. On the other hand, it was determined that the effect of the surgery increased as the age of strabismus decreased. In our study while the onset age of strabismus was under one year in 10 patients (41.6%) and between 1-3 years in 14 patients (58.3%), only 2 of them (8%) were over the age of 4. These findings are similar to the other studies in the literature.

In our study, 14 of 26 (53.86%) cases (13 ET, 1 XT) requiring a second intervention that had different levels of amblyopia in the preoperative period. The high incidence of amblyopia in our cases requiring a second operation may also be the reason for the failure of the first operations. In addition, the presence of amblyopia in 7 of 11 unsuccessful patients after the second operation supports the view that amblyopia negatively affects the outcome of the operation (Rajavi, 2018; Roth, 2019).

When the cases are classified according to refractive errors; the presence of a large amount of high hyperopia and anisometropia resulting in amblyopia were considered as factors affecting partial failure. In our study; 6 of the cases (23.07%) had +2.50 Diopter (D) and more hyperopia; 12 (46.15%) cases had refraction error between -1.50 and +2.50 D; 3 (11.5%) cases had myopia above -1.50 D and hypermetropic astigmatism was detected in 8 (30.8%); myopic astigmatism in 4 (15.4%) and anisometropia in 8 (30.8%) patients. To summarize; amblyopia was detected in 14 (53.86%) cases, 13 of whom were ET and one was XT, of 26 cases whose visual acuities could be determined before the first surgery. In the second postoperative evaluation, 7 (58.33%) of 12 cases who could not be surgically successful had amblyopia. In many different studies amblyopia, anisometropia and high hyperopia have been reported as a risk factors for the need for reoperation and also bad results of second surgery similar to our study (Reena, 2019; Bryselbout, 2019; Altıntaş, 2000; Rajavi, 2018; Christensen, 2018). Moreover, only 5 of 21 (%23) residual ET cases were partially accommodative (PA) in the case classification based on the accommodative factor. Since there were not many PA type cases in this series, the accommodative factor was not considered as one of the factors affecting surgical failure (Fletcher, 1966; Kampanartsanyakorn, 2005).

CONCLUSION

Considering the factors causing the second surgery within the scope of this study; in terms of both the age of the child and the age of onset of strabismus, it is emphasized that the first surgery should be performed in the appropriate period without delay. Also one should not wait no longer than 6 months for the second surgery.

It should also be considered that early diagnosis, timely surgical intervention, and treatment of amblyopia can increase the success rate. Many factors are affecting the success of strabismus surgery, therefore, alternative methods should be developed in addition to the classical standard interventions.

ETHICS COMMITTEE APPROVAL

The study was initiated after the approval of the Ministry of Health Haseki Training and Research Hospital Local Ethics Committee. Written informed consent was obtained from the families (mother or father) of the patients who underwent surgery after necessary explanations regarding the study were made.

AUTHOR CONTRIBUTIONS

Idea/concept: YFÇ, FÖ; Design: YFÇ, FÖ; Consultancy: YFÇ, FÖ; Data collection and/or Data Processing: YFÇ, FÖ; Analysis and/or Interpretation: YFÇ, FÖ; Source search: YFÇ, FÖ; Writing of the article: YFÇ, FÖ; Critical review: YFÇ, FÖ.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

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