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Infantile Esotropia: Clinical features and surgical outcomes

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Abstract

Aim: The objective of this study was to investigate clinical features and surgical outcomes of Infantile esotropia (IET) patients and to evaluate the effect of surgery age on binocular function.

Material and Methods: A total of 28 patients who underwent surgery were enrolled. Medical history of the patients was received, and the age of IET onset, prenatal history, family history and ocular therapies performed (closure therapy, using eyeglasses) were recorded. After cover-uncover test, patients' deviation angles were determined utilizing prism cover test using an accommodative target for far/near. Visual acuity was evaluated according to the optotypes, objects or fixation on the Snellen chart depending on the cooperation of the patients. Bilateral medial rectus recession was applied in all patients.

Results: The mean age of IET onset was determined as 2.11±2.18 months. Patients' age of surgery differed between 10 months and 25 years with a mean age of 5.3±6.1 years. In all patients, the preoperative amount of the far deviation was 48.39±1.06 PD (25-80 PD) and preoperative amount of near deviation was 48.57±12.97 PD (25-80 PD). Twenty-six patients first underwent bilateral medial rectus recession (maximum: 6.5 mm). When pre- and postoperative deviation angles were compared, postoperative deviation angles were significantly improved ($p<0.05$).

Discussion: The most appropriate time for surgery in IET cases should be taken as the earliest time when the amount of deviation can be accurately determined, refractive errors should be determined before and after surgery in all cases, treatment of amblyopia and early completion of surgical correction should be aimed at gaining binocular functions.

Keywords

Infantile Esotropia, Visual Acuity, Strabismus, Binocularity, Amblyopia

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Introduction

Strabismus is a misalignment of the eyes in which the visual axes deviate from bifoveal fixation. It can be divided into esotropia and exotropia. Infantile Esotropia (IET) is defined as the onset of constant strabismus in children less than 6 months of age. The incidence of IET is 1%, making it an important issue for pediatric ophthalmologists [1]. It can be congenital or acquired, intermittent or constant and may change patterns from intermittent to constant over time. In a meta-analysis, Hashemi et al. estimated the prevalence of IET as 0.77% [2].

A detailed history and physical exam are essential for all patients with esotropia presenting to the outpatient clinic. Medical history should include patients' age, onset of deviation, constant/intermittent and unilateral/alternating IETs. In addition, abnormal head posture, headaches, complaint of closing one eye in bright sunlight, and complaint of double vision should also be considered when receiving history [3]. In IET, children typically have a large angle of deviation, usually greater than 30 degrees. In children with IET, visual acuity or retinoscopy values are in general within normal range because of cross fixation, and no significant underlying refractive errors are expected [4]. However, there is still no consensus on the pathogenesis of IET and numerous studies have been performed about the treatment of this disorder. The widely adopted option is to treat IET as early as possible in order to obtain good motor and sensory results [5].

IET produces a convergent squint in a neurologically normal child. If a child with IET is not corrected timely, this wide-angle esotropia can affect life-long vision [6]. The ideal timing for surgery in patients with IET is not clear. In patients with IET, the ideal time for surgery is between 6 months and 2 years of age. The decision for surgery is based on the measurement of squint. The preference of surgery is also made by physician's discretion. Since the presence of amblyopia affects the surgery success negatively, it must be detected and treated postoperatively. Complications of IET surgery include residual esotropia, infection, suturing induced granuloma, anterior segment ischemia or lost muscle [7]. In addition, complications related to general anesthesia should also be taken into account in these patients.

The objective of this study was to investigate clinical features and surgical outcomes of IET patients and to evaluate the effect of surgery age on binocular function.

Material and Methods

This retrospective study included patients diagnosed with IET in the Strabismus Unit of the 1st Eye Clinic of the Ministry of Health, Izmir Ataturk Training and Research Hospital. A total of 28 patients who underwent surgery were enrolled.

Patients' informed consent forms were waived since the study was retrospectively designed. However, the necessary permission was obtained from the hospital management for using archive files. The study was performed in accordance with the relevant ethical principles of the Declaration of Helsinki.

The age and gender of the patients were recorded at the time of physical exams. Medical history of the patients was received, and the age of IET onset, prenatal history, family history and ocular therapies performed (closure therapy, using eyeglasses) were recorded. The cases were included in the study where strabismus was known to have started before 6 months of age, based on the history taken from the families and the patients and information obtained from the old photographs. Since obtaining a medical history from the patients who presented late was difficult, cases in which strabismus started under 6 months of age were also included if they carried other features of IET.

All patients underwent anterior segment examination. Cyclopentolate of 1% was dropped 3 times with 10-minute intervals, and after waiting for 45 minutes to achieve cycloplegia and pupil dilation, fundus examination and skiascopy were performed. Cycloplegia was provided with cyclopentolate 0.5% in infants. After cover-uncover test, patients' deviation angles were determined utilizing prism cover test using accommodative target for far/near. In whom we could not perform these tests, the amount of deviation was determined with the Krimsky test. Titmus and Worth 4-point tests were applied to the patients who could cooperate. Patients who could see the butterfly in the titmus test (3000 sec/arch) were considered to have stereopsis. Visual acuity was evaluated according to the optotypes, objects or fixation on the Snellen chart depending on the cooperation of the patients. The presence of amblyopia was accepted in patients with 2 or more lines of visual loss on the Snellen chart. Following glasses and closure treatment administered according to the result of cycloplegic refraction, alternation was provided and surgery was scheduled. Deviation angle was measured at least three times preoperatively. The amount of the surgery performed was calculated taking into account the amount of deviation and clinical features of the patients.

The patients were operated under local or general anesthesia according to age and coordination. Bilateral medial rectus recession was applied in all patients. In cases where the procedure was insufficient, resection of the lateral rectus was performed as the second surgery. Standard medial rectus recession and lateral rectus resection when necessary were performed through limbal incision. Inferior oblique myectomy was performed in the patients who developed inferior oblique hyperfunction (IOHF) and superior rectus recession in those who developed dissociated vertical deviation (DVD). 6/0 polyglactin (Vicryl) was used as the suturing material. All measurements were made at the insertion point of the muscles.

Antibiotic and steroid drops were applied 4 times a day for 5 days postoperatively to all patients. After the 1st, 10th days and 1st month, the patients were followed for a minimum of 6 months and a maximum of 48 months. The amount of deviation was re-evaluated postoperatively. In the follow-up, esotropia or exotropia cases with a deviation of 10 PD or less were considered successful, while cases with a deviation of more than 10 PD were considered unsuccessful.

Statistical Analysis

The data obtained in this study were statistically analyzed using SPSS version 13.0 (SPSS, Statistical Package for Social Sciences, IBM Inc., Armonk, NY, USA). Study data were expressed with descriptive statistical methods (mean ± standard deviation), and quantitative data were compared using Student's t-test. Qualitative variables were compared with the Chi-square test. $P<0.05$ values were considered statistically significant.

Results

A total of 28 patients operated due to IET were included in the study. The mean age at the time of admission was 5.07±6.24 years (4 months – 25 years). Of the 28 patients, 15 (53.60%) were boys and 13 (46.40%) were girls. No statistically significant difference was found in terms of gender. The mean postoperative follow-up duration was 1.73±0.95 years (6 months – 4years).

The mean age of IET onset was determined as 2.11±2.18 months. Family history was questioned in IET patients. Of all patients, 14.29% had a family history of IET, while 85.71% had not. Three (10.71%) patients had a history of preterm, while medical history was unremarkable in the remaining 25 (89.29%) patients.

Patients' age of surgery differed between 10 months and 25 years with a mean age of 5.3±6.1 years (Figure 1).

In all patients, the preoperative amount of the far deviation was 48.39±1.06 PD (25-80 PD) and the preoperative amount of near deviation was 48.57±12.97 PD (25-80 PD) (Figure 2). Twenty-six patients first underwent bilateral medial rectus recession (maximum: 6.5 mm). One patient underwent unilateral recession and resection and one patient had medial rectus recession and bilateral inferior oblique myectomy as the first operation. Four (14.29%) patients were operated for the second time on average 21.00±17.34 months after the first operation. These interventions were performed for residual esotropia and IOHF and carried out as resection to the lateral rectus and/or inferior oblique myectomy.

Two patients underwent two and two patients three operations. Horizontal deviation angle of 10 PD and below was accepted as the success criterion in the post-surgical examination performed from a distance of 6 meters. After the surgical correction, deviation angle was found as ≤10 PD in 22 patients, 10-20 PD in 3 patients and >20 PD in 3 patients (Figure 3).

When pre- and postoperative deviation angles were compared, postoperative deviation angles were significantly improved ($p<0.05$).

As a result of the surgeries, 22 patients (78.57%) were orthophoric, 4 patients were esotropic (12.28%), and 2 patients (7.15%) were exotropic (Table 1).

Preoperative refraction values were ≤ +2.00 D in 14 (50%) patients, between +2.5 and 5.00 D in 8 (28.57%) patients, emmetropia in 4 (14.29%) patients, >5 D in one (3.57%) patient and myopia in one (3.57%) patient.

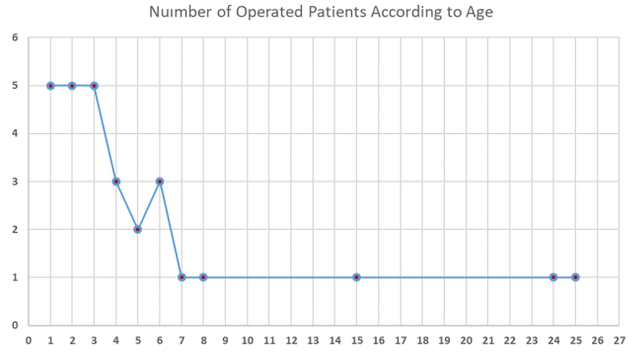


Figure 1. Number of operated patients according to age at the time of admission

Postoperative refraction values were ≤ +2.00 D in 15 (53.57%) patients, emmetropia in 4 (14.29%) patients, between +2.5 and 5.00 D in 6 (21.43%) patients, >5 D in two (7.14%) patients and myopia in one (3.57%) patient.

IET was accompanied by amblyopia in 15 (53.57%) patients,

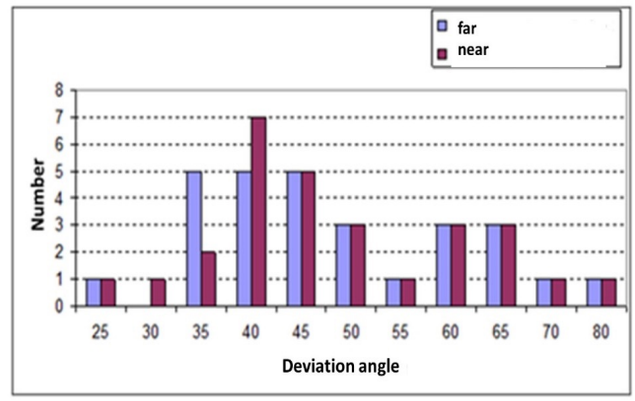


Figure 2. Distribution of preop far and near deviation angles

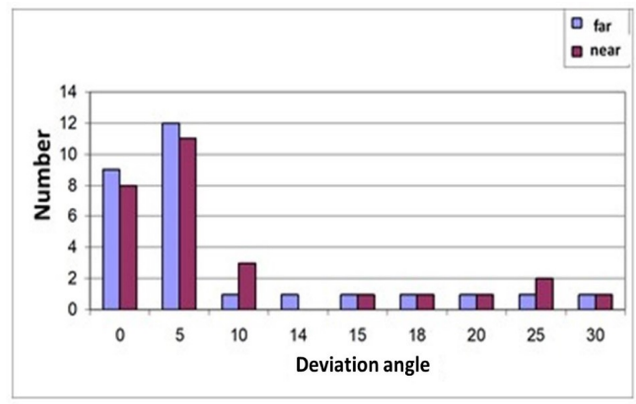


Figure 3. Distribution of postop deviation angles

Table 1. Surgical outcomes in IET patients

Postop Deviation Angle	Number	%
Orthophoric	22	78,57
Esotropic	4	14,28
Exotropic	2	7,15
Total	28	100

Table 2. The mean amount of recession according to the deviation angles

Preop. deviation angle	Recession	Number	%
25	5,0	1	5
35	4,9	5	25
40	5,0	4	20
45	5,2	5	25
50	5,0	2	10
55	5,5	1	5
60	5,7	2	10
Total	5,1	20	100

DVD in 4 (14.29%) patients, and IOHF in 8 (28.56%) patients with being bilateral in 3 (10.71%) patients and unilateral in 5 (17.85%) patients.

Binocular functions could be evaluated in 23 (82.14%) of 28 cases. In the evaluation performed with titmus tests, there was no binocularity postoperatively in 14 (60.86%) of these 23 patients. These patients were evaluated as the patients operated before 2 years of age, 2-4 years of age and after 4 years of age. Binocularity could not be evaluated in 3 of 6 patients who were operated before the age of 2 years. In the other 2, stereo acuity was detected at 3000 sec/arc level. Ten of 12 patients between the ages of 2 and 4 who were operated on could be evaluated. Stereo acuity of 3000 sec/arc was detected in 4 of 10 patients. Stereo acuity of 3000 sec/arch was detected in 3 of 10 patients who were operated after the age of four. No statistically significant difference was found between these patient groups in terms of the development of binocularity. There was a statistically significant difference between the 1st group and the 3rd group in terms of binocular vision (p=0.045).

Medial rectus recession was adjusted according to the deviation angles of the patients. According to the success criteria of 10 PD and below, a successful outcome was achieved with the first surgery in 20 patients (Table 2).

Discussion

IET is a fixed wide-angle nonaccommodative esotropia with an unexplained etiology, which is not accompanied by neurological findings, and occurs in the first 6 months of life [8]. It is inevitable that the binocular functions will be affected in IET because the deviation develops in the early period when the binocular functions are susceptible to be affected, and because it has a wider angle than other deviation types. Cross-fixation, IOHF, DVD, and latent nystagmus are often associated with IET [9].

The amount of deviation angle is higher in IET compared to the esodeviations occurring in advanced ages [10]. In our study, it was found as 48 PD. This angle was reported as 43 by Rajavi et al [11], 37.3 by Kim et al. [12], and 49 by von Noorden [13].

In the cycloplegic refraction distribution, in our study, hyperopia was found to be +2.0 D or less in 64.29% of cases, between +2.5 and +5.0 D in 28.57% of cases, over +5.0 D in 3.57% of cases, and myopia in 3.57% of cases. The prevalence of hyperopia ≥+4 diopters was 3.2% in the worse eye, with both eyes involved in 64.4% of cases in a study [14].

Vertical deviations and especially IOHF are common findings in IET. IOHF has been reported in the literature between 36-78%. [15, 16]. DVD has been reported to be between 21-90% in the literature [15, 16]. In our study, we found IOHF in 28.56% and DVD in 14.29%. von Noorden et al. found IOHF as 68 % and DVD as 51% in their 408 cases [13].

There is consensus on early surgery for the development of binocular functions in IET [13]. Deepa et al. found reduced stereopsis in 42.6 of 246 cases [17]. In a study published by Xu, normal contrast sensitivity binocular summation ratio in IET after surgical treatment suggest that the ability of the visual cortex in processing binocular information is intact at the contrast threshold level [18], subnormal binocular vision was obtained in 20 (80%) of 24 patients who were operated under the age of 1 year, and similar results were observed in only 40% of those who underwent surgery after 1 year of age. In the study by Yang et al. [19], the mean age of surgery was found to be 78.1 days months in the group with binocular vision. In a study published by the ELISS (Early vs. Late Infantile Strabismus Surgery Study) group, 532 patients were evaluated and stereopsis was observed to be better in patients who underwent surgery at an early age [20]. In a study by Yang et al. there was a significant difference between the age groups in terms of binocular vision [19]. In our study, there was no significant difference in stereopsis between those who underwent surgery before the age of 2 and between the ages of 2 and 4, and those who underwent surgery after the age of 4, but a significant result was obtained when the group who underwent surgery before the age of 2 years and the group who underwent surgery after the age of 4 years were compared in terms of stereopsis. This indicates that surgery should be performed as soon as possible, immediately after correcting the refractive error and amblyopia.

The aim of surgical correction in IET is to bring the eyes to the orthophoric position with a minimum number of surgeries. von Noorden [13] reported that an average of 2.1 surgeries per case were required to re-parallel the eyes with unilateral surgery. Önal et al. [21], in their study comparing the results of symmetric and unilateral surgery, compared the deviation angle differences before and after surgery for two surgery types and found unilateral surgery to be more effective in the treatment of IET.

Bilateral medial rectus recession is a popular surgical method in IET and we prefer to perform bilateral medial rectus recession in our study. We found a success rate of 78% as a result of bilateral medial rectus recession in our study. We did not observe any limitation of adduction or weakness of convergence in any of our cases with bilateral medial rectus recession.

Study Limitations

The major limitations of our study are its retrospective design and being conducted in a single center. In addition, more parameters related to IET could be studied. However, we believe that our results will serve as a guide for future studies on this topic.

Conclusion

In conclusion, the most appropriate time for surgery in IET cases should be taken as the earliest time when the amount of deviation can be accurately determined, refractive errors should be determined before and after surgery in all cases, treatment of amblyopia and early completion of surgical correction should be aimed at gaining binocular functions, albeit limited. For long-term stabilization after surgery, patients should be followed carefully for the development of amblyopia, DVD, primary IOHF and accommodative esotropia.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with

the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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