RESEARCH ARTICLE / *Araştırma Makalesi*

Factors Affecting Stereopsis in Patients with Refractive Accommodative Esotropia

Refraktif Akomodatif Ezotropyalı Hastalarda Stereopsisi Etkileyen Faktörler

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Öz

Objective	Aim of this study was to evaluate possible risk factors affecting stereopsis in patients with refractive accommodative esotropia (RAE).
Materials and Methods	The retrospective investigation was performed on the records of children with RAE. Two groups were made according to the presence of stereopsis. The presumed onset age of RAE, age at the initial refractive correction, mean best-corrected visual acuity (BCVA), mean angle of deviations in near and distance, presence of strong fixation preference, spherical equivalent (SE), and cylindrical error values, mean interocular differences in BCVA were compared between groups. Besides, mean SE and ocular movement disorders were also evaluated and compared between groups, statistically.
Results	The mean age of 66 children was 10,7±2,9 years. The mean follow-up time was 65,3±25,6 months. 38 children had measurable stereoacuity and 28 children who had not and composed groups 1 and 2, respectively. There were statistically significant differences between groups in terms of mean BCVA, the interocular difference in BCVA, mean SE, presence of amblyopia, and the presence of inferior oblique overaction.
Conclusion	Presence and depth of amblyopia, lower best-corrected visual acuity, higher spherical equivalent, and concomitant inferior oblique overaction were found to be potential risk factors for the maldevelopment of stereopsis in patients with refractive accommodative esotropia.
Keywords	stereopsis; refractive accommodative esotropia; risk factors

Abstract

Amaç	*Refraktif akomodatif ezotropyalı (RAE) hastalarda stereopsisi etkileyecek olası risk faktörlerini değerlendirmek.*
Gereç ve Yöntemle	*RAE tanılı hastaların kayıtları geriye dönük olarak incelendi. Stereopsis varlığına göre iki grup oluşturuldu. RAE başlama yaşı, ilk refraktif düzeltme yaşı, en iyi düzeltilmiş görme keskinliği (EİDGK), yakın ve uzakta kayma dereceleri, güçlü fiksasyon varlığı, sferik eşdeğer (SE), silindirik kusur, gözler arası EİDGK ve SE farkları ve göz hareketlerindeki bozukluklar 2 grup arasında karşılaştırıldı.*
Bulgular	*Toplam 66 çocuğun ortalama yaşı 10,7±2,9 yıldı. Ortalama izlem süresi 65,3±25,6 aydı. 38 çocukta ölçülebilir stereopsis varken 28 çocukta yoktu ve sırasıyla grup 1 ve 2'yi oluşturdular. Ortalama EİDGK, gözler arası EİDGK ve SE farkları, ambliyopi varlığı ve alt oblik hiperfonksiyonu iki grup arasında istatistiksel olarak anlamlı farklı idi.*
Sonuç	*Ambliyopi varlığı ve derinliği, düşük EİDGK, yüksek SE ve eşlik eden alt oblik hiperfonksiyonu, RAE'lı hastalarda stereopsis gelişimini olumsuz etkileyebilecek potansiyel risk faktörleri olarak bulunmuştur.*
Anahtar Kelimeler	*stereopsis; refraktif akomodatif ezotropya; risk faktörleri*

INTRODUCTION

Uncorrected hyperopia, accommodative convergence, and insufficient fusional divergence are the main factors that cause refractive accommodative esotropia (RAE).[1] Although this disease usually occurs in 2 or 3-year-old children, it may be present in children younger than 1 year. The angle of deviations in near and distance is typically the same and full correction of hyperopia based on cycloplegic refraction is the mainstay of the treatment.[2] Amblyopia may occur in these children with RAE and should be treated to achieve normal binocular vision.[3]

Normal binocular vision and stereopsis are developed between 8 and 18 months.[4] Although RAE usually begins in the 2rd or 3rd decade of life, the stereoacuity of these children is impaired. The possible risk factors affecting stereoacuity in children with refractive accomodative esotropia were investigated in previous studies.[1,3,5-7] Early onset of RAE, angle of deviation, fusional ability, presence and depth of amblyopia, constant misalignment were potential risk factors influencing stereoacuity in different studies.[5-7]

This current study aimed to evaluate possible risk factors influencing stereoacuity in children with RAE. Age of onset, refractive characteristics, angle of deviation, presence, and depth of amblyopia, vertical misalignments were investigated and compared between patients with and without stereopsis.

MATERIALS and METHODS

In this observational cross-sectional study, evaluation of patients' records was performed at the Ophthalmology Department of a Tertiary University Hospital, retrospectively. Prior approval was received from the Institutional Review Board (Sakarya University Ethical Board, date: 20.04.2020, IRB number: 71522473/050.01.04/168), and informed consent was taken from the parents of each child. This retrospective study was performed in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The retrospective investigation was performed on the records of children who were followed up in the Pediatric Ophthalmology Department. Esotropic children who were given full hyperopic correction at the initial visit were found out. Children with residual 10 prism diopter (PD) or less esotropia were diagnosed as RAE and were enrolled in this current study. The minimum follow-up time was considered as 36 months and children who were 11 years old or younger in the initial visit were enrolled in this current study. Children with additional neurological diseases, systemic syndromes, and ocular pathologies were not included.

Best-corrected visual acuity (BCVA) was measured by Snellen letters or figures according to patients' cooperation and age. The interocular difference in BCVA (VoD) was calculated at the initial visit and the final visit. The deviation angle was measured by an alternate cover test in near (33 cm) and distance (6 m). Strong fixation preference was assessed by the cover test and noted. Eye movements in six cardinal positions were evaluated and noted. AC/A ratio was calculated by the gradient method and patients with high AC/A ratio were not included in this study. Stereopsis was measured by using the Titmus test (Stereo Optical, Chicago, IL). If the picture with the largest disparity could not be seen, it was accepted that stereopsis was not present. According to the presence of stereoacuity, 2 groups were made. In group 1, there were children who had measurable stereoacuity, and in group 2 there were children with no stereoacuity.

Refractive error was performed after cycloplegic eye drops (1% cyclopentolate) were instilled three times in 10-minute intervals. Retinoscopy was performed 30 minutes after the last drop. To calculate the spherical equivalent (SE), algebraically 1/2 of the cylinder power was added to the sphere power. Children with SE ≥ 3 diopter (DP) and the interocular difference in SE ≤ 2dp were included in this study. Firstly, the hyperopic refractive error including astigmatism was fully corrected. Occlusion therapy (6 hours/

day) was also advised for amblyopic patients. Amblyopia was defined as 2 lines or more difference between eyes in Snellen chart, or visual acuity worse than or equal to 20/30 with full optical correction.[8] The presence of amblyopia in the initial and the final visit were noted.

The presumed onset age of RAE and the initial age of refractive correction by glasses were also noted and compared statistically between groups.

The mean BCVA, mean VoD, deviations in near and distance (uncorrected and corrected by glasses), presence of amblyopia at the first and last follow-up visits, inferior oblique overaction (IO OA), strong fixation preference, positive family history, mean SE, cylindrical refractive error, the interocular difference in SE, mean onset age of deviation, mean age at the initial refractive correction were statistically compared between groups.

SPSS statistical software (IBM SPSS Statistics, Version 23.0. Armonk, NY: IBM Corp.) was used for statistical analysis. Normality of distribution was tested by using Kolmogorov-Smirnov test. The numeric variables were presented as mean ± standard deviation. Comparison was performed by using an independent t-test. A p-value <0.05 was considered significant.

RESULTS

There were 66 children (28 female, 38 male) who were enrolled in this study. The mean age of children was 10,7±2,9 years. The mean follow-up time was 65,3±25,6 months.

In group 1, there were 38 children who had measurable stereoacuity and in group 2 there were 28 children who had no stereoacuity.

There were no significant differences between groups in terms of near and distance deviations with or without refractive correction, presence of strong fixation preference, the interocular difference in SE, cylindrical refractive error, positive family history, presumed onset age of RAE, and age at the initial refractive correction by glasses.

There were statistically significant differences between groups in terms of mean BCVA, the interocular difference in BCVA in the initial visit, mean SE, presence of amblyopia in the initial visit, and the presence of IO OA. Tables 1 and 2 reveal details of these parameters.

Table 1: Comparison of parameters between Group 1 and 2.

	Group 1 (n:38)	Group 2 (n:28)	p value
Near deviation	37,2±10,2	40,0±10,2	p:0,29
Corrected near deviation	3,5±3,4	3,9±3,9	p:0,65
Distance deviation	26,0±10,1	29,5±12,1	p:0,20
Corrected distance deviation	1,5±2,9	2,9±3,4	p:0,09
Presence of amblyopia (n)	16	20	p:0,02
Presence of SFP (n)	9	8	p:0,77
Presence of IO OA (n)	2	14	p<0,001
Presence of family history (n)	10	4	p:0,36
Interocular difference in SE	0,41±0,47	0,38±0,48	p:0,79
Interocular difference in BCVA	0,5±0,9	1,8±2,1	p:0,001
Presumed onset age of RAE	3,3±1,8	2,3±2,4	p:0,06
Mean age at the initial refractive correction	4,5±2,1	3,6±2,9	p:0,16

SFP: strong fixation preference IO OA: inferior oblique overaction SE: spherical equivalence BCVA: best corrected visual acuity RAE: refractive accommodative esotropia

We also evaluated the interocular difference in BCVA and the presence of amblyopia in the last ophthalmic visit. Mean interocular differences in BCVA was 0,5±0,7 and 1,5±1,8 in Group 1 and 2, respectively (p: 0,006). In 6 children in Group 1 and 12 children in Group 2; amblyopia was persistent in the last visit of follow-up time (p: 0,015). There were still statistically significant differences between groups in terms of mean the interocular difference in BCVA and the persistence of amblyopia at the last visit.

Table 2: Comparison mean BCVA, SE and cylindirical error between eyes in Group 1 and 2.

	Group 1 (n:76 eyes)	Group 2 (n:56 eyes)	p value
Mean BCVA	0,7±0,2	0,5±0,2	p<0,001
Mean SE	5,0±1,5	5,7±2,2	p:0,02
Mean cylindirical error	0,9±1,0	1,5±3,3	p:0,13

BCVA: best corrected visual acuity SE: spherical equivalence

DISCUSSION

Factors influencing stereopsis in patients with esotropia were investigated previously.[9-15] But, few studies were focused on refractive accommodative esotropia.[1,3,5-7] Therefore, this current study was planned as a retrospective observational study.

The near and distance deviations before and after refractive correction were not different in children with or without stereoacuity in this current study. But Lee et al[5] found that stereopsis could be achieved with a deviation of ≤4 PD at distance and ≤5 PD at near fixation. Güçlü et al[1] also reported higher near deviation as a risk factor for developing stereopsis. The sample sizes of groups were variable in this study. There was no other study assessing residual deviation in literature. In our opinion this issue was important and these incompatible results should be clarified.

Strong fixation preference was not found as a risk factor for developing stereopsis in this current study. In our previous study which was assessed patients with both RAE and amblyopia, we found that strong fixation preference was correlated with impairment in stereoacuity.[16] To the best of our knowledge; there was no other study assessing this issue.

The presence of IO OA was found to be more common in children who had no measurable stereo acuity in this current study. We also reported previously that the presence of IO OA might be a potential risk factor for the development of stereopsis in patients with both RAE and amblyopia.[16] On the other hand, Üretmen et al[6] also investigated ocular movement disorders in patients with RAE and they did not observe the presence of IO OA as a risk factor for the development of stereopsis. In our opinion; concomitant vertical ocular misalignments should be assessed when evaluating stereopsis. This approach might help us to gain more information about this item.

In this current study, both the presence and depth of amblyopia were found to be potential risk factors for the development of stereoacuity. Birch et al[17] and Guclu et al[1] also found a strong relationship between amblyopia and stereopsis. When we re-assessed the relationship between stereopsis and amblyopia after a follow-up time interval of at least 3 years, we observed a decrease in both the number of amblyopic patients and the depth of amblyopia but amblyopia has remained as a potential risk factor. Further studies with long-term follow-up time might clarify the relationship between amblyopia recovery and the gain of stereopsis.

The Maldevelopment of stereopsis was observed to be linked to worse BCVA in patients with RAE. Guclu et. al1 also found a relationship between low visual acuity and poor stereopsis in their study. Low visual acuity is linked to amblyopia and this impairment in stereopsis has already been expected.

We have already known that the degree of anisometropia is associated with amblyopia and poor stereopsis. 18 Thus, in this current study we did not include patients with an interocular difference in SE higher than 2 DP and two groups were not statistically different in terms of anisometropia. We observed that patients with stereopsis had lower SE than patients without stereopsis. This result was suggested to us that high SE might cause low BCVA and development of amblyopia and finally cause maldevelopment of stereopsis.

The presumed onset age of RAE and mean age at the initial refractive correction of patients were found to not affect

stereopsis development, in this current study. There were studies investigated the effect of onset age on stereopsis and our results were similar to these studies.[1,6,7] Birch et al[17] suggested that some abnormalities in stereoacuity might exist before the onset of esotropia.

The important limitation of our study was the relatively small sample size. On the other hand, we tried to perform a wide investigation including the history of RAE, family history, amounts of deviation, the effect of amblyopia, effects of refractive errors, effects of ocular movement disorders.

CONCLUSİON

The presence and depth of amblyopia, lower BCVA, higher SE, and concomitant inferior oblique overaction were found to be potential risk factors for the maldevelopment of stereoacuity in children with refractive accommodative esotropia.

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Declaration of interest statement

The authors report no conflict of interest.

Prior approval was received from the Sakarya University Ethical Board (Date: 20.04.2020, IRB number: 71522473/050.01.04/168) for this retrospective cross-sectional study.

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