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The assessment of anterior segment parameters using the Sirius topography in adults with anisohypermetropic amblyopia

Anizohipermetropik ambliyopisi olan yetişkinlerin ön segment parametrelerinin Sirius topografi ile değerlendirilmesi

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Abstract

Aim: To evaluate anterior segment parameters in the eyes of adults with anisohypermetropic amblyopia using the Sirius topography device.

Materials and Methods: Forty-eight patients with anisohypermetropic amblyopia were prospectively evaluated along with a control group of 45 healthy patients. All patients were examined with the Sirius topography system under cycloplegic and non-cycloplegic conditions. The anterior and posterior mean keratometry values, central corneal thickness (CCT), anterior chamber depth (ACD), corneal volume (CV), and anterior chamber volume (ACV) measurements were compared among groups.

Results: No significant difference was found in the anterior and posterior mean keratometry values, CCT, ACD, CV, and ACV measurements between amblyopic, fellow, and control eyes under cycloplegic and non-cycloplegic conditions ($p>0.05$).

Conclusion: This study shows that the anterior segment parameters measured by the Sirius topography device among amblyopic, fellow, and control eyes do not differ under both cycloplegic and non-cycloplegic conditions.

Keywords: Anisometropic amblyopia, anterior eye segment, corneal topography.

Öz

Amaç: *Anizohipermetropik ambliyopisi olan yetişkinlerde ön segment parametrelerini Sirius topografi ile değerlendirmek.*

Gereç ve Yöntem: *Anizohipermetropik ambliyopisi olan 48 hasta ve 45 sağlıklı yetişkin çalışma kapsamında prospektif olarak değerlendirildi. Tüm hastaların sikloplejik damla öncesi ve sonrasında Sirius topografi cihazı ile muayeneleri gerçekleştirildi. Ön ve arka ortalama keratometri değerleri, santral kornea kalınlıkları (SKK), ön kamara derinlikleri (ÖKD), kornea volümü (KV) ve ön kamara volümleri (ÖKV) gruplar arasında karşılaştırıldı.*

Bulgular: *Ön ve arka ortalama keratometri değerleri, SKK, ÖKD, KV ve ÖKV arasında ambliyopisi olan hastanın ambliyopik gözü, diğer göz ve kontrol hastasının gözleri arasında sikloplejik damla öncesi ve sonrası ölçümlerde fark saptanmadı ($p>0.05$).*

Sonuç: *Ambliyopisi olan yetişkinlerde ambliyopik göz, diğer göz ve kontrol gözler arasında sikloplejik damla öncesi ve sonrasında Sirius topografi ile yapılan değerlendirmede ön segment parametreleri arasında anlamlı fark saptanmamıştır.*

Anahtar Sözcükler: *Anizometropik ambliyopi, ön göz segmenti, kornea topografisi.*

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Introduction

Amblyopia, caused by strabismus, anisometropia, form deprivation, or a mix of these components, has been estimated to affect 2–5% of the population (1-4). Hyperopic anisometropia is the most common risk factor for amblyopia (3).

The current model of human emmetropisation maintains that blurry vision caused by the hyperopic refractive error in an infant's eye alters growth of the eye to reduce refractive error (5). Several studies have indicated that amblyopia is associated with some abnormalities in the optic nerve, lateral geniculate nucleus, retina, retina fiber layer (RNFL) and ganglion cell plus inner plexiform layer (6-10). The effect of amblyopia on the anterior segment has been also investigated. However, studies about this item are controversial, it is still unclear whether or not the anterior segment is entirely normal in amblyopia (11-16).

The Sirius system, Scheimpflug-Placido topographer, has been used to evaluate the anterior segment. This system combines a single-Scheimpflug rotating camera with Placido disk topography. The Sirius can simultaneously acquire more than 30,000 points on the anterior and posterior corneal surface and 25 radial sections of the cornea and anterior chamber within a single scan (17).

In the present study, we aimed to compare anterior segment parameters between the eyes of adults with anisohypermetropic amblyopia, fellow eyes and controls using the Sirius topography device.

Materials and Methods

This prospective study included 48 amblyopic eyes of 48 patients with anisometropic amblyopia (Group 1), the 48 fellow eyes of the amblyopic patients (Group 2), and the 45 right eyes of 45 healthy participants in the control group (Group 3).

Patients with histories of systemic disease, previous ocular surgery, ocular trauma, contact lens usage, intraocular pressure of >21 mmHg, evidence of cataract or glaucoma, dry eye, or any corneal, retinal, or choroidal pathology were excluded from the study. Hyperopic anisometropic amblyopia was defined as hyperopia of ≥1.5 D, an interocular difference of at least 1.5 D (spherical equivalent) and a visual acuity difference between the amblyopic and normal eyes of at least 2 lines on the Snellen chart. The spherical equivalent (SE) was calculated as the sum of the spherical value and half of the cylindrical value. The objective refraction was measured by retinoscopy after instillation of 2 drops, 10 minutes apart, of cyclopentolate hydrochloride 1% (Sikloplejin®, Abdi İbrahim, Turkey), whereas best-corrected visual acuity (BCVA) was obtained using Snellen charts and converted to LogMAR units for analysis. Controls were selected from patients who applied for routine ophthalmic examination. Emmetropia was defined as uncorrected distance visual acuity better than 20/25 by Snellen chart in each eye.

All patients had a detailed preoperative ophthalmologic examination including slit-lamp evaluation, Goldmann tonometry, fundoscopy, topography by Scheimpflug imaging (Sirius, Costruzione Strumenti Oftalmici, Florence, Italy). The AL was measured using partial coherence laser interferometry (Zeiss IOL Master; Carl Zeiss AG, Oberkochen, Germany).

The Sirius, a topographic device consisting of a combination of two rotating Scheimpflug cameras and a Placido disk, was used for topographical and central corneal thickness (CCT) measurements. Anterior and posterior corneal curvature,

CCT, corneal volume (CV), anterior chamber depth (ACD), and anterior chamber volume (ACV) values were recorded. All measurements were taken according to the manufacturer's guideline by the same trained examiner first under photopic conditions, and then under cycloplegic conditions.

This study followed the tenets of the Declaration of Helsinki and was approved by the local ethics committee. All patients provided informed consent prior to enrollment.

Statistical analysis

Three consecutive measurements were obtained, and their mean was used for statistical analysis. All analyses were performed with the Statistical Package for Social Sciences software (SPSS, Windows version 21.0; SPSS Inc.; Chicago, USA). A p value of less than 0.05 was considered statistically significant. Topographic findings were analyzed by one-way ANOVA test. The Bonferroni test was used for post hoc analysis.

Results

Our study was performed on a total of 93 individuals, including 48 participants with

anisometropic amblyopia and 45 controls. Among amblyopic patients, 22 participants were female and 26 were male, while 20 were female and 25 were male in the control group (p=0.936). The mean age of patients with anisometropic amblyopia was 35.6±10.2 years (range, 19-49 years) and of patients in the control group 35.1±9.7 years (range, 19-49 years) (p=0.813). Table-1 shows subject details.

There was no significant difference in the anterior and posterior mean keratometry values, CCT, CV, ACV or ACD measurements between amblyopic and fellow or healthy eyes under both cycloplegic and non-cycloplegic conditions (Table-2) (p > 0.05).

Table-1. Characteristics of the Patients.

	Amblyopic eyes	Fellow eyes	Healthy eyes	p† value
BCVA (logMAR)	0.41 ± 0.29	0.00 ± 0.00	0.00 ± 0.00	<0.001*
Refractive error (SE) (D)	2.76 ± 0.69	0.52 ± 0.38	0.42 ± 0.31	<0.001*
Axial length	21.49 ± 1.18	22.67 ± 0.92	23.02 ± 1.22	<0.001*(mm)

BCVA: Best-corrected visual acuity; SE: Spheric equivalent; D: Diopter
† ANOVA test, post hoc Bonferroni test
* p<0.05

Table-2. Comparison of Anterior Segment Parameters Among Three Groups.

Parameters	without cycloplegia				with cycloplegia			
	amblyopic eyes	fellow eyes	healthy eyes	p† value	amblyopic eyes	fellow eyes	healthy eyes	p† value
Anterior Km (D)	43.2±1.5	42.9±1.2	43.1±1.3	0.56	43.2±1.4	43.1±1.4	42.9±1.3	0.46
Posterior Km (D)	-5.9±0.1	-6.0±0.0	-6.1±0.1	0.39	-6.2±0.1	-6.1±0.1	-6.1±0.1	0.54
CCT (mm)	562.4±29.2	570.6±34.6	569.8±36.2	0.79	560.9±35.	563.8±34.6	562.3±36.1	0.89
CV (mm^3)	64.6±4.7	62.9±3.9	64.8±3.7	0.66	64.1±4.3	62.7±4.2	63.4±4.3	0.76
ACD (mm)	3.04±0.3	3.05±0.2	3.06±0.3	0.72	3.18±0.4	3.19±0.5	3.20±0.3	0.78
ACV (mm^3)	184.8±32.4	182.6±31.6	179.6±32.6	0.84	192.3±34.6	193.1±31.6	191.4±32.8	0.84
PD (mm)	3.01±0.1	3.02±0.2	3.02±0.1	0.96	6.42±0.5	6.43±0.3	6.43±0.4	0.65

Km: Mean keratometry; ACD: Anterior chamber depth; ACV: Anterior chamber volume; CCT: Central corneal thickness; CV: Corneal volume; D: Diopter; PD: Pupillary diameter; †ANOVA test, post hoc Bonferroni test

Discussion

No significant differences were found in anterior segment measurements obtained by the Sirius topography device between amblyopic and fellow or healthy control eyes. To our knowledge, this is the first study that compared the differences in the anterior segment parameters among the eyes of adults with anisohypermetropic amblyopia, fellow eyes and controls using the Sirius topography device.

Cass et al. (13) investigated ocular parameters and interocular differences between amblyopic and fellow non-amblyopic eyes in amblyopic children. They compared corneal curvature with keratometry and anterior chamber depth with A-scan ultrasound between amblyopic and fellow eyes. They reported no significant differences in corneal curvature or ACD between amblyopic and fellow eyes. A study by Wang et al. (11), using the Pentacam Scheimpflug imaging, reported no differences in anterior segment parameters between amblyopic and fellow eyes in children with hyperopic anisometropic amblyopia. Another study, including a third emmetropic normal group reported no difference in anterior segment parameters in children (12). The authors additionally evaluated pupil diameter and found no difference among the three groups. Similar to that study we had three groups in case the fellow eye of the amblyopic adult may also be abnormal. Our results were compatible with the previous studies. We found no significant difference both in anterior segment parameters and pupil diameter in adults with anisohypermetropic amblyopia.

Contrary to the previous studies mentioned, Demircan et al. (15) found significant differences in mean BCVA, SE, mean anterior corneal curvature, ACD, and AL between amblyopic and fellow eyes, while finding no significant difference in corneal thickness using IOL Master and Pentacam Scheimpflug imaging. Cankurtaran et al. (14) also reported difference in mean keratometry and CCT values between hyperopic and fellow eyes of the patients with anisometropia without amblyopia using the LenStar LS-900 device.

Palamar et al. (16) reported ACD, AL and mean keratometry values measured by Pentacam, were statistically different between hyperopic anisometropic and fellow eyes although they did not observe significant differences for the rest of the measured parameters. The mean difference for AL was 0.9 mm and for ACD was 0.03 mm.

Anisometropia is predominantly axial in nature and it might be expected that lesser ACD associates with shorter AL. The results in the literature were contradictory. In our study we found about 2.2 D difference in the mean spherical equivalent value between amblyopic and fellow eyes, and the mean axial length was shorter about 1.2 mm in

amblyopic eye than fellow eyes. Although the mean ACD was 0.01 mm lower in amblyopic eye the difference was not significant.

Topical administration of cyclopentolate hydrochloride 1% is commonly used, especially in pediatric ophthalmologic examinations, to obtain transitory cycloplegia and mydriasis. Earlier studies evaluated the effects of cyclopentolate hydrochloride 1% on anterior segment in children and young adults using the Pentacam (18,19). In study by Arıcı et al. (18), the cycloplegic effect of 1% cyclopentolate increased ACD and ACV, and decreased anterior chamber angle (ACA) values in anterior segment parameters, due to the backward movement and decreased thickness of the crystalline lens. Palamar et al. (19) found that cyclopentolate hydrochloride 1% instillation causes statistically significant increase in ACD and ACV and decrease in CCT, compared with precycloplegia measurements. Changes in ACA values were not statistically significant. Given these effects of cycloplegia on such parameters, this study compared all three groups both under cycloplegic and non-cycloplegic conditions. There were no differences in anterior segment parameters between amblyopic and fellow or healthy eyes under both cycloplegic and non-cycloplegic conditions in our study.

The limitations of this study include its small sample size. Moreover, we did not include patients with other forms of amblyopia, specifically strabismic, form deprivation, or any multifactorial amblyopia.

Conclusion

In our study, we found no significant effect of anisometropia on anterior chamber measurements with the Sirius topography device. Larger series of amblyopia with different etiologies may better clarify the relationship between human emmetropisation and anisometropia.

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