Anterior Segment Parameters and Axial Length Value in Emmetropic Eyes in Different Age Groups

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ABSTRACT

Purpose: To determine and compare anterior segment parameters and axial length value in emmetropic eyes according to age groups.

Materials and Methods: In this study, 160 patients aged 7-73 years were divided into four groups according to age: Group 1 (7-18 years, n=33), Group 2 (19-44 years, n=39), Group 3 (45-60 years, n=60) and Group 4 (61-73 years, n=28). Central corneal thickness (CCT), anterior chamber depth (ACD), lens thickness (LT), and axial length (AL) measurements obtained by non-contact optical low coherence refractobiometry from 160 emmetropic eyes were analyzed.

Results: Gender distribution, mean spherical equivalent and CCT values were comparable across groups (p=0.192, p=0.124 and p=0.638, respectively). Mean ACD was higher in Group 1 (3.80±0.24 mm) than Group 2 (3.57±0.29 mm), Group 3 (3.52±0.37 mm) and Group 4 (3.50±0.43 mm), (p=0.001). Mean LT was lower in Group 1 (3.41±0.25 mm) than Group 2 (3.72±0.31 mm), Group 3 (4.04±0.43 mm) and Group 4 (4.20±0.43 mm). Also, it was lower in Group 2 than Group 3 and 4 (p <0.001). Mean AL was 23.35±0.70 mm in Group 1, 23.52±0.69 mm in Group 2, 23.59±0.84 mm in Group 3 and 24.03±0.72 mm in Group 4 with only difference between Group 1 and 4 (p=0.006).

Conclusion: ACD was lower while LT and AL were higher in emmetropic eyes of patients aged> 61 than those of children aged<18 years

Key Words: Age, Anterior segment parameters, Axial length, Emmetropia.

INTRODUCTION

In recent years, population-based studies have shown that there are significant differences in prevalence of refractive errors in the context of ethnicity, education level, age, gender and socioeconomic status.[1] Emmetropization is to focus image on retina by coordination of refractive elements using active and passive continuum.[2,3] Changes in corneal curve, lens power and axial length, primary determinants of refractive power, occur throughout first year of eye development after birth. The refraction is shifted from +2.00 diopter (D) to +0.75 diopter (D) between 3 months and 3.5 years of age.[4] At approximately 3 years of age, there is hypermetropia in 71%, myopia in 6% and emmetropia in 23% of children;[5] thereafter, a tendency to myopia is observed in children.[3] Hypermetropia is observed in 8.6% and myopia in 10.1% of school age children (aged 6-14 years).[6] In adulthood, hypermetropia is observed in 13.2%, myopia in 35% and emmetropia in 51.8% of individuals aged 20-25 years while hypermetropia in 17.4%, myopia in 30.3% and emmetropia in 52.3% of individuals aged 40-45 years.[1] In advanced years, shift towards hypermetropia is seen between 40 and 65 years of age while shift towards myopia is observed after seventh decade.[7,8]

The aim of this study was to determine whether there are differences in anterior segment parameters and axial length values in emmetropic eyes according to age groups and whether it is clinically relevant.

MATERIALS AND METHODS

This study was approved by Ethics Committee of Ankara Numune Teaching and Research Hospital, Health Sciences University. It was conducted at Ophthalmology Clinic of Ulucanlar Eye Research and Teaching Hospital, Health Sciences University in accordance to Helsinki Declaration. We retrospectively reviewed patient files in prior 4 years. We analyzed measurements from healthy, emmetropic eyes of 160 patients (aged 7-73 years) who admitted to eye

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clinic with surgical indication who had no ocular disorder (glaucoma, cataract, pseudoexfoliation, any corneal disease, anterior chamber abnormality, retinal detachment, uveitis) and no history of trauma/previous surgery. In the study, the patients underwent a thorough ophthalmological examination including best-corrected visual acuity as measured by Snellen chart, intraocular pressure by non-contact tonometry and anterior chamber and dilated fundus examination (0.5% tropicamide drop, Tropamid, Bilim İlaç, İstanbul, Turkey) by slit lamb biomicroscopy were included to the study. The eyes with spherical equivalent (spherical D value plus cylindrical D value/2) ≤0.75 D and full visual acuity (1.0) were considered as emmetropic. The patients with complete data regarding central corneal thickness (CCT), anterior chamber depth (ACD; between cornea epithelium and lens), lens thickness (LT) and axial length (AL) as measured by optic low-coherence refractometry (LenStar LS 900®, Haag-Streit AG, Switzerland) after dilated examination were included to the study. The patients were divided into 4 groups representing childhood and adolescents, young adult, presbyopic period and advanced age. The patients were classified as follows: group 1 (7-18 years, n=33), group 2 (19-44 years, n=39), group 3 (45-60 years, n=60) and group 4 (61-73 years, n=28).

Data analysis

Data were analyzed using SPSS version 22.0 (SPSS, Chicago, IL, USA). After confirmation of normal distribution, parametric methods were used. Descriptive statistics were presented as mean±standard deviation. Categorical variables were assessed using Chi-square test. One-way ANOVA was used to determine whether there is significant difference in parameters according to age groups (Group 1, 2, 3, 4). In case of significant difference, Scheffe test was used as post hoc test to perform multiple comparisons). Pearson's correlation test was used to assess relationship between age and parameters. A p value<0.05 was considered as statistically significant.

RESULTS

The study included healthy eyes without any ocular disease of patients who were admitted to eye clinic due to blunt eye trauma (n=21), penetrating eye injury (n=44), corneal leukoma (n=8), cataract (n=68) vitreous disorder (n=2), epiretinal membrane (n=5), macular hole (n=2) and retinal detachment (n=10). Of 160 patients included, 111 were male and 49 were female. Mean age was 41.94±18.45 years. Mean spherical equivalent was 0.18±0.38 D. In the study population, mean CCT was calculated as 538.23±35.19 µm while mean ACD as 3.59±0.35 mm, mean LT as 3.86±0.46 mm and mean AL as 23.60±0.78 mm. When patients were classified according to age, it was found that there were 33 patients in group 1 (7-18 years of age), 39 patients in group 2 (19-44 years of age), 60 patients in group 3 (45-60 years of age) and 28 patients in group 4 (61-73 years of age).

Table 1 presents the distribution of anterior segment parameters and axial length values according to age

Table 1. *Anterior segment parameters and axial length values according to age groups.*

	Group 1 (7-18 years, n:33)	Group 2 (19-44 years, n:39)	Group 3 (45-60 years, n:60)	Group 4, (61-73 years, n:28)	p value	Inter-group difference (One-way ANOVA test-Scheffe test)
Age (Mean±SD)	12.21±3.12	35.90±7.22	51.65±4.03	64.57±3.07	<0.001*	1-2, 1-3, 1-4, 2-3, 2-4, 3-4
Gender (Male: Female)	20/13	32/7	39/21	20/8	0.192**	-
Spherical equivalent (Mean±SD)	0.09±0.32	0.22±0.33	0.14±0.42	0.30±0.38	0.124*	None
CTT (Mean±SD)	545.12±37.79	537.36±31.65	535.32±35.58	537.53±36.64	0.638*	None
ACD (Mean±SD)	3.80±0.24	3.57±0.29	3.52±0.37	3.50±0.43	0.001*	1-2, 1-3, 1-4
LT (Mean±SD)	3.41±0.25	3.72±0.31	4.04±0.43	4.20±0.43	<0.001*	1-2, 1-3, 1-4, 2-3, 2-4
AL (Mean±SD)	23.35±0.70	23.52±0.69	23.59±0.84	24.03±0.72	0.006*	1-4

SD: Standard deviation, n: count, **CCD:** Central corneal thickness (µm), **ACD:** Anterior chamber depth (mm), **LK:** Lens thickness (mm), **AL:** Axial length(mm). *: One -way ANOVA test, **: X^2 test

groups. Mean age was 12.21±3.12 years in group 1, 35.90±7.22 years in group 2, 51.65±4.03 years in group 3 and 64.57±3.07 years in group 4.There was no significant difference in gender and mean spherical equivalents among groups (p>0.05). Again, there was no significant difference in CCT among groups 1 (545.12±37.79 µm), 2 (537.36±31.65 µm), 3 (535.32±35.58 µm) and 4 (537.53±36.64 µm) (p>0.05). Mean ACD was higher in Group 1 (3.80±0.24 mm) than Group 2 (3.57±0.29 mm), Group 3 (3.52±0.37 mm) and Group 4 (3.50±0.43 mm), (p=0.001). Mean LT was lower in Group 1 (3.41±0.25 mm) than Group 2 (3.72±0.31 mm), Group 3 (4.04±0.43 mm) and Group 4 (4.20±0.43 mm). Also, it was found to be lower in Group 2 than Group 3 and 4 (p <0.001). Finally, it was found that mean AL was higher in Group 4 (24.03±0.72 mm) than Group 1 (23.35±0.70 mm) (p=0.006).

It was found that there was no correlation between age and CCT (r=-0.062; p=0.433). However, a weak, negative correlation was observed between age and ACD (r=-0.296, p < 0.001) while a positive correlation between age and LT and AL (r = 0.615, p < 0.001; r = 0.237, p = 0.002, respectively).

DISCUSSION

There are studies reported that anterior segment parameters and axial length values are changed by age.[9-12] In addition, there are studies suggested that corneal thickness is increased by advancing age.[9-11] This was linked to increased corneal hydration due to reduction in endothelial cell density by aging.[11] On the other hand, it was reported that CTT is decreased by 3 µm per decade.[12] In our study, no significant correlation was detected between CCT and age in agreement with studies reported no significant correlation between age and corneal thickness.[13-15]

We observed that there was a reduction in ACD by increasing age in our patients. The narrowing in anterior chamber that may occur by advancing age can enhance risk for narrow-angle glaucoma and endothelial loss in cataract surgery at advanced ages.[16-17] There are many studies which found negative correlation between age and ACD as similar to our study.[15, 18-22] The reduction in ACD can be anterior deployment of lens secondary to relaxation in zonules by advancing age and age-related increase in lens.[23, 24] In our study, we found significant increase in LT by advancing age in agreement with literature[15, 22] This may be due to decreased lens and capsule elasticity, structural changes in lens and stiffened lens core material accompanied by sclerotic changes.[25, 26] Some authors reported that AL did not alter by aging.[15, 27, 28] However, Lee et al. suggested that there was a decrease in AL by advancing age because of higher prevalence of myopia in young adults.[20] In a study on 271 patients aged 4-70 years, Grossvenor et al. found that AL was decreased by advancing age. This is explained by adult emmetropization mechanism developed against increase in total refractive power of eye resulting from decreased ACD, increased lens and cornea refraction.[29, 30] In our study, we found that AL values were significantly higher in group 4 when compared to group 1. Our study is supportive to the study Atchison et al. who evaluated age-related AL changes in emmetropic eyes.[22] It is possible that younger subjects could become hypermetropic by advancing age. Some older subjects could be myopic (longer AL) when they were young.[22] Studies suggested that refraction tends to be stabile at third and fourth decades and is shifted towards hypermetropia by 1.5 D followed by myopic shift after 70 years of age also confirm this explanation.[31, 32] Our study has some limitations including retrospective design and relatively small sample size. There is a need for population-based case series.

CONCLUSION

By optical low-coherence refractometry, it was seen that ACD was lower while LT and AL were higher in emmetropic eyes of patients aged>61 years than those of aged <18 years.

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