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Investigation of the relationship of corneal densitometry, corneal volume and central corneal thickness with age in healthy individuals

Sağlıklı bireylerde korneal dansitometrinin, kornea hacminin ve santral korneal kalınlığın yaş ile ilişkisinin değerlendirilmesi

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Abstract

Aim: Many changes occur in the body with aging, from which the eye is also affected. In this study, we aimed to investigate the relationship of corneal densitometry (CD), corneal volume (CV), and central corneal thickness (CCT) with age in healthy individuals.

Methods: This prospective cross-sectional study included 89 healthy individuals aged between 18-79 years. CD, CV, CCT measurements were performed with Pentacam HR (Oculus, Wetzlar, Germany) with a Scheimpflug camera. CD measurements were performed manually in the central 6 mm optical zone, 90-270 degrees plane. The data obtained were analyzed with SPSS 21 program.

Results: CD correlated positively, and CV correlated negatively with age (P=0.01, r=0.25 and P=0.04, r=-0.213, respectively). There was no significant correlation between age and CCT (P=0.42, r=-0.08).

Conclusion: Age is a crucial factor affecting overall health. It positively correlated with CD and negatively correlated with CV in healthy individuals. According to these results, these parameters responsible for vision health may be affected by age.

Keywords: Age, Cornea densitometry, Central corneal thickness, Cornea volume, Pentacam

Öz

Amaç: Yaş ile beraber vücutta farklı mekanizmalara bağlı birçok değişiklik meydana gelmektedir. Buna bağlı olarak bu değişimlerden göz de etkilenmektedir. Bu sebeple, çalışmamızda sağlıklı bireylerde kornea dansitometrisinin (KD), kornea hacminin (KH) ve santral korneal kalınlığın (SKK) yaş ile olan ilişkisini araştırmayı amaçladık.

Yöntemler: Bu prospektif, kesitsel çalışmaya yaşları 18-79 yaş arasında değişen 89 sağlıklı birey dahil edildi. Bireyler yaşlarına göre 18-40 ve 41-79 yaş olmak üzere iki gruba ayrıldı. KD, KH, SKK ölçümleri Scheimpflug kameraya sahip Pentacam HR (Oculus, Wetzlar, Almanya) ile yapıldı. KD ölçümü, santral 6 mm'lik optik zonda, 90-270 derece düzleminde, manuel olarak ölçüldü. Elde edilen veriler Spss 21. programı ile analiz edildi.

Bulgular: KD'nin yaş ile pozitif yönde, KH'nin yaş ile negatif yönde korelasyon gösterdiği bulundu (sırasıyla P=0,018 r=0,25 ve P=0,04 r=-0,213). SKK ile yaş arasında anlamlı bir korelasyon bulunamadı.

Sonuç: Yaş, vücut sağlığını etkileyen önemli bir faktördür. Sağlıklı bireylerde yaşın KD ile pozitif yönde, KH ile negatif yönde korelasyon gösterdiği bulunmuştur. Bu sonuçlara göre görme sağlığından sorumlu bu parametreler yaştan etkileniyor olabilir.

Anahtar kelimeler: Yaş, Kornea dansitometrisi, Santral korneal kalınlık, Kornea hacmi, Pentacam

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Introduction

The cornea is the transparent anterior structure of the eye with refractive features. Microscopically, it consists of six layers: front to back the epithelium, bowman, stroma, dua layer, descement, and endothelium. It provides 70% of the refractive power of the eye with approximately 43 dioptric refractive power. Especially the regular structure of collagen in the stroma layer is responsible for the transparency of the cornea. In cases such as previous corneal surgery, trauma, and keratitis, the transparency of the cornea may be impaired. This results in a decrease in the degree of vision and quality in patients [1].

Corneal densitometry (CD) is a noninvasive and quantitative measurement that provides information about the transparency of the cornea. It is used to evaluate the response to treatment and follow-up in corneal diseases. There are several studies about the use of CD in keratoconus, bacterial keratitis, photorefractive keratectomy, cross-linking, and Lasik surgery [2-6]. CD, measured with Pentacam HR with a Scheimpflug camera, is affected by keratoconus and various systemic diseases [7,8].

As is known, central corneal thickness (CCT) is important in intraocular pressure measurements. On the other hand, corneal volume (CV) is a parameter that is parallel to CCT and affected by various diseases. Also, CV has been shown to decrease with age [9].

In the literature, several studies are investigating CD, CV, and CCT. All these three parameters are related to vision health together. Our study is the first in our country that examines the relationship of all these three parameters with age. In our study, we aimed to investigate whether CD, CCT, and CV are related with age in normal healthy people.

Materials and methods

Eighty-nine eyes of 89 participants, aged between 18 and 79 years, who were admitted to Pamukkale University Training and Research Hospital Cornea Clinic from June 2019 to September 2019 were included in this prospective, cross-sectional study. Patients with trauma, previous ocular surgery, glaucoma, uveitis, collagen tissue disease, autoimmune disease history, more than + 3 hypermetropia, and -3 myopia were excluded from the study. A total of 110 participants were evaluated in the cornea clinic, 21 of which were excluded from the study due to several reasons (not meeting inclusion criteria, corneal problems, scars, opacity, keratoconus, low test quality). The flow diagram is shown in Figure 1.

The participants were divided into two groups as those aged between 18-40 and 41-79 years. The rationale of dividing participants with this age cut off was based on physiological differences between two age groups. After the visual acuity, biomicroscopic examinations, and fundus examinations of the participants, measurements were made with Pentacam HR, Scheimpflug camera (Oculus, Wetzlar, Germany). CD was measured manually in the central 6 mm optical zone, 90-270-degree plane (Figure 2). The two groups were compared in terms of CD, CV and CCT values. The relationship between CD, CV, and CCT with age and gender were investigated. Our study was carried out following the Helsinki Declaration principles with the approval of the Pamukkale University Ethics Committee (date: 5/21/2019, number: 10). Detailed informed consent was obtained from the participants of the study.

Statistical analysis

The data were evaluated with SPSS 21 package program. Student's t-test was used to compare patients over and under 40 years of age. Correlation between CD, CCT, and CV with age was measured by the Pearson correlation test. *P*-values below 0.05 were considered significant.

Results

The mean age of the patients was 41.17 (15.78) years. Thirty-nine (43.8%) were male and 50 (56.2%) were female. The mean ages of males and females were 38.82 (17.40) and 43.02 (14.31), respectively, which were similar (P=0.07). There was no difference between genders in terms of CD, CV, and CCT values (P=0.54, P=0.37, P=0.65, respectively) (Table 2). The mean CD value of individuals between the ages of 18-40 and 41-79 years were 12.00 (0.97) and 12.37 (1.23), respectively. There were no significant differences between these two groups in terms of CD, CV, and CCT values (P=0.39 P=0.63 P=0.39, respectively) (Table 3). A significant positive correlation was observed between CD and age (P=0.01, r=0.25). The mean CCT and CV values of participants were 543.67 (31.92), and 59.68 (3.85), respectively. While CCT was not correlated with age (P=0.425, r= -0.086), CV was (P=0.04, r=-0.213).

Table 1: CD, CV, CCT measurements according to gender

	Male	Female	*P*-value
CD	12.28 (1.39)	12.13 (0.87)	0.54
CV	59.89 (4.00)	59.52 (3.77)	0.37
CCT	547.12 (32.78)	540.98 (31.30)	0.65

CD: Cornea densitometry, CV: Cornea volume, CCT: Central corneal thickness

Table 2: CD, CV, and CCT measurements according to age groups

	Group 1 (18-40 age)	Group 2 (41-79 age)	*P*-value
CD	12.0 (0.97)	12.19 (0.97)	0.39
CV	59.86 (4.02)	60.27 (3.65)	0.63
CCT	539.97 (26.44)	554.28 (33.48)	0.39

CD: Cornea densitometry, CV: Cornea volume, CCT: Central corneal thickness

Discussion

Transparency of the cornea in the central 6 mm area is important for visual clarity. In our study, a significant positive correlation was observed between the central 6 mm CD and age, which was consistent with the literature [10-13]. Contrary to these studies, there are numerous studies indicating that the CD is not affected by age in the central 6 mm area [14]. In another study, CD was found to positively correlate with age, and negatively correlate with corneal endothelial cell density [15]. It is known that corneal endothelial cells decrease with age. In fact, it has been shown that there is a 0.6% loss of cells every year [16]. Corneal endothelium plays a significant role in corneal transparency [17], which may be one of the reasons for CD increase with age.

In our study, there was no significant difference between patients aged below and above 40 years of age. Alzahrani et al. [18] classified 97 patients between the ages of 10 and 69 years at 10-year intervals, and found the CD values of participants in the 10-19 and 40-49 age groups higher, and attributed this to hormonal changes in the body in these age groups. We divided the participants into two groups since the age of 40 is a sensitive period for hormonal changes in the body but

observed that this does not affect CD. Similarly, we observed that the two groups did not differ in terms of CV and CCT. Studies with more participants are needed to thoroughly investigate this situation.

In our study, no differences were observed between male and female genders in terms of CD, CV, and CCT. In a recent study, total CD was significantly higher in women than in men. It is emphasized by the authors that this result has no specific reason and can be neglected in clinical practice [19]. In another study, it was emphasized that gender does not affect CD [13]. Although studies are stating that CCT differs with gender, there are studies that state otherwise [20,21].

In some studies, CCT has been shown to decrease with increasing age [20,21], while in others, it was unrelated [19]. In a study conducted in our country, it was stated that CCT increased in older age groups [22]. In our study, no significant relationship was found between CCT and age. In addition, numerous studies reported that CV decreases with increasing age (9). In our study, it was found that CV correlates with age negatively.

It is known that corneal endothelial cells decrease with aging. It is thought that CD has changed due to this decrease. It has been shown in previous studies that CV also varies with age and is associated with CCT [9]. It would not be wrong to say that all three parameters are somehow related to each other in the light of previous studies. Therefore, investigating the effect of aging on these parameters can shed light on changes in visual quality with age.

Limitations

Our study has several limitations. We think that our study may be affected by the factors that depend on the participants since it is a study involving a limited number of patients at a certain time. It is also possible that racial characteristics will affect these parameters. On the other hand, corneal endothelial functions were not measured in this study. Also, CD measurements were made only from the central 6 mm area. Therefore, there is a need for studies in which more corneal parameters are included and the peripheral parts of the cornea are also measured.

Conclusion

CD, CV, CCT are parameters which are responsible for the quality of vision. In our study, it was found that CD correlated positively with age, and CV correlated negatively. Age seems to affect the corneal parameters which are responsible for visual clarity.

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