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ORIGINAL ARTICLE

Anterior Segment Data Comparison by Age and Gender

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ABSTRAK

Tujuan kajian ini adalah untuk mencatat indeks segmen anterior di Corum dan bahagian sekeliling serta membandingkan data tersebut berdasarkan umur dan jantina. Sejumlah 566 (265 lelaki, 301 perempuan) data pesakit telah dikaji. Kumpulan umur dibahagi kepada kumpulan umur rendah (GLA) (berumur antara 18-39 tahun, 140 lelaki, 143 perempuan) dan kumpulan umur tinggi (GHA) (berumur antara 40-65 tahun, 125 lelaki, 158 perempuan). Indeks yang dikaji termasuklah ketebalan korneal pusat (CCT), kedalaman anterior kamar (ACD), sudut anterior kamar (ACA), keratometri rata (K1), keratometri condong (K2) dan keratometri purata (Kavg). Hasil ACD (3.71 + 0.36 mm untuk GLA dan 3.23 + 0.44 mm untuk GHA), ACA (43.22 + 6.39 untuk GLA dan 37.76 + 8.70 untuk GHA) dan K2 (44.49 + 1.69D untuk GLA dan 43.99 + 1.53D untuk GHA) adalah rendah di kalangan GHA, berbanding dengan GLA dengan signifikasi ($p<0.0001$, $p<0.0001$ dan $p=0.001$). Lelaki mempunyai nilai ACD yang lebih tinggi ($p=0.002$) berbanding dengan perempuan. Sudut anterior kamar di kalangan perempuan lebih sempit daripada lelaki ($p<0.0001$). Perempuan mempunyai nilai keratometri yang lebih tinggi berbanding dengan lelaki ($p<0.0001$ untuk semua). Walau bagaimanapun, perbandingan antara jantina dilakukan di kalangan GLA menunjukkan tiada perbezaan antara ACD dan ACA. Kajian ini menunjukkan indeks segmen anterior adalah berbeza dengan data di kawasan lain dalam negara. Di samping itu, kajian ini menunjukkan gabungan faktor jantina dan umur memberi perbezaan ACD dan ACA, tetapi tidak ketara antara jantina sahaja.

Kata kunci: penuaan, anterior kamar, korneal, topografi korneal, jantina

ABSTRACT

The aim of this study was to record anterior segment indices in Corum and surrounding regions and to compare these data according to age and gender. A

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total of 566 (265 male, 301 female) patient data sets were reviewed. Age groups were formed as group lower age (GLA) (aged 18-39 years, 140 male, 143 female) and group higher age (GHA) (aged 40-65 years, 125 male, 158 female). Evaluated indices were corneal central thickness (CCT), anterior chamber depth (ACD), anterior chamber angle (ACA), flat keratometry (K1), steep keratometry (K2) and average keratometry (Kavg). The ACD (3.71 $\pm$ 0.36 mm for GLA and 3.23 $\pm$ 0.44 mm for GHA), ACA (43.22 $\pm$ 6.39 for GLA and 37.76 $\pm$ 8.700 for GHA) and K2 (44.49 $\pm$ 1.69D for GLA and 43.99 $\pm$ 1.53D for GHA) results were all significantly lower in GHA compared with GLA ($p<0.0001$, $p<0.0001$ and $p=0.001$, respectively). Men had higher ACD values ($p=0.002$) than women. Women's ACAs were narrower ($p<0.0001$) than men. Women showed higher keratometry results as opposed to men ($p<0.0001$ for all). However, when gender comparison was done among GLA, there was no difference of ACD and ACA between genders. We showed our regional anterior segment results were different from other regions in the country. In addition, we showed that the significant differences of ACD and ACA did not present below the age of 40, as opposed with previous literature. It was suggested that gender combined with age gave significant differences of ACD and ACA, but not gender alone.

Keywords: aging, anterior chamber, cornea, corneal topography, gender

INTRODUCTION

Calculations of anterior segment parameter are considered indispensable in ophthalmology practices. These data are used in patients with glaucoma and corneal disease, in addition to intraocular surgery preparations. There were previous studies that showed corneal and anterior chamber indices not only changed with age, but changed differently between aging individuals of different genders (Goto et al. 2001). Therefore, ophthalmology clinics can use their data to form their normative database for their local populations (Sedaghat et al. 2017). There are a number of methods for assessing the anterior segment parameters, one of which is the Scheimpflug camera-Topographer. The Sirius Scheimpflug -Topographer (CSO, Firenze, Italy) is one of the common devices in ophthalmology clinics which is used for anterior chamber and corneal meaurements worldwide. It combines rotating Scheimpflug cameras with Placido disc topography and enables 25 radial sections of the cornea and anterior chamber in seconds. This imaging provides measurements of central corneal thickness (CCT), anterior chamber depth (ACD), anterior chamber angle (ACA) and keratometry (Polat et al. 2016).

There were two purposes for this study. First was to find and record the patterns of these mentioned data for our clinic which was the main

ophthalmology practice in the region. Second was to compare these data according to age and gender in order to provide data as a reference in future clinical practice.

MATERIALS AND METHODS

Subject topography recordings from Corum and surrounding cities were retrospectively taken for this study. Patient data sets acquired between 2014 and 2020 were reviewed and analyzed (Figure 1).

Refugees and non-local immigrants from other countries were excluded so the subject pool can only represent local areas. Patients that had corneal surgeries or pathologies, intraocular surgery, glaucoma, laser trabeculoplasty or laser iridotomy were excluded from the study. Patients that had more than grade 1 nuclear sclerosis were also excluded for not to interfere with iridocorneal angle measurements. The study followed the tenets of the Declaration of Helsinki and was approved by the Hitit University Research Ethics Committee. (Approval number:350)

Recordings in Hitit University Hospital between 2014 and 2020 were taken for this study. Right eyes of 566 subjects were taken into the study. There were 265 males and 301 females. Age groups were formed as group lower age (GLA) that had 18-39 years old subjects and group higher age (GHA) with 40-65 years old subjects. Each group had 283 eyes. The GLA gender distribution was 140 males and 143 females whereas the GHA had 125 males and 158 females. Anterior segment parameters were taken by Sirius anterior segment analysis system (Sirius, CSO, Florence, Italy). Evaluated indices were CCT, ACD, ACA, flat keratometry (K1), steep keratometry (K2) and average keratometry (Kavg) in diopters (D). A sample size calculation estimated that 300 eyes would be necessary for a type 1 error rate of 0.05 and a power of 80% with mean keratometry results of 42.29 ± 1.41D and 42.85 ± 1.52D found in previous studies (Orucoglu et al. 2015). Continuous data with a normal distribution were represented as

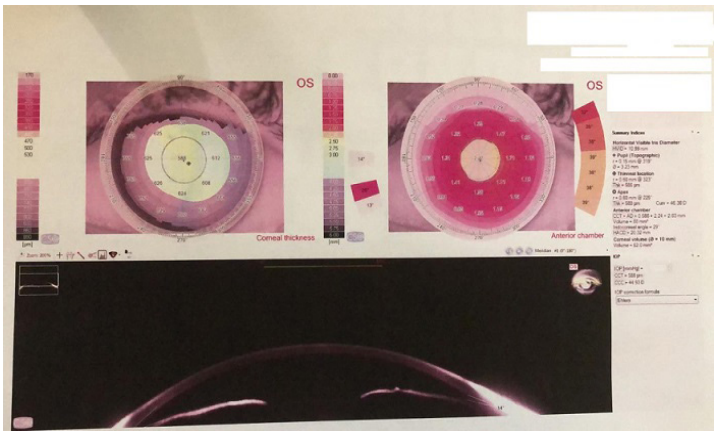

Figure 1: Sirius Scheimpflug -Topographer results page of a patient

mean values and standard deviations. Comparisons between groups were performed using independent sample t-test with Statistical Package for the Social Science (IBM SPSS Statistics for Windows, Version 24.0). A value of $p<0.05$ was considered statistically significant.

RESULTS

A total of 566 subjects' results were found that matched the study criteria. In total, there were 265 males and 301 females. In GLA, there were 140 males and 143 females. In GHA, there were 125 males and 158 females. The minimum, maximum and mean values of age, CCT, ACD, ACA, K1, K2 and Kavg were given in Table 1.

The CCT, ACD, ACA, K1, K2 and Kavg results were compared between the younger and older age groups (Table 1), where the p values were p=0.652, p<0.0001, p<0.0001, p=0.196, p=0.001 and p=0.324, respectively. The ACD (3.71 ± 0.36 mm for GLA and 3.23 ± 0.44 mm for GHA), ACA (43.22 ± 6.39° for GLA and 37.76 ± 8.70° for GHA) and K2 (44.49 ± 1.69D for GLA and 43.99 ± 1.53D for GHA) results were all significantly lower in GHA compared with the GLA.

Total subjects and subgroups were then divided according to gender. The minimum, maximum and mean values of CCT, ACD, ACA, K1, K2 and Kavg are given in Tables 2 and 3. When all subjects were compared according to gender, p values (p=0.143) were only insignificant in CCT values. The ACD mean values of male and female were 3.53 ± 0.45 mm and 3.42 ± 0.48 mm, respectively. Men had higher ACD values (p=0.002). The ACA mean values of male and female were 41.89 ± 7.88° and 39.25 ± 8.11°, respectively.

Table 1: The minimum, maximum and mean values of anterior segment data divided by age groups.

	GLA n=283 Male=140 Female=143	**GHA n=283 Male=125 Female=158**	**Total n = 566 Male=265 Female=301**
Age (years) Min-Max (Mean ± SD)	18-39 (25.81 ± 5.96)	40-65 (53.49 ± 7.01)	18-65 (39.65 ± 15.30)
Corneal Central Thickness (μm) Min-Max (Mean ± SD)	247-630 (538.87 ± 39.97)	392-654 (537.62 ± 35.53)	247-654 (538.25 ± 37.78)
Anterior Chamber Depth (mm) Min-Max (Mean ± SD)	2.71-5.42 (3.71 ± 0.36)	2.16-4.60 (3.23 ± 0.44)	2.16-5.42 (3.47 ± 0.47)
Anterior Chamber Angle (°) Min-Max (Mean ± SD)	26-60 (43.22 ± 6.39)	13-69 (37.76 ± 8.70)	13-69 (40.49 ± 8.10)
K1 (Diopters) Min-Max (Mean ± SD)	33.54-47.53 (42.60 ± 1.82)	38.15-46.43 (42.79 ± 1.45)	33.54-47.53 (42.69 ± 1.65)
K2 (Diopters) Min-Max (Mean ± SD)	39.88-49.52 (44.49 ± 1.69)	38.80-48.49 (43.99 ± 1.53)	38.80-49.52 (44.23 ± 1.63)
K average (Diopters) Min-Max (Mean ± SD)	39.48-48.00 (43.51 ± 1.60)	38.50-47.30 (43.38 ± 1.39)	38.50-48.00 (43.45 ± 1.50)

GLA: Group lower age; GHA: Group higher age

Table 2: The minimum, maximum and mean values of anterior segment data divided by male gender.

	GLA n=140	GHA n=125	Total n = 265
Age (years) Min-Max (Mean ± SD)	18-39 (25.15 ± 5.66)	40-65 (53.86 ± 7.08)	18-65 (38.69 ± 15.70)
Corneal Central Thickness (µm) Min-Max (Mean ± SD)	247-630 (540.28 ± 43.91)	448-654 (540.82 ± 34.32)	247-654 (540.53 ± 39.60)
Anterior Chamber Depth (mm) Min-Max (Mean ± SD)	2.71-4.44 (3.74 ± 0.33)	2.16-4.33 (3.29 ± 0.44)	2.16-4.44 (3.53 ± 0.45)
Anterior Chamber Angle (°) Min-Max (Mean ± SD)	29-57 (43.92 ± 6.49)	16-60 (39.62 ± 8.66)	16-60 (41.89 ± 7.88)
K1 (Diopters) Min-Max (Mean ± SD)	33.54-46.62 (42.20 ± 1.82)	38.15-46.43 (42.52 ± 1.44)	33.54-46.62 (42.35 ± 1.68)
K2 (Diopters) Min-Max (Mean ± SD)	39.88-47.93 (44.26 ± 1.72)	38.80-48.08 (43.60 ± 1.54)	38.80-48.08 (43.95 ± 1.67)
K average (Diopters) Min-Max (Mean ± SD)	39.48-47.06 (43.20 ± 1.59)	38.50-47.13 (43.05 ± 1.41)	38.50-47.13 (43.13 ± 1.50)

GLA: Group lower age; GHA: Group higher age

With the p<0.0001, women were showed to have narrower iridocorneal angles compared with men. The K1 mean values of male and female were 42.35 ± 1.68D and 43.0 ± 1.55D, respectively and their K2 results were 43.95 ± 1.67D and 44.47 ± 1.56D, respectively. Kavg values were 43.45 ± 1.50D and 43.72 ± 1.44D. When comparing both genders, women showed higher keratometry results as opposed to men (p<0.0001 for all).

Subgroups were then compared within each other according to gender.

Table 3: The minimum, maximum and mean values of anterior segment data divided by female gender.

	GLA n=143	GHA n=158	Total n = 301
Age (years) Min-Max (Mean ± SD)	18-39 (26.46 ± 6.20)	40-65 (53.19 ± 6.96)	18-65 (40.49 ± 14.91)
Corneal Central Thickness (µm) Min-Max (Mean ± SD)	444-629 (537.50 ± 35.79)	392-642 (535.10 ± 36.37)	392-624 (536.24 ± 36.05)
Anterior Chamber Depth (mm) Min-Max (Mean ± SD)	2.84-5.42 (3.68 ± 0.37)	2.18-4.60 (3.18 ± 0.44)	2.18-5.42 (3.42 ± 0.48)
Anterior Chamber Angle (°) Min-Max (Mean ± SD)	26-60 (42.53 ± 6.24)	13-69 (36.29 ± 8.47)	13-69 (39.25 ± 8.11)
K1 (Diopters) Min-Max (Mean ± SD)	37.40-47.53 (42.99 ± 1.69)	38.82-46.14 (43.00 ± 1.43)	37.40-47.53 (43.00 ± 1.55)
K2 (Diopters) Min-Max (Mean ± SD)	40.75-49.42 (44.67 ± 1.65)	40.52-48.49 (44.29 ± 1.46)	40.52-49.52 (44.47 ± 1.56)
K average (Diopters) Min-Max (Mean ± SD)	40.03-47.43 (43.18 ± 1.57)	40.43-47.30 (43.64 ± 1.31)	40.03-48.00 (43.72 ± 1.44)

GLA: Group lower age; GHA: Group higher age

With gender comparison in GLA, CCT, ACD and ACA were found statistically insignificant with p=0.380, 0.130 and 0.057, respectively. The K1 values for men and women were 42.20 ± 1.82D and 42.99 ± 1.69D. The K2 values for men and women were 44.26 ± 1.72D and 44.67 ± 1.65D. The Kavg values were 43.20 ± 1.59D and 43.81 ± 1.57D. Women showed higher keratometry results with p<0.0001, p=0.044 and p=0.003 respectively.

In GHA, all categories except CCT were statistically significant between genders. The CCT did not show significant difference between genders (p=0.258). The ACD values for men and women were 3.29 ± 0.44 mm and 3.18 ± 0.44 mm showing the women had narrower ACD (p=0.016). The ACA results were 39.62 ± 8.66° and 36.29 ± 8.47° for males and females (p=0.001). The K1 values for men and women were 42.79 ± 1.45D and 43.00 ± 1.43D (p=0.006). The K2 results were 43.99 ± 1.53D and 44.29 ± 1.46D for males and females (p<0.0001). The Kavg results were 43.05 ± 1.41 and 43.64 ± 1.31D with p=0.001.

DISCUSSION

In this study, we found that mean CCT ± SD was 538.25 ± 37.78 μm in total. Male and female CCT were 540.53 ± 39.60 μm and 536.24 ± 36.05 μm, respectively. There were multiple studies that found negative correlation between age and gender with CCT (Kadhim & Farhood 2016). In the present study, the age and gender groups showed no statistically significant differences of CCT. When comparing with other studies in Turkish populations, Altinok et al. (2007) found that their population's mean CCT ± SD values for male was 552.2 ± 35.9 μm and 552.3 ± 35.4 μm for female. They also found that CCT for men decreased with age. Büyük et al. (2011) found the mean CCT to be 573.8 ± 35.7 μm in their normal subjects. These results were higher than in our study population, and we did not find any significant correlation of CCT with age. In contrast, Goktas et al. (2012) found CCT as 500 ± 37 μm in their subjects. Arici et al. (2014) found CCT to be 521 ± 33 μm in healthy Turkish population. The closest results came from Diyarbakir region with the CCT value of 540 ± 31.1 μm (Cinar et al. 2013). To compare with non-Turkish populations, the most similar CCT results in neighboring countries came from Iraqi studies with 543.95 ± 32.58 μm and 541.25 ± 34.96 μm (Kadhim & Farhood 2016; Rashid & Farhood 2016).

The studies that calculated anterior chamber depth in Turkey, Cınar et al. (2013) found that ACD value with 2.95 ± 0.30 mm ACD had negative correlation with age. Two different studies from Afyon region found their ACDs to be 3.42 ± 0.44 mm and 3.69 ± 0.35 (Polat et al. 2016; Ertan & Doğan 2019). A study in Malatya had ACD of 3.14 mm (Emre et al. 2008). Moreover, a study from Sakarya had 2.5 ± 0.2mm ACD (Ozkan Aksoy et al. 2018). In the present study, ACD was significantly lower in the GHA, similar to Cınar et al.'s results. This was also similar to other studies, that

argued that ACD was narrowing with age which might due to increased of the lens vault and iris bowing during aging (Sun et al. 2012).

Gender wise, the male subjects had larger ACD then women. This was in line with previous studies that showed women tend to have narrower ACD (Rüfer et al. 2010). However, when gender comparison was done in the age groups, we found that there was no difference of ACD between genders below the age of 40 years. The significant difference in the gender group was apparent among the women above age of 40, so the factor was not gender alone, but with combination of gender and age that resulting narrower ACD. This result was in contrast to Yamashita et al. (2012) study that showed young Japanese women to have shallower ACD. However, it was similar to the German study that showed ACD differences between gender had more statistically significant with advancing age (Rüfer et al. 2010).

In the perspective of ACA, a study from Ankara showed an average of 39.4 ± 2.8° for younger group and 31.2 ± 5.5° for the elder group, as opposed to our results, 43.22 ± 6.39° and 37.76 ± 8.70°. (Tezel et al. 2014). A study from Sakarya showed an average of 30.5 ± 2.3° in their ACA with location (Ozkan Aksoy et al. 2018). Our ACA mean of total subject was 40.49 ± 8.10° and showed significant differences between age groups and genders. However, similar to ACD results, the difference from the gender groups were significant among older women. Younger females had no significant difference of ACA compared with men. Advanced age in female were previously found to be associated with a narrow iridocorneal angle in other studies (Rüfer et al. 2010). Interestingly, age adjusted ACA (linear relationship between the eye measurements and age that was allowed to change after age 65 years) showed no significant differences between genders in Alaskan Eskimo population, which was similar to our outcome (Wojciechowski et al. 2003).

In our total subjects K1, K2 and Kavg results were 42.69 ± 1.65D, 44.23 ± 1.63D and 43.45 ± 1.50D, respectively. In a study from Istanbul, healthy subjects K1/K2 readings were 43.37/44.33 D. In Afyon, Polat et al. (2016) found K1 and K2 as 42.62 ± 1.71D and 44.10 ± 1.65D by using Sirius topographer. This was similar to our results. In Diyarbakir, K1, K2 and Kavg was found to be 43.1 ± 1.32D, 43.8 ± 1.4D and 43.5 ± 1.32D in 145 subjects (Cinar et al. 2013). Although this study also evaluated age effects on keratometry, their results showed no significant correlation between keratometry values and age.

Our keratometry values showed that only steep keratometry was significantly different when compared with age, with K2 values lower in the higher age group. This was in accordance to previous studies that argued cornea steepened and therefore shifted from with-the-rule to against-the-rule astigmatism with age (Hayashi et al. 1995). When compared according to gender, all keratometry values were higher in the female groups regardless of age. Females had steeper

keratometry values were previously shown in the literature (Orucoglu et al. 2015; Shrestha et al. 2015). Iyamu & Osuobeni (2012) postulated that the tendency for females to have steeper corneas may be due to the result of women having shorter axial lengths than males. De Bernerdo et al. (2020) also found similar results, and added that females having steeper corneas might be resulted by sex hormones which should be studied further.

The present study had limitation where the retrospective nature made the results dependent on only one topography evaluation. Further studies were needed to find the cause-result relations for this epidemiological study.

CONCLUSION

In conclusion, we found anterior segment indices change with age and gender, and recorded regional anterior segment results for country-wide evaluations. We believe that by going through recordings, each main hospital in country's regions can come up with a local data and show its differences with other regions ages and genders.

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