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Prevalence of corneal astigmatism and axial length in cataract surgery candidates in Turkey

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ABSTRACT

Objectives. To analyze the corneal astigmatism and axial length values in cataract surgery candidates. ***Methods.*** The files of patients who undergone cataract surgery between November 2012 and November 2013 were retrospectively selected and reviewed. The preoperative corneal keratometry measurements in the flat and steep axis and the axial lengths of the patients were recorded. ***Results.*** The study comprised of 449 eyes of 449 patients with a mean age of 68.6±9.8 (range; 40-90) years. The mean axial length value was 23.1±1.0 mm; mean corneal astigmatism was 1.00±0.70 D. The corneal astigmatism was 1.00 D or less in 315 eyes (70.1%); between 1.00 and 2.00 D in 99 eyes (22%); and 2.00 D or more in 35 eyes (8%). With-the-rule astigmatism was present in 51% of the patients, against-the-rule astigmatism was present in 32% of the patients, and oblique astigmatism was present in 17% of the patients. We observed an increase in against-the-rule astigmatism (p=0.032) and oblique astigmatism with age (p=0.040). ***Conclusions.*** The current study is the most populous study in this field of research ever carried out in our country. The mean axial length in our study in comparison to Chinese and German populations was found to be shorter.

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Keywords: Astigmatism; keratometry; axial length

Introduction

The only treatment of cataract is surgery and that is the most prevalent surgery all over the world [1]. Patients' expectations about postoperative vision quality are progressively increasing [2]. Astigmatism is probably the most important factor affecting vision quality, following the cataract surgery [3]. One of the significant markers of astigmatism values that emerge in the postoperative period is the corneal astigmatism values in the preoperative period. Detection of these values and adaptation of the cataract surgery procedure based on these values will enhance the postoperative vision quality. While preoperative values have been widely researched in many countries in the world [4-7], data as to preoperative corneal astigmatism values in surgery candidates are insufficient in our country. The purpose of our study was to measure the values of corneal astigmatism and axial length values in cataract surgery candidates.

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Methods

Four hundred and forty-nine eyes of 449 consecutive cataract patients hospitalized at the Bursa Yuksek Ihtisas Training and Research Hospital between November 2012 and November 2013 were included in our study. The files of the patients were retrospectively analyzed. Patients with cataract, Caucasian, aged 40 years and older were included in the study. Exclusion criteria for the study were previous ocular, refractive or intra-ocular surgery, history of ocular inflammation, pterygium, ocular trauma, and endothelial, ocular surface disorders. This study was approved by the local Ethics Committee. All procedures were in adherence with the tenets of the Declaration of Helsinki.

The patients were divided into two groups based on their ages. The group aged 59 and under was referred to as the Group 1 and those aged 60 and above were gathered under Group 2. For better understanding effects of aging in elderly age groups, the patients aged over 60 were further divided into three groups; those aged between 60-69; between 70-79 and the ones who were 80 and older. The auto refractokeratometric measurements made in the preoperative period were evaluated. Canon RK-F2 (Canon Inc., Tokyo, Japan) autorefractometer was used to obtain keratometry and Opticon Pacline (OPTIKON 2000 S.p.A, Rome, Italy) was used to perform ocular axial length. The corneal keratometry measurements in the steep and flat axis were recorded based on the Canon RK-F2 (measurement range 33.75 to 67.5 D) autorefractometer outputs and also the axial lengths were noted based on the Opticon Pacline output. All patients were tested by the same experienced examiner. Corneal astigmatism was accepted as with-the-rule when the axis of correcting minus cylinder was within 180±30 degrees (the steep meridian of the cornea being within 90±30 degrees in this case), against-the-rule when the correcting minus cylinder axis was within 90±30 degrees, and oblique if it was neither with-the-rule nor against-the-rule.

Statistical Analysis

In the definitive statistics set of the data, standard deviation, lowest, highest median, frequency, and rate values have been utilized. All analyses were performed using SPSS software (version 18.0, International Business Machines Corp.). Kolmogorov-Smirnov and Kruskal-Wallis tests were used and *p* values less than 0.05 were considered significant.

Results

This study enrolled 449 patients (250 female, 199 male). The mean age was 68.6±9.8 years (range; 40-90 years). The mean axial length was 23.1±1.0 mm and the mean corneal astigmatism was 1.0±0.7 Dioptry (D). Corneal astigmatism was present in 315 eyes (70.1%) with a value of 1D or less; between 1 and 2 D in 99 eyes (22%), and 2 D or higher in 35 eyes (8%). No significant difference was observed in the amount of axial length, flat K and steep K, and corneal astigmatism values between Group 1 and 2 ($p>0.05$) (Table 1).

The patients aged older 60 years, on the other hand, were divided into ten-year groups amongst themselves and were analyzed. The patients' groups and their comparison in terms of the regularity of astigmatism are illustrated in Table 2. While the rate of against-the-rule astigmatism increases with the age ($p=0.032$), after 80 years old against-the-rule astigmatism decreases and it was seen that oblique astigmatism also increases ($p=0.040$) (see Table 2). The mean corneal astigmatism values in each age group and the mean steepest axes are illustrated in Table 3. Distribution of the type of astigmatism in age groups was not statistically significant ($p=0.522$). No significant difference in term of astigmatism was

Table1. Ocular biometric parameters of the groups

	Group 1 (<59 years) (n=77)	Group 2 (≥60 years) (n=372)	*p*
Age	52.57±5.31	71.92±6.81	
Axial length	23.08±0.92	23.14±1.01	0.647
K1	42.96±1.56	43.06±1.58	0.644
K2	44.06±1.80	44.02±1.53	0.817
Astigmatism	1.10±0.85	0.97±0.70	0.161

Data are shown as mean±standard deviation. K1=flat keratometry, K2=steep keratometry

Table 2. Distribution of astigmatism in the age groups

	≤59 years	60-69 years	70-79 years	≥80 years
Against-the-rule astigmatism	20 (26)	41 (27.5)*	64 (38.8)*	20 (34.5)
With-the-rule astigmatism	47 (61.0)	83 (55.7)	76 (46.1)	23 (39.6)
Oblique astigmatism	10 (13.0)	25 (16.8)**	25 (15.1)**	15 (25.9)

Data are shown as number and percent. *p= 0.032, ** p= 0.040

Table 3. The mean corneal astigmatism values and the steepest axes in each age group

	≤59 years	60-69 years	70-79 years	≥80 years	*p*
Astigmatism	1.10±0.85	0.98±0.7	0.98±0.7	0.93±0.7	0.522
Steepest astigmatic meridian	83°	90°	85°	80°	83°

Data are shown as mean±standard deviation.

found between the groups (p=0.161) (see Table 1). The distribution of patients within the groups was similar regarding gender and in terms of which eye was being examined. No significant difference was found between the groups (p>0.05).

Discussion

The results obtained in the after the cataract surgery have become almost perfect thanks to certain new techniques being applied in cataract surgery and new-generation lenses [20, 21]. However, astigmatism still appears as the most important problem that we are confronted with, affecting patient satisfaction and vision quality in the postoperative period pursuant to surgery of cataract, which is a particular old age disease [8, 9]. In order to minimize this current problem, corneal relaxing incisions and toric intraocular lenses eliminating the astigmatism when placed on a specific axis are being utilized [10]. Nevertheless, despite these methods, success cannot always be granted and problems about postoperative vision quality may occur. In this study, we investigated preoperative corneal astigmatism values, which were very important for the vision quality in the postoperative period after a cataract surgery, by classifying them according to the ages of the patients.

Type and distribution of astigmatism is different in country. In a study by Ferrer-Blasco *et al.* [5] (Spain), examining the 4,540 eyes of 2,515 patients, they found out that corneal astigmatism was 1.0 D and higher in 35% of the patients. In a study by De Bernardo *et al.* [19] (Italy), examining the 757 eyes of 380 patients, they found out that roughly 50% of the eyes have more than 1 D of astigmatism. In the study in which Hoffmann and Hutz [14] (Germany), noted a corneal astigmatism rate of over 1.0 D 36% rate in 23.239 eyes. Gunes [12] (Turkey) examined 240 eyes of 163 patients. In their study, corneal astigmatism proved over than 1 D in 27.1 %. Khan *et al.* [9] (England) found that over 1 D astigmatism rate 40% in 1230 eyes. Chen *et al.* [8] investigated 2849 Chinese patients; they reported that over than 1 D astigmatism in 41% of the patients. In present study, 29.9% of eyes had corneal astigmatism of 1.00 D or more, which is less than other country.

Against-the-rule astigmatism increased with age and this result was known [3, 5]. The reasons for this were the changes in the eyelid along with aging and also the pressures of these changes on the cornea leading to astigmatic changes on the cornea [17]. Guan *et al.* [6] investigated 827 Chinese patients, and less than 1 D astigmatism was found in 54.5% of patients and against-the-rule increased and linear regression with age. Chen *et al.* [8], and Khan and Muhtaseb [9] were found similar result. Moreover, our study also showed that against-the-rule astigmatism increased with age, in contrast over the 80 age astigmatism

decreased. This result was different from other study results. This may occur due to different eyelid structures [18] or nutrition disorders and the structural differences based on ethnic characteristics. We calculate total corneal astigmatism with autokerotometry, didn't measure the posterior astigmatism. Keratometric astigmatism overestimates total corneal astigmatism in eyes with with-the-rule astigmatism and underestimates total corneal astigmatism in eyes with against-the-rule astigmatism [22].

Axial lengths is important factor for intraocular lens calculation, the average axial length in our population was measured as 23.1±1.0. In the study that Cui *et al.* [13] carried out on the 6,750 eyes of Chinese patients, it was measured as 24.07±2.14 mm. In their study in which they examined 23,239 eyes in Germany, Hoffmann *et al.* [14] measured the mean axial length as 23.43±1.51 mm. In a study conducted on 80 patients fromTurkey by Kamis *et al*. [11], the mean axial length of the patients was found out to be 23.63±0.76 mm (22-25 mm). The axial length in our study, on the other hand, was shorter than the axial length in the Chinese and German populations. Furthermore, our study also pointed out that axial length decreased as the age increased. Similar results were also found in a study involving Chinese population in Singapore, and it was explicated that this outcome might come out due to the effort to compensate for the increasing refraction that happens more frequently with an increasing age [15,16]. In our study, the mean flat keratometry 43.03 D and steep keratometry 44.02 D was found. Ferrer-Blasko et al. [5] reported flat and steep keratometry 43.48 D and 44.08 D, respectively. Khan et al. [9] also reported 43.43 D and 44.46 D. Our keratometry values were lesser than these studies.

Conclusions

In the present study, we found out that against-the-rule astigmatism and oblique astigmatism increased by age and after 80 ages against-the-rule astigmatism decreases; 29.9% of eyes has corneal astigmatism of more than 1.00 D, we found no significant difference in the distribution of astigmatism forms by decades. Our keratometric and axial values were lesser than other studies. Since we could not find a comprehensive study in which Turkish population was also studied, the ethnicity-related discussion of our data is limited. This study reason is benefit for astigmatism management in Caucasian population.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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