

Prevalence Of Keratoconus In Egyptian Subjects With High Corneal Astigmatism

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Purpose: To determine the prevalence of keratoconus in subjects with corneal astigmatism of two diopters (2D) or greater using data from the Pentacam Scheimpflug images.

Methods: This prospective cross-sectional study included 1200 eyes of 1200 patients seeking refractive surgery who are older than 18 years and not previously diagnosed as keratoconus. Patients were divided into Group I (Patients with 2 diopters or greater of corneal astigmatism) and Group II (Patients with less than 2 corneal astigmatism).the second group was taken as a comparative group.

Results: The corneal cylindrical refractive error among individuals in-group I (high astigmatism) was -2.93 ± 0.89 ranging from -2.00 to -7.0. In-group II (low astigmatism) the cylindrical refractive error among normal individuals was -0.7 ± 0.49 ranging from 0.0 to -1.75. It was found that among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) were keratoconus patients. There was a highly significant difference between the two groups ($P < 0.00001$).

Conclusions: The current study showed that subjects with 2D or more of astigmatism had higher prevalence of keratoconus than subjects with less than 2 D astigmatism

Keywords: keratoconus, high astigmatism, pentacam

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Introduction

Astigmatism is an error of refraction in which incident parallel rays cannot be focused to a single point. ⁽¹⁾

Total corneal astigmatism is the sum of both the anterior and the posterior corneal surface astigmatism.⁽²⁾ Astigmatism has several classifications ,most common is the classification into regular and irregular. In the regular astigmatism, the steepest and the flattest meridian are perpendicular on each other.⁽¹⁾ In the irregular astigmatism, the difference between the steepest and flattest meridian is less than 90 making it difficult to obtain a clear retinal image just by simple cylinder correction at one meridian.⁽³⁾

Keratoconus (KC) is a corneal ectatic disorder characterized with axial protrusion of the cornea and stromal thinning which eventually makes the cornea conical in shape leading to myopia and irregular astigmatism,^{(4) (5)} .It is typically a disease of adolescence with progressive vision loss .^{(6) (7)(8)}

Pentacam is the imaging modality of choice for keratoconus.⁽⁹⁾ ,not only for diagnosis but also for proper classification of ectetic corneal disorders and monitoring keratoconus progression. Pattern of Keratoconus determined with pentacam depends on the curvature map, Thickness map, elevation maps, Keratoconus indices and Belin Ambrosio display.⁽¹⁰⁾ . In this study, we detect the prevalence of keratoconus in subjects with astigmatism of two dioptrres (2D) or greater using data from the

Pentacam Scheimpflug images in comparison to equal number of patients with less than 2 diopters o astigmatism.

Materials & Methods

The Ethics Committee of the Faculty of Medicine, Alexandria University, Egypt, approved the study protocol. Written informed consent was obtained from each participant

This is as cross sectional study conducted between April 2019 and July 2021. It included 1200 eyes of 1200 patients presented to El Safwa Laser vision correction center seeking refractive surgery. For eah person only 1 eye was enrolled in the study taking into consideration that keratoconus is bilateral disease so we wanted to avoid confounding factor of bilaterality in the statistical analysis.All these patients had a 2 or more diopters of corneal astigmatism as measured with pentacam. All participants had an age of 18 years or more. Equal number of patients seeking refractive surgery with less than 2 diopters of astigmatism were taken as a comparative group. Patients with Present or past ocular pathology other than refractive error, dry eye disorders, corneal opacity or dystrophy, previous ocular surgery, previous ocular trauma, age less than 18 years were excluded from the study.

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All patients included in the study were subjected to eye assessment including: History taking (age, medical history, surgical history, previous trauma, last time they used contact lens if they are contact lens wearer), a thorough ophthalmic examination was done before pentacam (uncorrected visual acuity , cycloplegic refraction and slit lamp biomicroscopy to examine the cornea, and detect any abnormalities in the iris, lens and retina).

Pentacam imaging was done using Oculus Pentacam HR (Wavelight ,Germany). The rotating Scheimpflug camera captured 50 images automatically around the optical axis of the eye. Following parameters were recorded from the Pentacam maps: Topographic astigmatism, Kmax, central corneal thickness and thinnest location thickness. Diagnosis of keratoconus depended on presence of 3 pentacam derived criteria of keratoconus:

1. Kmax value greater than 48 diopters.
2. Corneal thinning coinciding with steepest corneal point in relation to central corneal thickness
3. Increased posterior surface elevation more than 18 μ at the central 6 mm zone.

Pentacam images were obtained by a single operator and data analysis for keratoconus diagnosis was performed by the same doctor

Statistical analysis

Quantitative data were presented in mean± SD. Statistical analysis was carried out by SPSS, version

2.3.2. (SPSS Inc., New York, New York, USA). **Chi-square test** was used in the comparison between two groups with qualitative data. **Independent t-test** was used in the comparison between two groups with quantitative data and parametric distribution and **Wilcoxon Mann-Whitney test** was used in the comparison between two groups with quantitative data and non-parametric distribution. The comparison between two quantitative data and parametric distribution were done by using **Pearson Correlation Test**. **Spearman correlation coefficients** were used to assess the significant relation between two quantitative parameters in the same group and non-parametric distribution. The difference was considered statistically significant if the P value was less than 0.05.

Results

A total of 600 eyes of 600 patients represented group I (patients with 2 diopters or greater of corneal astigmatism) (n=600) while group II (patients with less than 2 corneal astigmatism) (n=600), with mean age 28.55 ± 8.96 years and 26.69 ± 8.83 years in group I and II, respectively. There was no statistically significant difference between the two groups as regards gender. The mean cylindrical refractive error of our studied population was -2.97 ± 0.96 and -0.703 ± 0.495 in group I (high astigmatism) and II (low astigmatism) respectively. The mean K-max in group I patients was 45.4 ± 2.4, while in group II it was 44.6 ± 1.6.

Table (1): Correlation between Cylinder and Pentacam findings in the both studied groups.

	Pentacam findings	Group I (n=600)		Group II (n=600)	
		Spearman correlation		Spearman correlation	
		P	r	P	r
Cylinder	Topographic cylinder	<0.0001*	0.36	<0.0001*	0.48
	K-max	0.0037*	0.2	0.0049*	0.16
	Thinnest location corneal thickness	0.773	0.02	0.05*	-0.11

* A statistically highly significant positive correlation

Table (1) shows that a strong positive correlation was found between topographic astigmatism and cylindrical refractive error was found in both group I and II (r = 0.36, p <0.0001 and r = 0.48, p <0.0001, respectively). A statistically highly significant positive correlation was found between K-max and cylindrical refractive error was found in group I (r = 0.2, p = 0.0037) and group II (r = 0.16, p = 0.049). There was a statistically insignificant correlation between cylindrical refractive error and thinnest location corneal thickness in both group I (r = 0.02, p= 0.773). This correlation in group II was statistically significant (r = -0.11, p= 0.05).

According to table (2) and figure 1 it was found that among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) were keratoconus patients. There was a highly significant difference between the two groups (P < 0.00001).

Table (3) shows that in group I (high astigmatism) the cylindrical refractive error among normal individuals was -2.93 ± 0.89 ranging from -2.00 to -7.0, while that among keratoconus patients was -3.22 ± 1.17 ranging from to -2.00 to -8.00. No significant difference was found (P= 0.107).

In group II (low astigmatism) the cylindrical refractive error among normal individuals was -0.7 ± 0.49 ranging from 0.0 to -1.75 , while that among

keratoconus patients was -0.75 ± 0.43 ranging from 0.0 to -1.75 . No significant difference was found ($P= 0.65$). (figure 2 and 3)

Table (2): Comparison between the studied groups according to Diagnosis of keratoconus

Diagnosis	Group I (n= 600)		Group II (n=600)		Chi square test	
	No.	(%)	No.	(%)		
Normal	526	87.7%	590	98.3%	$\chi^2= 24.6$	P < 0.00001*
KC	74	12.3%	10	1.7%		

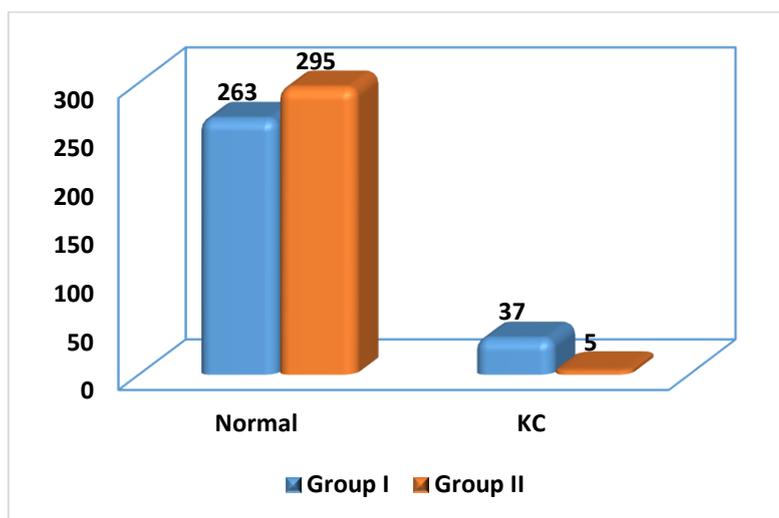


Fig. 1: Distribution of Diagnosis between the two studied groups.

Table (3): Distribution between Cylinder and diagnosis in Group I and Group II

Cylinder				
Group I (n=300)				
Diagnosis	Range	Mean \pm SD	Median (IQR)	P
Normal	-2 – -7.0	-2.93 ± 0.89	-2.75 (-2.25- -3.375)	0.107
KC	-2.0 – -8.0	-3.22 ± 1.17	-3.00 (-2.5 - -3.75)	
Group II (n=300)				
Normal	0.0 – -1.75	-0.7 ± 0.49	-0.5 (-0.25- -1.0)	0.65
K C	0.0 – -1.75	-0.75 ± 0.43	-1.0 (-0.75 - -1.0)	

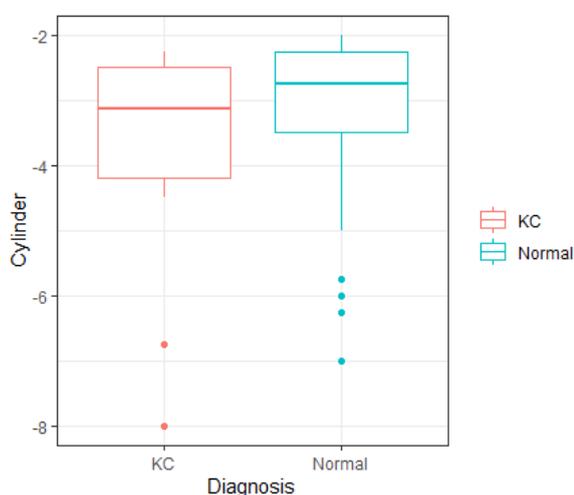


Fig. 2: Boxplot between Diagnosis and Cylinder in Group I.

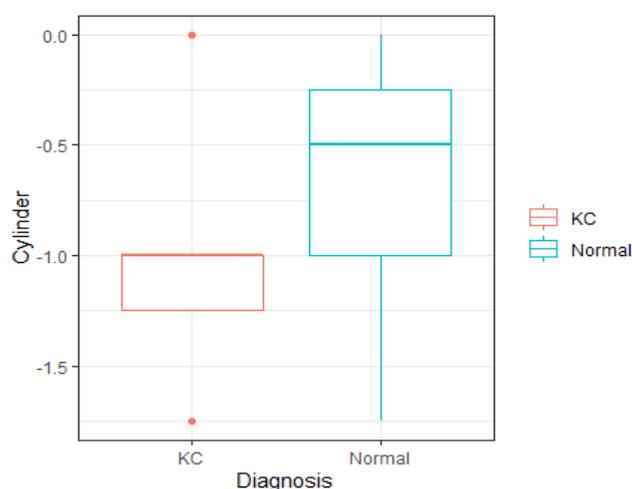


Fig. 3: Boxplot between Diagnosis and Cylinder in Group II

Discussion

keratoconus is typically characterized by the progressive corneal protrusion leading to myopia and irregular astigmatism together with corneal thinning. Keratoconus is commonly detected in the course of an eye examination and patients may be unaware of it, even though they may complain of poor vision and may seek spectacle prescription or even refractive surgery. Detecting early cases of subclinical and clinical KC may provide earlier interventions to halt the progression of the disease and guard against one of the common causes of vision loss.⁽¹¹⁾

The aim of this study was to determine the prevalence of keratoconus in subjects with astigmatism of two diopters (2D) or greater using data from the Pentacam Scheimpflug images. This prospective cross-sectional study included 600 eyes of 600 patients with high cylinder more than 2 diopters and equal sample of low astigmatism less than 2 diopters.

The current study reported that in group I a strong positive correlation was found between topographic astigmatism and cylindrical refractive error in both group I and II ($r = 0.36$, $p < 0.0001$ and $r = 0.48$, $p < 0.0001$, respectively). *Galindo et al.* study result comes in agree with our results.⁽¹²⁾

A statistically highly significant positive correlation was found between K-max and cylindrical refractive error in both study groups. There was a statistically insignificant correlation between cylindrical refractive error and thinnest location in both group I ($r = 0.02$, $p = 0.773$). This correlation in group II was statistically significant ($r = -0.11$, $p = 0.05$).

Linke et al in previously conducted study detected that refractive state showed a positive correlation with the thinnest point in corneal thickness ($r = 0.07$, $P < .001$).⁽¹³⁾

In our study among group I population (high astigmatism) 12.3% diagnosed as keratoconus patients, while 1.7% of group II (low astigmatism) had keratoconus. There was a highly significant difference between the two groups ($P < 0.00001$).

The study published by *Serdarogullan et al.* found that, 14.1% of patients suffering astigmatism ≥ 2 D had some degree of KCN (6.3% of eyes had KCN and 7.8% had subclinical KCN).⁽¹⁴⁾ The current result is a different finding from the prevalence of KC reported by *Shakir and Alwan* where 21% of the patients with astigmatism ≥ 2 D.⁽¹⁵⁾

It is obvious that higher prevalence of keratoconus is more common when cylindrical power increases. Our study has several limitations the most important of them is small sample size making results possibly do

not reflect the actual prevalence of KCN in the population with high astigmatism.

Conclusion

The current study showed that subjects with 2D or more of astigmatism had higher prevalence of keratoconus than subjects with less than 2 D astigmatism. Therefore, it can be concluded that magnitude of astigmatism can be a risk factor for having keratoconus and may need careful assessment.

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Conflicts of interest

there are no conflicts of interest for any of the author

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