

Topographic Pattern of Keratoconus patient at First Presentation in Tertiary Eye Hospital of Bangladesh

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Abstract

Objective: To evaluate the topographic pattern of keratoconus patient at first presentation in a tertiary eye hospital of Bangladesh. **Methods:** This was a cross sectional study conducted over 200 eyes of 100 keratoconus patients attending at National Institute of Ophthalmology & Hospital, Dhaka, for a period of 6 months. Selected patients underwent detail history, ocular and systemic examination as well as related investigations which includes corneal topography, keratometry and auto refractometry. **Results:** Mean age of the patients was 21.24 ± 6.25 (SD) years and among the patients male predominance was observed, male to female ratio was 2.1:1. The mean unaided visual acuity of better eye was 0.86 ± 0.38 (SD) Log MAR and mean unaided visual acuity of worse eye was 1.16 ± 0.44 Log MAR. Among 200 eyes there were 36 mild (18.0%), 100 moderate (50.0%) and 64 severe (32.0%) keratoconus eyes. Majority of the eyes (81.0%) showed three common topographic pattern, these are asymmetric bowtie with skewed axis (32.0%), asymmetric bowtie with inferior steepening (30.0%) and inferior steepening (19.0%). In mild keratoconus patients topography showed largely one pattern, inferior steepening (30.6% of mild keratoconus). In case of moderate keratoconus patients topography shows mainly three patterns, asymmetrical bowtie with skewed axis (19.0%), asymmetric bowtie with inferior steepening (16.5%) and inferior steepening (10.5%). In severe keratoconus patients topography shows mainly three patterns, asymmetrical bowtie with inferior steepening (10.5%), asymmetric bowtie with skewed axis (9.5%) and irregular pattern (8.5%). There was no round, superior steepening, symmetric bowtie or asymmetric bowtie with superior steepening pattern in severe keratoconus. **Conclusion:** The pattern of topography varies among the different stages of keratoconus patients. From the topography pattern we can diagnose the keratoconus early and also get the information of severity of the disease and treat accordingly.

Keywords: Corneal topography, keratoconus, severity of keratoconus, tertiary eye hospital of Bangladesh.

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Introduction

Keratoconus is a progressive, non-inflammatory, bilateral, asymmetrical ectatic corneal disease characterized by paraxial stromal thinning and weakening, resulting in corneal surface distortion. Visual impairment is caused primarily by irregular astigmatism and myopia, and secondarily by corneal scarring.¹ Keratoconus is a complex condition with an etiology involving both external factors such as allergies, eye rubbing and genetic factors.^{2,3,4}

The incidence of keratoconus in general population is approximately 2 per 100,000 (0.002%) according to well designed United States study that collected data over a 48 years period.⁵ Other study undertaken in United Kingdom and Finland report similar incidences of 2.2 and 1.4 cases per 100,000 respectively. There is no reliable data available regarding the

incidence and prevalence of keratoconus in Bangladesh.

Identifying keratoconus is an extensive process which is based on certain clinical signs in addition to corneal topographic values. The mainstay of early detection, diagnosis and tracking of ectasia remain videokeratography specially the corneal topographic mapping of axial dioptric power with colour coded contour.

Corneal topography is classically defined as a non-invasive exploratory technique to analyze both qualitatively and quantitatively the morphology of the cornea,⁶ enabling its geometric characterization and differentiating standard patterns from those potentially devastating for vision disorders.

Keratoconus is classified into 3 stages; mild, moderate and severe on the basis of keratometry readings.⁷ On the basis of colour coded map of topography keratoconus can present following pattern: round, superior steepening, inferior steepening, asymmetric bowtie with inferior steepening, asymmetric bowtie with superior steepening, asymmetric bowtie with skewed axis, symmetric bowtie, symmetric bowtie with skewed axis, irregular pattern.⁸

The purpose of this study was to find out the pattern of topography of each keratoconus patient according to severity of keratoconus. This study will be helpful for recognition of severity of keratoconus and proper planning of treatment modality as well as for further research regarding this study.

Methodology

This cross sectional study was conducted among 100 keratoconus patients with both eyes affected attending at National Institute of Ophthalmology & Hospital, Dhaka from May 2018 to October 2018. All the patients fulfilling the selection criteria were included in the study. Patients suffering from other ocular surface diseases, having history of ocular injury and ocular surgery were excluded. Selected patients underwent detail history, ocular and systemic examination as well as related investigations which includes corneal topography, keratometry and

autorefractometry. Ethical clearance was taken from the Ethical Review Committee of National Institute of Ophthalmology and Hospital. The pattern of corneal topography was categorized into nine different types⁹-

1. Round: The steepest part of the cornea is round and often decentered.
2. Superior steepening: The steepest part of the cornea is localized in the upper part of the cornea.
3. Inferior steepening: The steepest part of the cornea is localized inferior to the apex of the cornea

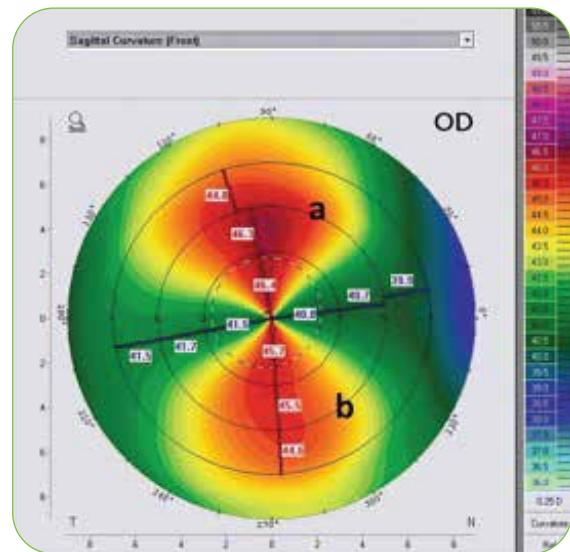


Fig. Corneal topography (symmetrical bowtie pattern)

4. Symmetric bowtie: When the difference between curvature power of segment “a” and segment “b” is less than 1.4D.
5. Asymmetric bowtie with inferior steepening: The curvature power of segment “a” is higher than that of segment “b”. If the difference is more than 1.4 D on the 3 mm central circle, it is considered significant.
6. Asymmetric bowtie with superior steepening: The curvature power of segment “b” is higher than that of segment “a”. If the difference is more than 2.5 D on the 3 mm central circle, it is considered significant.
7. Asymmetric bowtie with skewed axis: It is an asymmetric bowtie with angulation between the axes of the two segments. Angulation is considered clinically significant when it is $>22^\circ$.
8. Symmetric bowtie with skewed axis: It is a symmetric bowtie with angulation between the axes of segments “b” and “a”. Angulation is

considered clinically significant when it is $>22^\circ$.
9. Irregular. Corneal surface has no particular shape, that is, in this pattern steep areas are mixed with flat areas.

Patient's corneal topography were analyzed and put into any of the above categories.

Severity of keratoconus can be graded by the highest axis of corneal power on keratometry as mild (<48 D), moderate (48-54 D) and severe (>54 D).¹⁰

Data were recorded in a pre-designed data collection sheet. Statistical analysis was carried out by using SPSS v26.0. Descriptive statistics

was used for the interpretation of the findings. The results were given as number and percentages for qualitative variables and mean and standard deviation for quantitative variables.

Results

Mean age of the patients was 21.24 ± 6.25 (SD) years where 44 (44.0%) patients were in 11-20 years age group and 40 (40.0%) patients were in 21-30 years age group. Out of 100 patients 68 (68.0%) were male and 32 (32.0%) were female with a male to female ratio of 2.1:1 (table 1).

Table 1. Age and sex distribution of patients (n=100)

Criteria	No. of patients	Percentage
Age groups (in years)		
0-10	6	6.0
11-20	44	44.0
21-30	40	40.0
31-40	8	8.0
41-50	2	2.0
Mean \pm SD	21.24 \pm 6.25	
Sex		
Male	68	68
Female	32	32

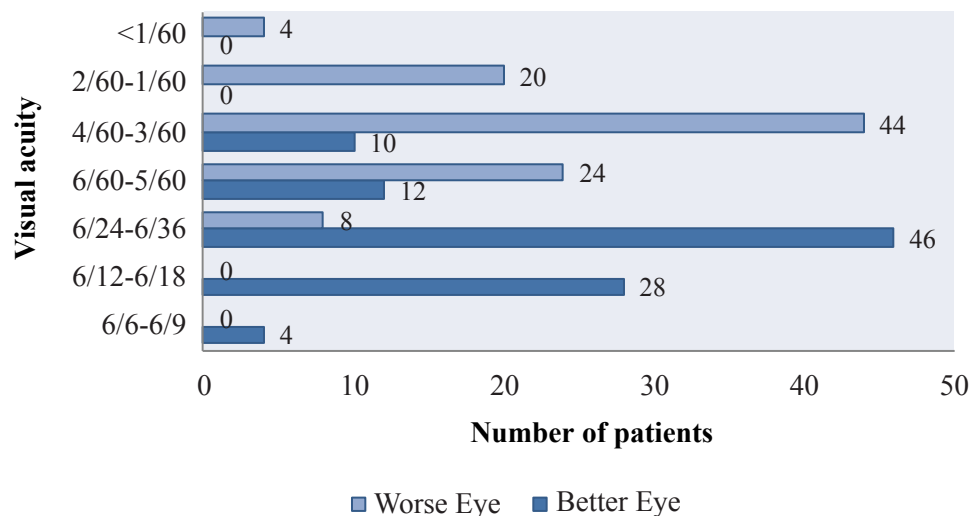


Figure 1: Distribution of unaided visual acuity of study subjects

In the worse eye, no patient had 6/6-6/9 visual acuity while 44 (44.0%) patients in their worse eyes had 6/60-3/60 visual acuity (figure 1).

Table 2: Severity of keratoconus depending on keratometry

Severity of keratoconus	Number of eyes	Percentage
Mild (<48 D)	36	18.0
Moderate (48-54 D)	100	50.0
Severe (>54 D)	64	32.0

D=Diaptor

In this study, 100 (50.0%) eyes had moderate keratoconus. The ratio of mild, moderate and severe keratoconus was 0.36:1:0.64 (table 2).

Table 3: Distribution of topographic pattern of keratoconus according to severity

Topographic pattern	Mild	Moderate	Severe	Total
Round	2 (5.5%)	(0.0%)	(0.0%)	2 (1.0%)
Superior steepening	3 (8.3%)	4 (4.0%)	(0.0%)	7 (3.5%)
Inferior steepening	11 (30.6%)	21 (21.0%)	6 (9.4%)	38 (19.0%)
Asymmetric bowtie with inferior steepening	6 (16.7%)	33 (33.0%)	21 (32.8%)	60 (30.0%)
Asymmetric bowtie with superior steepening	3 (8.3%)	2 (2.0%)	(0.0%)	5 (2.5%)
Asymmetric bowtie with skewed axis	7 (19.4%)	38 (38.0%)	19 (29.7%)	64 (32.0%)
Symmetric bowtie	3 (8.3%)	1 (1.0%)	(0.0%)	4 (2.0%)
Symmetric bowtie with skewed axis	1 (2.8%)	1 (1.0%)	1 (1.6%)	3 (1.5%)
Irregular pattern	0 (0.0%)	0 (0.0%)	17 (26.6%)	17 (8.5%)
Total	36 (100.0%)	100 (100.0%)	64 (100.0%)	200 (100.0%)

The study showed that among moderate keratoconus eyes (50.0%) most eyes (92.0%) follow three common patterns; asymmetric bowtie with inferior steepening (33.0%), asymmetric bowtie with skewed axis (38.0%) and inferior steepening (21.0%). Severe keratoconus eyes (32.0%) follow three common patterns; asymmetric bowtie with inferior steepening (32.8%), asymmetric bowtie with skewed axis (29.7%) and irregular pattern (26.6%) (table 3).

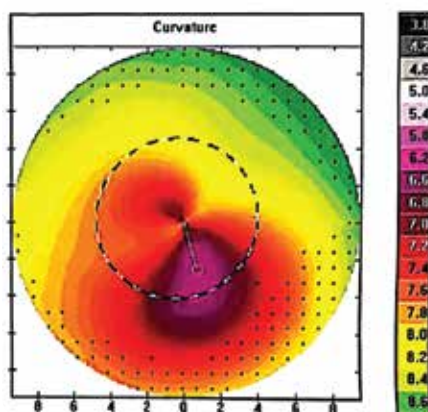


Figure 2. Corneal topography: Asymmetric bowtie with skewed axis pattern

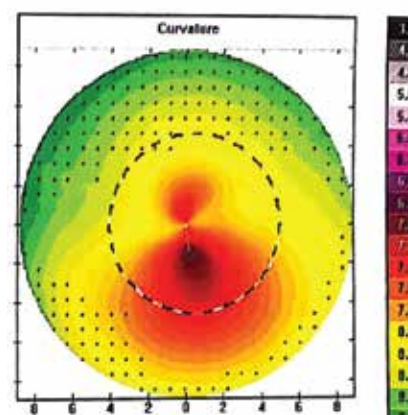


Figure 3. Corneal topography: Asymmetric bowtie with inferior steepening pattern

Discussion

Identifying keratoconus is an extensive process which is based on certain clinical signs in addition to corneal topographic values. In this study, the keratometric and morphological data of 200 eyes with keratoconus were analyzed. All participants had both eyes affected.

In this study, mean age of study population was 21.24 ± 6.25 (SD) years. Mohd-Ali et al.¹¹ evaluated the demographic profile of keratoconus patients in Malaysia and showed that the mean age at the time of diagnosis was 21.46 ± 6.17 (SD) years. Rashid et al.¹² evaluated characteristics of keratoconus patients attending at eye hospital in Kenya and showed that mean age at presentation to the clinic was 20.97 ± 11.13 years. Both of which fairly correspond with our study.

In the present study, we found that majority of the study population were male (68.0%), whereas the female were (32.0%). The male to female ratio was 2.1:1, which was almost 2 times higher than female. Study done by Rashid et al.¹² in Kenya showed that male to female ratio was 1.5:1. Vinay¹³ in India showed that male to female ratio was 2.2:1. This is compatible with the findings of our study. The reason behind this ratio was female group were comparatively neglected and they come lately or even do not come to seek treatment at all.

In our study the mean unaided visual acuity of better eye was 0.86 ± 0.38 (SD) Log MAR and mean unaided visual acuity of worse eye was 1.16 ± 0.44 Log MAR. Mahadevan et al.¹⁴ in India showed that at presentation mean visual acuity of better eye was 0.48 ± 0.39 Log MAR and mean visual acuity of worse eye was 1.22 ± 0.49 Log MAR. The visual acuity of worse eye of this study corresponds with our study but the visual acuity of better eye does not correspond. Late presentation in the hospital may be the reason behind it.

Depending on average keratometry reading, keratoconus is classified into three categories; mild (<48 D), moderate (48-54 D) and severe (>54 D). In our study we found 36 mild (18.0%), 100 moderate (50.0%) and 64 severe (32.0%)

keratoconus eyes. Vinay¹³ showed that at presentation mild keratoconus was 12.04%, moderate keratoconus was 72.26% and severe keratoconus was 15.69% depending on average keratometry readings. Mahadevan et al.¹⁴ evaluated that mild keratoconus was 5.7%, moderate keratoconus was 36.27% and severe keratoconus was 53.37%. It is noted in our study and the study done by other mentioned researchers, the majority of patients presented during the moderate or severe stages of keratoconus. The reason is in mild stage most of the time keratoconus remains undiagnosed and treated as simple refractive error.

In this study we evaluated the topographic pattern of keratoconus of 200 eyes. Majority of the eyes (81.0%) showed three common topographic pattern, these were asymmetric bowtie with skewed axis (32.0%), asymmetric bowtie with inferior steepening (30.0%) and inferior steepening (19.0%). In mild keratoconus patients topography showed largely one pattern, inferior steepening (30.6% of mild keratoconus), other pattern share small percentages. Inferior steepening (21.0%), asymmetric bowtie with skewed axis (38.0%), asymmetric bowtie with inferior steepening (33.0%) were found more in moderate keratoconus (46.0% of total eyes). In severe keratoconus patients topography showed mainly three patterns, asymmetric bowtie with inferior steepening (32.8%), asymmetrical bowtie with skewed axis (29.7%), and irregular pattern (26.6%). Irregular pattern were present only in severe keratoconus (8.5% of total eyes). There was no round, superior steepening, symmetric bowtie or asymmetric bowtie with superior steepening in severe keratoconus. Amreeh et al.⁸ evaluated the topographic pattern of keratoconus of 210 eyes in Jordanian patients and found that the most common pattern is the inferior steepening (40.9%), followed by the asymmetric bowtie with skewed axis (22.8%), the asymmetric bowtie with inferior steepening (18.6%) and the symmetric bowtie (8.6%). This study had similar topographic pattern with our study. One thing is noticeable here that in our study there was considerable number of irregular pattern (8.5%). Late presentation of the patient may be the reason for that. Jordan et al.¹⁵ evaluated topographic pattern of keratoconus eye in New Zealand found asymmetric bowtie with

inferior steepening (29.0%), round (18.0%), or inferior steepening (17.0%). Geographical variation and racial variation may be contributing factor for this dissimilarity.

Limitations: Study setting was the drawbacks of this study; we studied keratoconus patients who visited our hospital, reducing the results generalizability and increasing the selection bias. In this regard more population based studies are therefore warranted.

Conclusion

A high percentage of the patients in our study had moderate to severe keratoconus and age of the presentation was younger. Pattern of topography depends on severity of keratoconus. Asymmetric

bowtie with inferior steepening and asymmetric bowtie with skewed axis are the commonest topography pattern we found. Irregular pattern found only in severe keratoconus. From the topography pattern we can diagnose the keratoconus early and also get the information of severity of the disease and treat accordingly.

Conflict of interest: There is no conflict of interest to declare.

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