Original Research Article

Prevalence of keratoconus and subclinical keratoconus in subjects with two or more diopters (D) of astigmatism using pentacam derived parameters

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ABSTRACT

Backgournd: Keratoconus is a common progressive asymmetric, bilateral, ectatic corneal disorder that arises due to biomechanical and structural defects in organization of corneal collagen. It is characterized by axial protrusion of cornea and thinning of corneal stroma which deforms the shape of cornea leading to myopia and irregular astigmatism with decreased vision.

Materials and Methods: This is a prospective cross-sectional study. All the patients within age group of 8-45 years who attended Outpatient Department of a Tertiary Care Hospital, Ajmer, with signs and symptoms of keratoconus or with astigmatism ≥2D with no previous history of ocular trauma or surgery were evaluated and a complete ophthalmic examination was done including the best corrected visual acuity, retinoscopy, slit lamp biomicroscopy and fundus examination and the findings were recorded. Only subjects with no other signs and symptoms of other ocular pathology were included.

Results: 334 eyes (167 subjects) were included in this study and among 334 eyes, 291 eyes had ≥2 D Astigmatism, 152/167 (91.02%) right and 139/167 (83.23%) left eyes. Mean age of the patients was 19.6±9.09 years ranging from 8 to 45 years. 50.3% of study subjects were females and 49.7% were males. Overall, in both eyes, prevalence of astigmatism was found to be 73.88%, FFKCN was 10.31% and KCN was found 15.81% among the study population having ≥2 D astigmatism.

Conclusion: Patients with astigmatism of ≥2D who attend outdoor clinics should be evaluated with corneal tomography for early diagnosis, even if visual acuity is not significantly affected. Pentacam gives a more accurate diagnosis than corneal topography devices used conventionally, particularly in keratoconus suspicious eyes.

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1. Introduction

Keratoconus (KCN) is the most common progressive asymmetric, bilateral, ectatic corneal disorder that arises due to biomechanical and structural defects in corneal collagen organization.[1] It is further characterized by axial protrusion of the cornea and stromal thinning which deform the shape of cornea leading to myopia, irregular astigmatism with decreased visual function,[2,3] hence; it is essentially significant to understand the severity of the disorder for early treatment. KCN suspect, Forme-fruste KCN (FFKCN), and subclinical KC are described as[4] a topographically normal eye that has frank KC in the fellow eye, or[5] subtle topographic changes without clinical signs of KC or a change in visual acuity. Systemic associations - Down Syndrome, Turner Syndrome, Ehlers Danlos, Marfan Syndrome, Atopy, Osteogenesis imperfecta, Mitral value prolapses. Ocular Associations-Vernal keratoconjunctivitis (VKC), Aniridia, Ectopia lentis, Leber's congenital amaurosis, Retinitis Pigmentosa. Irrespective of ethnicity it affects both the genders equally and its global prevalence is 138 per

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100,000[6] however, in some population studies, prevalence has been estimated as high as 8.9%.[7] The annual incidence of KCN is two per 100000 with a prevalence of 54.5 per 100000 (1 per 2000)[8] but, prevalence in India varies according to the diagnostic criteria and was observed to be 2.3%,[9] however, prevalence report on KCN from Rajasthan is unreported. Etiopathogenesis of KCN is considered to be multifactorial. Environmental factors,[10] genetic, biochemical, hormonal and physical agents have been responsible in initiation and progression of the disorder. The classical description of KCN is considered as non-inflammatory disorder, however; recent studies have provided evidences of inflammatory markers causing KCN.[11] Clinical manifestation of KCN typically varies and may progress asymmetrically between the two eyes of the same patient. Patients initially presents with itching and frequent eye rubbing, blurred vision, frequent change of glasses. Gradually in the untreated eyes thinning of the cornea induces irregular astigmatism, myopia, and protrusion with unique slit lamp finding which causes a mild to marked decrease in vision. Slit lamp findings include thinning of corneal stroma, axial bulging of cornea, vogt striae in descements layer which disappear on pressure, Fleischer ring at the base of cone, Descemet's breaks, subepithelial fibrosis, and apical scars.[12]

2. Aims and Objectives

The present study aims to determine the prevalence of Keratoconus- KCN and subclinical KCN in subjects having astigmatism of ≥2D using data from the Pentacam Scheimpflug imaging tomographer.

3. Materials and Methods

Total 334 eyes (167 subjects) were included in this study and among 334 eyes, 291 eyes had ≥2D astigmatism. The subjects were asked to place his/her chin on the chin rest and the forehead against the head rest. The subject was asked to look at the fixation target with both eyes wide open. The joystick is aligned until the rotating Scheimpflug camera automatically captures 25 single images within 2 seconds for each eye. The HR Pentacam (Oculus Optikgeräte GmbH, Wetzlar, Germany) uses a rotating scheimpflug camera for a detailed analysis of the cornea and captures up to 100 Scheimpflug images with the HR Pentacam during the rotating scan. Scheimpflug principle states that in order to get a higher depth of focus, the picture plane, the objective plane, and the film plane should be moved in such a way that they cut each other in one line or one point of intersection, known as the Scheimpflug intersection. From the Pentacam examination flat keratometric reading (K1) and steep keratometric reading (K2), Maximum simulated keratometry (Kmax), Corneal thickness at the thinnest point of the cornea (minimal pachymetry), Index of surface variance (ISV), Index of vertical asymmetry (IVA), KCN index (KI), Anterior elevation (AE) and Posterior elevation (PE) were recorded into an Excel worksheet. The data was coded and entered into Microsoft Excel spread sheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. The variables were assessed using Anova test. Descriptive statistics included computation of % ages, means and standard deviations. Level of significance was set at P≤0.05. The study was approved by Institutional Review Board of J.L.N. Medical College, Ajmer, Rajasthan. Written informed consent was taken from each participant prior to data collection.

4. Results

The mean age of the patients was 19.65 with range from 8 to 45 years. As per the sample size total 334 eyes (167 subjects) were included in this study and among 334 eyes, 291 eyes had ≥2 D Astigmatism, 152/167 (91.02%) right and 139/167 (83.23%) left eyes. 50.3% of study subjects were females and 49.7% were males. Table 1 shows right eye (number of participants 152) 75.65% participants had Astigmatism, 9.87% participants had FFKCN, 14.48% participants had KCN. In left eye (number of participants 139) 71.94% had Astigmatism, 10.79 had FFKCN, 17.27% had KCN. Overall, in both eyes, the prevalence of astigmatism was found to be 73.88%, that of FFKCN was found to be 10.31% and KCN was found 15.81% among the study population having ≥2 D astigmatism. Our results demonstrate the value of the Pentacam parameters in right and left eye, and found statistically significant values between the KCN, astigmatism and subclinical keratoconus which suggest that Scheimpflug system could differentiate between KCN, FFKCN & Astigmatism.(Table 2). No syndromic associations were seen in this study. 4 patients had a family history of keratoconus.

5. Discussion

The early detection of subclinical ectasia provides patients with an option to begin treatment such as corneal collagen-cross linking (C3R) that may slow or halt the progression of the disease. Corneal tomography is a tool that helps clinicians to characterize the level of susceptibility each patient has for the development of ectasia. Corneal tomography is a valuable diagnostic tool for diagnosing subclinical KC and for tracking the progression of the disease. The Belin ABCD classification/staging system was introduced on the Oculus Pentacam (Oculus GmbH, Wetzlar, Germany) in response to the shortcomings of the Amsler Krumeich (AK) system and, also to meet the needs outlined in the global consensus on keratoconus and ectatic disease.[13] Due to the small sample size of this investigation, our findings may not accurately reflect the prevalence of
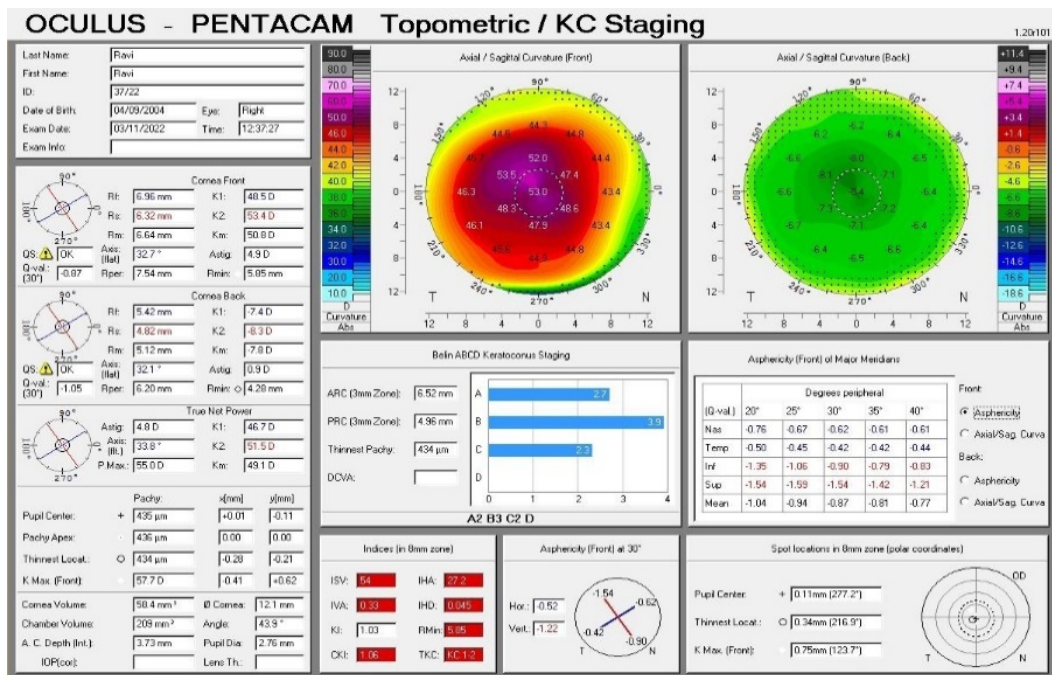
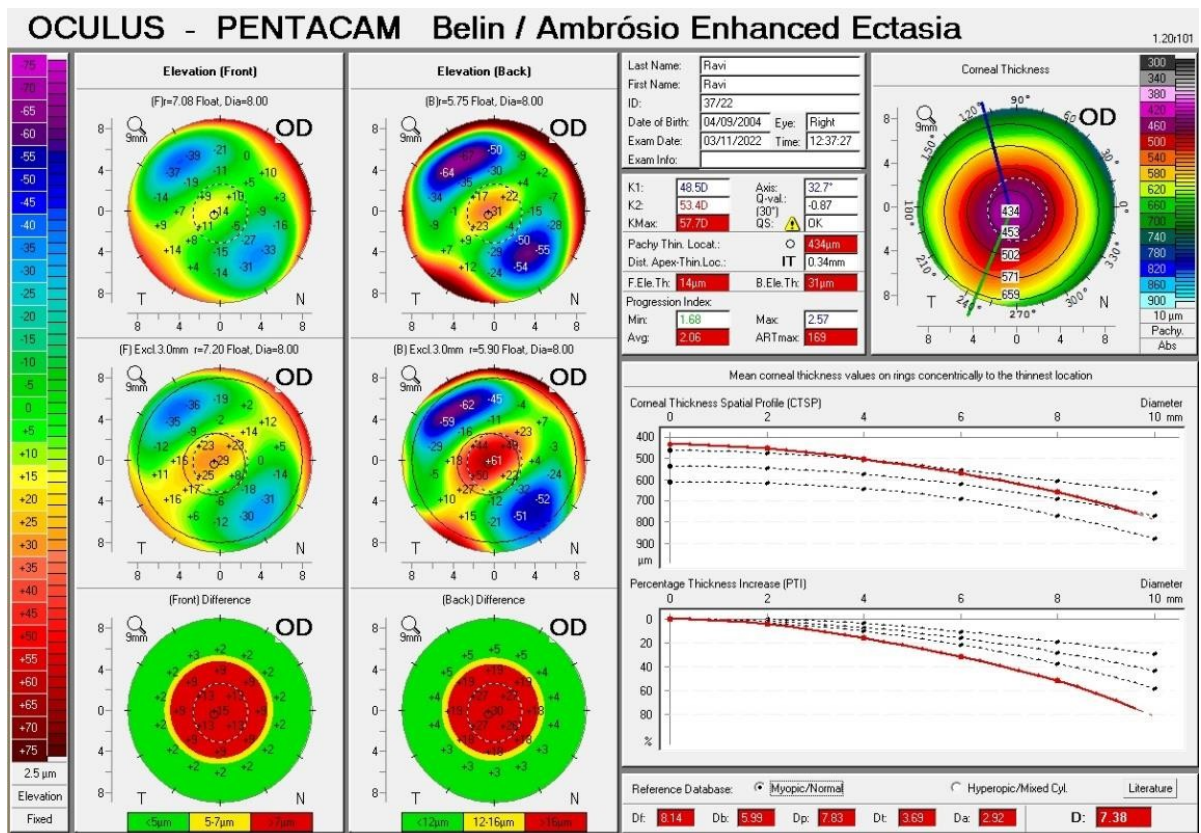**Fig. 1:** Pentacam analysis of a keratoconus patient

Fig. 2: Belin Ambrosio enhanced ectasia display in a keratoconus patient

Table 1: Number of cases with KCN and FFKCN in study sample

Parameter	Right (n=152)		Left (n=139)		Both eyes (291)	
	Frequency	%	Frequency	%	Frequency	%
Astigmatism	115	75.65	100	71.94	215	73.88
FFKCN	15	9.87	15	10.79	30	10.31
KCN	22	14.48	24	17.27	46	15.81
Total	152	100	139	100	291	100.00

Table 2: Mean values of pentacam parameters in study group

Parameter	KCN (mean±SD)	FFKCN (mean±SD)	Astigmatism (mean±SD)	P Value
K1	49.34±3.49	44.66±1.17	42.99±1.48	0.001 (S)
K2	54.32±3.95	47.97±1.38	46.26±1.55	0.001 (S)
Kmax	58.49±4.37	50.14±1.52	47.02±1.68	0.001 (S)
Min Pachy	431.0±37.43	479.46±32.10	513.91±33.71	0.001 (S)
ISV	74.0±25.61	40.73±10.49	32.29±8.82	0.001 (S)
IHA	27.23±19.18	27.87±16.23	8.92±8.14	0.001 (S)
KI	1.13±0.14	1.08±0.07	1.03±0.04	0.001 (S)
AE	19.81±9.25	9.0±5.71	4.86±2.74	0.001 (S)
PE	40.81±21.95	14.07±7.93	7.46±5.31	0.001 (S)

Flat (K1) and steep (K2) keratometric readings, Maximum simulated keratometry (Kmax), Corneal thickness at the thinnest point of the cornea (minimal pachymetry),Index of surface variance (ISV), KCN index (KI), Index of height asymmetry (IHA), Anterior elevation (AE) and Posterior elevation (PE)

KCN in the community with ≥2D astigmatism. However, our research found that several parameters derived from Pentacam readings can help distinguish between eyes with varying degrees of KCN and normal eyes. The examination of these parameters is critical in distinguishing between eyes with subclinical KCN and normal eyes. The HR Pentacam (Oculus Optikgeräte GmbH, Wetzlar, Germany) uses a rotating Scheimpflug camera and the Sirius tomography system (Costruzioni Strumenti Oftalmici, Florence, Italy) combines two mechanisms of the scheimpflug rotating camera with Placido disk topography to image the anterior segment of the eye. These tomographic systems could not be used interchangeably in the clinical diagnosis and follow-up.[14,15] There is no such study done in this geographical area.

6. Conclusion

The diagnosis of KCN is gaining importance, as several techniques, such as cross-linking are being developed to halt the progression of this ectatic disease. Because of the increasing usage of imaging devices, such as the Pentacam, the incidence of KCN is also going higher than anticipated previously. Because keratoconus causes irregular astigmatism and myopia, patients with astigmatism of 2D or larger who attend outpatient clinics should be evaluated with corneal tomography for early diagnosis, even if their visual acuity is not affected. Pentacam delivers a more accurate diagnosis than conventional corneal topography devices, particularly in keratoconus suspicious eyes. In present study, total 334 eyes were examined among 167 patients. Out of these, ≥2 D astigmatism was observed among 152/167 (91.02%) right and 139/167

(83.23%) left eyes. Prevalence of KCN (keratoconus) was found to be 15.81% among the study population having ≥2 D astigmatism using Pentacam Scheimpflug tomographer derived parameters.

7. Limitations

One of the limitations of the current study is the small sample size, which limits the generalizability of the results to other populations. As a result, future studies should recruit larger sample sizes and include more demographic variables.

8. Source of Funding

None.

9. Conflict of Interest

None.

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