



Topographic Corneal Changes in Patients with Vernal Keratoconjunctivitis - A Cross Sectional Study

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Abstract

Background: Vernal Keratoconjunctivitis (VKC) is a seasonally recurring bilateral allergic condition of the cornea and conjunctiva characterized by symptoms like itching, watering, foreign body sensation and ropy discharge. Chronic epithelial trauma provoked by eye rubbing due to intense ocular itching has been postulated as an important risk factor in the pathogenesis of keratoconus in VKC patients.

Objectives: To detect anterior corneal surface changes like astigmatism and keratoconus by topographic evaluation of cornea.

Methodology: This was a cross sectional study carried out on 424 eyes of 212 patients between 5 to 20 years of age at Post Graduate Department of Ophthalmology, Government Medical College, Srinagar between September 2016 and September 2018. Best Corrected Visual Acuity (BCVA), slit lamp examination, pachymetry, fundus examination and corneal topography was done in all the patients. Parameters like steep K, Sim K astigmatism, I-S difference and SRAX were analysed and keratoconus like topography noted.

Results: Out of 212 patients, 145 were males and 67 were females. Majority were in the age group of 5-10 years. Among the study eyes, $K_{max} > 47.2$ D was seen in 10.1 %, Sim K astigmatism > 1.5 D in 29%, I-S difference > 1.2 D in 19.6 %, SRAX $> 21^\circ$ in 20% and $K_{max} > 47.2$ D + Sim K astigmatism > 1.5 D i.e keratoconus like topography was seen in 7.5 %.

Conclusion: Incidence of astigmatism and keratoconus in VKC patients is more when compared to general population of the same age group.

Keywords: Vernal Keratoconjunctivitis(VKC), Topography, Astigmatism, Keratoconus.

Introduction

Vernal keratoconjunctivitis (VKC) is a bilateral, chronic, external ocular inflammatory disorder, mainly affecting patients in their first or second decade.¹ It is common in warm, temperate climates during spring and summer seasons. The onset of disease is generally before the age of 10

years. It lasts for 2 to 10 years and it usually resolves during late puberty.² A male preponderance has been observed, especially in patients under 20 years of age, among whom the male:female ratio is 4:1–3:1.³

VKC is characterized by symptoms like itching, photophobia, watering, foreign body sensation,

thick ropy mucoid discharge, blepharospasm and signs like confluent papillary hypertrophy on the limbus and tarsal conjunctiva.⁴

Vernal keratoconjunctivitis is a condition mediated by Th2 lymphocytes and the precise roles of mast cells, eosinophils, fibroblasts and their cytokines in the inflammatory process and the remodelling of conjunctival tissue remain poorly established.⁵

VKC is associated with complications like superficial punctate keratitis with superficial pannus, pseudogerontoxon, shield ulcer, peripheral corneal stromal degeneration leading to astigmatic type of refractive error, keratoconus which leads to visual impairment.

In our clinical practice, we see many patients of VKC every year but corneal topography is not performed routinely in every case. Hence this study was conducted with the aim of detecting corneal surface changes like astigmatism and keratoconus in VKC subjects by analyzing topographic maps.

Materials and Methods

This was a cross sectional study carried out in Department of Ophthalmology, Govt. Medical College Srinagar on 424 eyes of 212 patients over a period of two years. The age group of the patients was 5- 20 years and both the genders were selected for the study. The study was approved by the ethical committee of the institute. The patients or their parents were interviewed as to details of history including age of onset, duration of illness, frequency of eye rubbing, visual difficulties and presence of allergic disease. All the patients underwent detailed ocular examination including recording of best corrected visual acuity (BCVA), slit lamp biomicroscopy, retinoscopy, fundus examination, pachymetry and corneal topography.

Topography was done using Atlas Model 9000 Corneal Topography System. Three keratographic images ensuring proper fixation were taken. One keratograph of each eye was chosen for analysis. The parameters analysed were Steep K, Flat K, Sim K astigmatism, I-S Difference and SRAX. To

detect keratoconus, the corneal topographic data were quantitatively analysed by using Rabinowitz criteria.⁶ For normal corneas, central corneal power is set at 47.2D, I-S value at 1.2 D, SimK astigmatism at 1.5 D and SRAX is set at 21°. Therefore, maps with central corneal power greater than set up values were considered to have the keratoconus pattern. Based on these findings, patients were categorized into groups of astigmatism < 1D, astigmatism 1-2 D, astigmatism > 2D, keratoconus like topography (Kmax > 47.2D + astigmatism > 1.5 D). Also the VKC patients with keratoconus were classified into categories of mild (47.2-48 D), moderate (48-54) and severe (>54D).

Results

The mean age was 10.8±4.19 years (range 5-20 years) and maximum patients were clustered between 5-10 years of age. Out of 212 patients, 145 were males and 67 were females. The mean age of onset of the disease was 7.6±3.43 years with maximum (51.9%) patients having age of onset between 5-9 years of age. The mean duration of illness was 3.2± 2.69 years. The most common symptoms present were itching (100%), redness (99.1%) and ropy discharge (56.1%). About 88 % of the patients rubbed their eyes frequently (> 8 times) and 12% rubbed their eyes occasionally (< 4 times). The mean central corneal thickness (CCT) among the study eyes was 495.9±30.7µm.

Table 1 Summary of Vernal keratoconjunctivitis subjects

Clinical Characteristics	Data
Age at presentation(yrs) Mean± SD(range)	10.8± 4.19 (5-20 yrs)
Sex (M/F)	145 /67
Age of onset (yrs) Mean± SD(range)	7.6 ± 3.43(2-17)
Duration of symptoms (yrs)	3.2 ± 2.69
<i>Symptoms</i>	<i>Percentage of eyes</i>
Itching	100 %
Redness	99.1 %
Ropy discharge	56.1 %
<i>Lid Signs</i>	<i>Percentage of eyes</i>
Papillae	11.3 %
Cobblestone papillae	3.3%

<i>Conjunctival Signs</i>		
Redness		92.9 %
<i>Corneal Signs</i>		
Limbitis		67.5%
Trantas Dots		38.2%
Pseudogerontoxon		22.6%
Central Corneal		495.9 ± 30.7
Thickness(μm)		

Topographic Changes

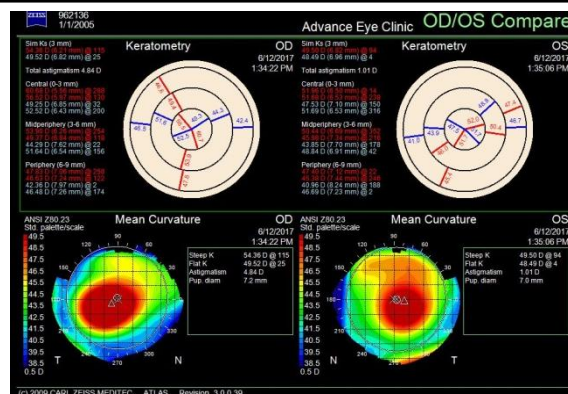
The incidence of keratoconus like pattern (K max > 47.2 D + SimK astigmatism > 1.5D) in our study eyes was 7.5 % on corneal topography. Out of 424 eyes of 212 patients, Kmax > 47.2 D was seen in 10.1 %, I-S Difference in 19.6%, SimK astigmatism > 1.5D and SRAX > 21° in 20%. About 3.3 % of the eyes (10 patients/2.4 % of patients) fulfilled all the criteria of Rabinowitz. The mean duration of illness in eyes with KCN pattern was 6.7 yrs and in eyes with severe KCN and astigmatism was 8.5 yrs and 5.7 yrs which more as compared to eyes with non KCN pattern.

Table 2 Severity of keratoconus in study eyes and the mean duration of illness

Kmax(D)	Percentage	Mean Duration of illness(yrs)
Mild (47.2 -48)	5.4	5.2
Moderate (48-54)	2.8	7.5
Severe (≥ 54)	1.9	8.5

Table 3 Severity of astigmatism in study eyes and the mean duration of illness

SimK Astigmatism (D)	Percentage	Mean Duration of illness(yrs)
<1	49.5	2.3
1-2	30.9	2.5
>2	19.6	5.7



Topography showing KCN pattern and skewing of radial axes in VKC patient.

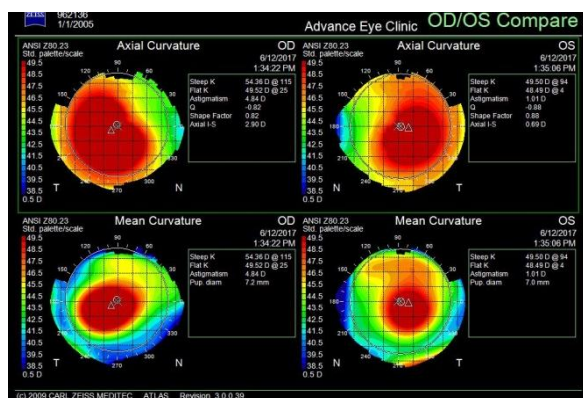
Discussion

Vernal keratoconjunctivitis is known to be one of the most severe forms of ocular allergy with potential to cause corneal damage and permanent visual loss. Corneal involvement in VKC patients occurs in the form of superficial punctate keratitis, with superficial pannus, pseudogerontoxon, shield ulcer, astigmatism and keratoconus.

Children with VKC have a high incidence of keratoconus and astigmatism and have more abnormal corneal topography patterns compared with normal eyes.^{7,8,9} Chronic ocular trauma and rubbing of eyes due to pruritis could be the environmental factor ('trigger') associated with keratoconus development in genetically predisposed individuals.^{10,11} Microtrauma due to eye rubbing in susceptible individuals injures the epithelium, leading to cytokine release, myofibroblast differentiation, a change in biomechanical forces and thinning of corneal tissue and this has been proposed as the possible mechanism.

The cornea is elastic and, therefore, susceptible to changes in shape. The force and frequency of rubbing are key factors associated with corneal eye rubbing related changes. Both vigorous knuckle-grinding rubbing and repetitive gentle rubbing have been linked to the development of keratoconus.¹²

The purpose of this study was to evaluate the incidence of astigmatism, incidence of keratoconus in VKC patients by quantitative analysis of topographic maps and to detect clinical characteristics of VKC associated keratoconus.



The mean age of the patients was 10.8 ± 4.19 years with an age range of 5 to 20 years. Majority (52.4 %) were clustered between 5 to 10 years of age. In a study conducted by Totan Y et al⁸, majority of the patients were clustered between 8 -22 years of age and the mean age of the patients was 15.04 ± 6.11 years which is comparable to our study and indicates that vernal keratoconjunctivitis is common in this age group. Among the study population, out of total 212 patients, 145 were male (68.4%) and 67 were female (31.6%). In a study conducted by Leonardi A et al³ 76.6% were males and 23.4% were females which is comparable to our study hence indicating that VKC is common in males than females.

The most common presenting symptom were itching, redness and ropy discharge seen in 100%, 99.1 % and 56.1 % of study eyes. About 88 % of the patients rubbed their eyes frequently(> 8 times) and 12% rubbed their eyes occasionally(< 4 times). In a study conducted by Gupta A et al¹³ itching was the most common presenting symptom in 92% of the subjects. We reported the comparable frequency of eye rubbing and percentage of itching in our study patients. In VKC, eye rubbing is common, because of intense itching. The role of chronic eye rubbing has been described in the pathogenesis of keratoconus¹³

The mean central corneal thickness (CCT) among the study eyes was $495.9 \pm 30.7 \mu\text{m}$. In a study conducted by Vijay Gautam et al¹⁴, the mean CCT observed in VKC patients was $507.2 \pm 9.8 \mu\text{m}$, $511.1 \pm 9.8 \mu\text{m}$ in VKC with non- keratoconus like topography and $470.6 \pm 11.2 \mu\text{m}$ in VKC with keratoconus- like topography which is low as compared to $526.4 \pm 8.6 \mu\text{m}$ in normal subjects. This is comparable to our study where we found that CCT is significantly decreased in patients with significant topographic changes. This can be clearly attributed to micro trauma caused by frequent eye rubbing and hence resulting in significant thinning of CCT in VKC patients.

Corneal videokeratography is very important investigative tool in detecting keratoconus and

helps in detecting early or subclinical forms of keratoconus. In our study, corneal topography using Atlas Model 9000 Carl Zeiss was done in all the patients and various corneal topographic indices were found to be altered in VKC patients. To detect keratoconus, the corneal topographic data were quantitatively analysed by using Rabinowitz criteria which includes 4 indices. Therefore, maps with $K_{\text{max}} > 47.2 \text{ D}$, I-S difference $> 1.2 \text{ D}$, Sim K astigmatism $> 1.5 \text{ D}$ and $\text{SRAX} > 21^\circ$ were considered to have keratoconus pattern.

The Rabinowitz indices among study eyes revealed mean K_{max} of $44.9 \pm 2.62 \text{ D}$ The mean I-S difference was $0.82 \pm 1.39 \text{ D}$ (min -0.8 and max 10 D). The mean Simk astigmatism among study eyes was $1.41 \pm 1.24 \text{ D}$ and mean SRAX was $11.8 \pm 14.08^\circ$. As per Rabinowitz criteria, in study eyes, $K_{\text{max}} > 47.2 \text{ D}$ was seen in 10.1 % , I-S Difference $> 1.2 \text{ D}$ in 19.6%, Simk Astigmatism $> 1.5 \text{ D}$ in 29% and $\text{SRAX} > 21^\circ$ in 20% using data analysis software. In our study we found that out of the four Rabinowitz indices, the most common topographic change noted in study eyes of VKC patients was Sim K astigmatism $> 1.5 \text{ D}$ seen in 29%. The two most important indices for detecting keratoconus like topography are K_{max} and Sim K astigmatism and in our study we noted that about 7.5% of the study eyes had $K_{\text{max}} > 47.2 \text{ D} + \text{SimK astigmatism} > 1.5$ and 3.3% (10 patients) had all the indices of the criteria fulfilling.

In our study we divided the study eyes of patients with keratoconus like pattern on topography into mild ($K_{\text{max}} 47.2 - 48 \text{ D}$) seen in 5.4%, moderate (48-54D) in 2.8% and severe ($> 54 \text{ D}$) in 1.9% and the mean duration of illness of each group was 5.2 years, 7.5 years and 8.5 years respectively.

Based on topography of study eyes, astigmatism $< 1 \text{ D}$ was seen in 49.5%, 1-2D astigmatism was seen in 30.9% and $> 2 \text{ D}$ was seen in 19.6% which is significantly higher when compared to the general population. The mean duration of illness was 2.3 years and 2.5 years in astigmatism $< 1 \text{ D}$ and 1-2 D respectively and 5.7 years in

astigmatism >2D which was significantly higher as compared to other groups. Also the mean duration of illness was 6.7 years in patients with KCN like topography which was higher as compared to non KCN like topography. In a study conducted by Gupta A et al¹³ the mean duration of symptoms in group of patients with astigmatism of 1- 2 D was 9.3 months and in astigmatism >2D was 15.3 months, which is comparable to our study where we found that the mean duration of illness was higher in patients with increasing severity of astigmatism and keratoconus. This indicated that longer the duration of symptoms, more are the chances of corneal changes.

Keratoconus is a bilateral asymmetrical disease and there is a strong association between VKC and KCN. Our aim was to detect the anterior corneal surface changes in patients with VKC using quantitative and descriptive methods of corneal topography. In a study conducted by Khan et al¹, they reported a 7% incidence of keratoconus. In a study conducted by Gautam V et al¹⁴, 11.3% were found to have keratoconus-like topography. In a study conducted by Gupta A¹³ on 100 patients, the incidence of keratoconus in VKC was 8%. In the study by Lapid-Gortzak R et al¹⁵ about 11.25% KCN like pattern was noted in VKC patients. Totan et al⁸ in a video keratographic study conducted on 82 patients of VKC reported a 26.8% incidence of keratoconus in VKC. In our study, the incidence of keratoconus detected by topography in VKC was 7.5% which correlates with Khan et al¹, Gupta A et al¹³ and Gautam V et al¹⁴ studies, but does not correlate with Totan et al⁸ study, which shows higher incidence. The lower incidence rate in our study may have resulted due to younger age of VKC patients with maximum patients clustering between 5-10 years of age as the duration of disease plays an important role in VKC induced keratoconus.

Conclusion

- Incidence of astigmatism and KCN like topography is higher in patients with VKC

and there is a strong association of keratoconus with VKC.

- Longer duration of disease is associated with more topographic corneal changes in patients of VKC.
- Eye rubbing due itching plays an important role in inducing the anterior corneal surface changes in patients of VKC.
- Corneal topography should be done in all the patients of VKC since it is possible to detect early, mild form of keratoconus by qualitative and quantitative assessment of video keratographic maps thus allowing early detection and management of KCN and related complications.

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