

# Keratoconus: Epidemiology and clinical characteristics at Ho Chi Minh Eye Hospital

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## ABSTRACT

**Background:** Keratoconus is a non-inflammatory corneal ectasia disease that can lead to visual impairment. Therefore, detecting symptoms of keratoconus is very important. So, we conducted this study to describe the epidemiology and clinical characteristics of keratoconus at Ho Chi Minh City Eye Hospital. **Methods:** This is a cross-sectional study of keratoconus cases diagnosed at the Optometry department in Ho Chi Minh Eye Hospital. **Results:** Keratoconus was diagnosed in 124 eyes of 64 patients. The mean age was  $20.7 \pm 5.2$  and the ratio between male and female patients was 1.5 : 1. The majority of patients had the habit of rubbing their eyes (71.9%), 45.3% of patients had allergic conjunctivitis and 9.4% had relatives with keratoconus. Most of the patients had keratoconus in bilateral eyes. Wearing spectacles helps improve visual acuity, and the group without clinical symptoms had better vision. The most common symptom was scissor reflex (67.7%), followed by Fleisher ring (52.4%), Rizzuti sign (49.2%), and Vogt's striae (21.8%); 21.8% of eyes had no clinical symptoms. **Conclusions:** The percentage of patients who habitually rubbed their eyes was significantly high. Allergic conjunctivitis was a prevalent comorbidity in patients with keratoconus. Scissor reflex, Fleisher ring, Rizzuti sign, and Vogt's striae were common signs of keratoconus.

**Keywords:** keratoconus, rubbing eyes.

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## INTRODUCTION

Keratoconus is a non-inflammatory corneal ectasia disease characterized by progressive thinning of the central or paracentral cornea and the protrusion of the anterior corneal area with cone shape [1]. In the early stage, visual acuity gradually decreases due to changes in refraction, and in the late stage, the visual acuity is affected seriously by the changes in corneal structure [2]. The causes of disease have not yet been clearly determined [1]. Keratoconus could be diagnosed by clinical examination combined with corneal topography. Nowadays, screening and

detecting patients with keratoconus is extremely important when refractive surgery is increasingly developed. Around the world, there have been several studies on keratoconus; however, in Viet Nam, there are not many studies on this disease, and the information on keratoconus characteristics is limited, and corneal topography machines are not available in many places, therefore, patients are normally diagnosed at a late stage, directly affecting the effectiveness of the treatment result [3]. Therefore, we had some questions: "Whose patients have more chance of having keratoconus? What are the typical clinical characteristics of the

disease?”. So that we conducted this study with two objectives: (1) Describe the epidemiology characteristics of patients with keratoconus at Ho Chi Minh City Eye Hospital from November 1, 2022 to June 30, 2023; (2) Describe the clinical characteristics of eyes with keratoconus in these patients. The results obtained will hopefully contribute to the early detection of keratoconus.

## METHODS

### Materials

Patients with keratoconus examined at the Refractive Department of Ho Chi Minh City Eye Hospital during the period from November 2022 to June 2023

*Selection criteria:* Patients were diagnosed with keratoconus based on the corneal topography which had three criteria: Abnormal posterior elevation, abnormal corneal thickness distribution, and no clinical signs of inflammatory corneal thinning and agreed to participate in the study [1].

*Exclusion criteria:* Exclusion criteria: Patients with accompanying eye diseases

such as corneal ulcers, corneal scars due to other causes that cannot be examined, or patients with a history of surgery on the affected cornea were excluded from the study.

During the research process, we collected data on 124 eyes with keratoconus in 64 patients.

### Methods

*Research design:* cross-sectional study

*Data collection method:* After the patients met the eligibility criteria, the patients were recorded as age, gender, and medical history. Characteristics of gender and place of residence, visual acuity before and after spectacles correction, and refraction were collected in medical records. Then the patient was examined and recorded symptoms including scissor reflex, Rizzuti sign, Munson sign, Fleisher ring, Vogt lines, corneal scars, and hydrops.

*Statistical analysis:* Data was entered into EpiData 3.1 software. All analyses were performed using SPSS 20.0 statistical software. A p-value of 0.05 or lower was considered statistically significant.

## RESULTS

### Epidemiology characteristics

*Table 1. Epidemiology characteristics of patients with keratoconus*

Variable	Number (n = 64)	Percentage%
<b>Age (Mean: 20.7 ± 5.2)</b>		
Children	11	17.2
Adult	53	82.8
<b>Sex</b>		
Men	38	59.4
Women	26	40.6
<b>Place</b>		
Ho Chi Minh City	20	31.3
Southeast	3	4.7
Mekong Delta	15	23.4
Central Highlands	19	29.7

South Central Coast	6	9.4
Red River Delta	1	1.6

The average age of patients in the study was:  $20.7 \pm 5.2$  years. The adult patient group accounted for a higher proportion than the child patient group. The number of male patients was more than female patients, and the male-to-female ratio was 1.5:1. The number of patients from Ho Chi Minh City accounted for the highest ratio with 31.3%. Next was the Central Highlands region with 29.7%.

**Table 2.** Characteristics of medical history

Medical history	Number of patients	Proportion (%)
Eye rubbing	46	71.9
Allergic conjunctivitis	29	45.3
Contact lens wearing	1	1.6
Down syndrome	0	0
Family history	6	9.4

The majority of patients in the study had the habit of rubbing eyes (71.9%) and all patients had the habit of rubbing their eyes in both eyes. 45.3% of patients had allergic conjunctivitis recorded through examination or medical history, of which 25 patients had the habit of rubbing their eyes, corresponding to 86.2%. Only 1 patient had a history of using soft contact lenses. 9.4% of patients have a relative with keratoconus.

### Clinical characteristics

*Eyes with keratoconus:* Most patients have keratoconus on both sides, accounting for 93.8%.

*Visual acuity:* The results of visual acuity and refraction of 124 eyes in the study are described in Table 3.

**Table 3.** Visual acuity of eyes with keratoconus

Index	No symptom n = 27	Symptomatic n = 97	Total n = 124	p value
Uncorrected visual acuity	$0.7 \pm 0.5$	$1 \pm 0.4$	$0.9 \pm 0.5$	0.02*
Best-corrected visual acuity	$0.1 \pm 0.2$	$0.4 \pm 0.4$	$0.3 \pm 0.4$	<0.001*
Spherical refraction	$-2.6 \pm 2.9$	$-2.2 \pm 4.2$	$-2.3 \pm 3.9$	0.28*
Cylindrical refraction	$-2.1 \pm 1.8$	$-3.8 \pm 2.8$	$-3.5 \pm 2.7$	0.002*

\* Mann-Whitney

The average logMAR visual acuity of eyes with keratoconus was  $0.9 \pm 0.5$  without glasses correction and  $0.3 \pm 0.4$  after correction. Analysis results showed that there was a statistically significant difference in visual acuity before and after correction and astigmatism between eyes with keratoconus with and without clinical symptoms, while spherical refraction between the two groups did not differ.

### Clinical symptoms

**Table 4.** Clinical symptoms of eyes with keratoconus

Symptoms	Number of eyes	Proportion (%)
Scissor reflex	84	67.7
Fleisher ring	65	52.4
Rizzuti sign	61	49.2
Vogt triate	27	21.8

Munson sign	15	12.1
Corneal scar	12	9.7
Hydrops	0	0
No symptom	27	21.8

Scissor reflex was the most common sign with 67.7%, including 21/124 (16.9%) eyes with scissor-shaped pupillary shadow as the only symptom. The second most common symptom was Fleisher's ring appearing in 52.4% of eyes with keratoconus, followed by Rizzuti's sign, Vogt's line, Munson's sign, and corneal scarring. There were no eyes with hydrops in the study. In the study, it was noted that 21.8% of eyes with keratoconus had no symptoms with retinoscopy and biomicroscopic examination. These cases were diagnosed with keratoconus based on the results of corneal topography.

## DISCUSSIONS

### Epidemiology characteristics

**Epidemiological characteristics:** The average age of patients in the study was 20.72 ± 5.17 years. Studies on keratoconus in Asia by Jagjit S. Saini, Mohammad Naderan, and Yujie Mou also reported similar results [4–6]. However, the average age in Our study is higher than that of Truong Khanh My Hang [3]. While the average age of keratoconus in Europe ranges from 26 – 36 years old [7–11] and in the US ranges from 25 – 37 years old [12]. It can be seen that Asian patients have an earlier average age of keratoconus than patients in Europe and patients in the US [9,11]. This difference may be due to the weather conditions of the country. Asian countries have hot, humid, dusty climates that lead to a higher rate of eye rubbing, leading to the disease manifesting earlier. In our study, the adult patient group accounted for a higher proportion than the child patient group. However, this is the age recorded at the time of the patient's medical examination, so it does not reflect the true onset time of the disease.

In our study, the number of male patients was higher than that of female patients. Studies in Vietnam and around the world also noted that keratoconus is more common in men than in women, with a difference between men and women. and women ranged

from 1.3 to 2.1 times [3,13,14]. The reason for the difference in gender distribution in keratoconus is still unknown. However, our study was performed at Ho Chi Minh City Eye Hospital with patients who were diagnosed with keratoconus, so this difference cannot confirm that men have more keratoconus. than women.

In our study, the number of patients from Ho Chi Minh City accounted for the highest proportion of 32.3%, because patients in Ho Chi Minh City have more favorable geographical and transportation conditions than patients from other provinces. other. However, the area with the highest number of patients after Ho Chi Minh City is the Central Highlands instead of the provinces neighboring Ho Chi Minh City. This shows that besides the convenient geographical location, climate, and environmental conditions also need to be considered. However, with a small study sample size, this difference is not clear, so a study on keratoconus disease with a larger sample size and broader research scope is necessary to investigate. Monitor the incidence of keratoconus disease in the above provinces and cities.

**Characteristics of medical history:** The proportion of patients with the habit of rubbing their eyes in the study was very high (71.9%). Other studies about keratoconus

also reported similar rates [6,10,15,16]. This not only emphasizes the relationship between eye rubbing and keratoconus but also shows patients information about the disease was not enough, leading to patients not being aware of the effects of frequent eye rubbing on the progression of the disease. The association between eye rubbing and corneal apnea is explained as follows: eye rubbing causes micro-trauma in the epithelium, increasing inflammatory factors that contribute to the apoptotic process of corneal cells, leads to gradual thinning of the cornea, decreased corneal stiffness and corneal remodeling, leading to increased corneal curvature (17).

Regarding the history of wearing contact lenses, only 1.6% of patients wore contact lenses. Research by author Truong Khanh My Hang did not record any patients with a history of wearing contact lenses [3]. This rate is very low when compared to the studies of authors Shehata A. and Wagner H. [15,16]. This difference can be explained by the fact that the use of contact lenses in Vietnam is not very popular compared to other countries. Besides, hard contact lenses to treat keratoconus are not available at many medical facilities in our country.

45.3% of patients had allergic conjunctivitis. The relationship between allergic conjunctivitis has been mentioned in many studies, according to research by Shih-Feng Weng, patients with allergic conjunctivitis are 2.25 times more likely to develop keratoconus than those with conjunctivitis. control group [17]. The cause is that allergic conjunctivitis leads to patients rubbing their eyes frequently. At the same time, in patients with allergic conjunctivitis and rubbing their eyes, there is an increase in the concentration of inflammatory mediators such as MMP-9 and interleukin. – 4,

interleukin – 5, interleukin – 10, interferon –  $\gamma$ , and interferon –  $\alpha$  are related to the death process of corneal cells [18]. Besides, allergic conjunctivitis can also make patients less adaptable when needed. treatment with contact lenses [19]. From the above results, the assessment of allergic conjunctivitis and treatment in patients with keratoconus plays a very important role.

Family history is also a factor worth noting when exploring the history of corneal apical disease. Our study found that 9.4% of patients had a relative with keratoconus noted when taking the history. This rate could be higher if there were conditions to examine and map the cornea of these people. family member of the patient.

#### **Clinical characteristics**

*Eyes with keratoconus:* Eyes with keratoconus: Our study recorded that 6.2% of patients had keratoconus on one side, similar to the results of Rafati S. et al.15. However, according to the 2015 Global Consensus on Keratoconus, unilateral keratoconus is not actually present [1]. Therefore, patients with unilateral keratoconus still need to continue to be monitored and re-examined periodically and counseled about the risk of developing keratoconus in the remaining eye.

*Visual acuity:* According to the results in Table 3, the average logMAR visual acuity in the group of eyes with keratoconus before and after spectacles correction decreased from  $0.9 \pm 0.5$  to  $0.3 \pm 0.4$ . Converted into Snellen visual acuity, visual acuity improved after correcting glasses from approximately 2/10 to 5/10, so when using frame glasses, the vision of eyes with keratoconus improved, but did not achieve 10/10 vision. The reason is that when the cornea gradually thins and protrudes, it causes irregular astigmatism with high-order aberrations, so vision correction with glasses is less effective,

especially in cases of keratoconus. severe stage. If the patient has corneal scarring, vision will be more seriously damaged. Eyes with asymptomatic keratoconus have an average astigmatism of 2.1 D, visual acuity after glasses correction is  $0.1 \pm 0.2$  (logMAR visual acuity), converted into Snellen visual acuity corresponding to 8/ 10, thus the group of patients with keratoconus without clinical symptoms can have good vision correction with eyeglasses. The symptomatic group has a higher degree of astigmatism, nearly 4D, and visual acuity only reaches 4/10, requiring other optical correction methods such as hard contact lenses, and scleral lenses [2].

*Clinical symptoms:* Diagnosis of keratoconus is easy when there are clinical signs such as Munson sign, corneal scar, Fleisher ring, Vogt line, and irregular thinning of the cornea observed on the slit lamp. However, for eyes with early-stage keratoconus or subclinical keratoconus, additional diagnostic tools such as a corneal topographer are necessary. In our study, 21.8% of eyes with keratoconus were asymptomatic both on retinoscopy and biomicroscopy but had abnormalities in corneal topography. This shows the indispensable role of corneal topography in the early detection of keratoconus.

In addition to modern equipment, retinoscopy also plays a very important role in detecting keratoconus, especially when the patient is a child or disabled person or in places where there is no corneal mapping machine. Our study recorded that 67.7% of patients had scissor shadows when examining the pupil. This result is also similar to the study of Naderan M. [5].

Fleisher rings appeared in 52.4% of eyes with keratoconus in our study. Research results show that this is the most common clinical sign on biomicroscopy when

examining patients with keratoconus. This is the result of iron deposition originating from the tear film due to changes in corneal curvature between the more curved corneal region (apical region) and the flatter region. The Fleisher ring does not cause vision loss in patients [20].

Besides Fleisher's ring, Vogt's line is also a common clinical symptom of keratoconus.

In our study, 12.1% of eyes with keratoconus had Munson's sign and 49.2% of patients with keratoconus had Rizzuti's sign. These are two clinical signs of keratoconus that can be detected without the aid of a biomicroscope or retinoscope. However, compared to Munson's sign, Rizzuti's sign has not been widely applied in clinical practice. Our study results show that the proportion of eyes with keratoconus with Rizzuti's sign is higher than the proportion of eyes with Munson's sign. Therefore, the Rizzuti sign should be applied in places where modern equipment is not available to detect keratoconus.

Our study noted that 9.7% of eyes in the study had corneal scars. This rate is lower than the studies of Shehata A. (18.7%) and Naderan M. (30.2%) [5,15]. The reason for this difference is that the proportion of patients wearing contact lenses in our study is much lower than in the study of the above authors. No keratoconus eyes had hydrops in our study.

## CONCLUSIONS

Male patients accounted for a higher number than females. Patients who came from Ho Chi Minh City accounted for the highest proportion, followed by the Central Highlands region. Most patients had the habit of rubbing eyes; allergic conjunctivitis was the most common combination disease. The majority of patients had keratoconus in both

eyes. Visual acuity improved when using spectacles, the group had no symptoms had better vision. Scissor reflex was the most common clinical symptom, followed by Fleisher ring, Rizzuti sign, and Vogt triate.

### Recommendation

It is necessary to disseminate information about keratoconus disease and the negative effects of eye rubbing leading to keratoconus to reduce the rate of patients with habitual rubbing eyes. It is important to well evaluate and control allergic conjunctivitis in patients with keratoconus. When there is no available corneal topography, ophthalmologists need to pay attention to pupil reflection to detect keratoconus.

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### Institutional Review Board Statement:

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Council in Biomedical Research, University of Medicine and Pharmacy at Ho Chi Minh City number 869/HĐĐĐ-ĐHYD.

**Informed Consent Statement:** Informed consent was obtained from all patients involved in the study.

**Conflicts of Interest:** The authors declare no conflict of interest.

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