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Incidentally discovered keratoconus in patients seeking vision correction by LASIK

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Abstract:

Introduction: Preoperative screening and diagnosis of Keratoconus (KC) is particularly crucial for patients seeking vision correction by refractory surgery because postoperative corneal ectasia is one of the main complications resulting from operating an eye with undetected KC. The main origin of KC is still unidentified. One of the major risk factors that may predispose to this disease is family history, and this may be explained by the fact that up to 20 percent of people with keratoconus have a favorable family history.

Aim of study: To assess the prevalence of keratoconus among patients seeking vision correction by LASIK.

Subjects and Methods: This research is a cross-sectional study. The study included adult participants who received keratoconus screening as part of normal preoperative testing before receiving laser vision correction (LVC). Keratoconus was diagnosed with the help of an analysis of Pentacam-derived parameters.

Results: About 20 patients out of 188 candidates presenting for LASIK were incidentally discovered as clinical or subclinical keratoconus cases and were excluded from performing the LVC procedure. The frequency distribution of keratoconus in patients seeking vision correction by LASIK was 11.9%. The most important risk factor predisposing to KC was family history.

Conclusion: Patients seeking LVC had a high prevalence of keratoconus. An essential method for determining the prevalence of keratoconus in the Egyptian community is the screening of LVC candidates for keratoconus.

Keywords: keratoconus; prevalence; vision correction by LASIK.

1. Introduction

Keratoconus (KC) is described as a progressive bilateral degenerative noninflammatory ectatic corneal disease manifested by corneal axial protrusion and thinning of the stroma that subsequently causes the cornea to take the shape of the cone, which is responsible for variable astigmatism and myopia [1].

There are numerous genetic and environmental risk factors associated with KC, but the exact cause is unknown. It is unknown how much each component contributes to the development of KC. However, in people with genetic predispositions, the environment may act as a stimulus for the disease. Even though the standard definition is known as a degenerative disease in which any mechanical damage produced by trauma accelerates its progression, a significant body of evidence shows that inflammation is fundamental to the pathogenesis of KC [2]. Numerous studies have connected KC with different inflammatory mediators (cytokines) [3].

There are several variables that increase the incidence of keratoconus, including family history, rubbing your eyes, eczema, asthma, and allergies [4]. It is linked to decreased visual acuity, especially in connection with progressive corneal irregularity, and typically manifests asymmetrically in the same patient's two eyes.

On rare occasions, the patient may exhibit photophobia, glare, and monocular diplopia symptoms [5].

Keratoconus frequently begins to appear in the second and third decades of life, and it is only in the fourth decade that it becomes fully developed. The keratoconic process often begins around the time of adolescence. The process continues for the next 10 to 20 years until the progression eventually comes to an end. When the disorder's growth ends, its severity can range from barely perceptible irregular astigmatism to severe thinning, protrusion, and scarring that needs keratoplasty [6].

People of all sexes and races have been impacted by the disease. The average incidence rates stated in various research studies range from 0.00002 to 3.33%, or 0.02 to 3333 cases per individual. However, refractive surgery clinics experienced a higher proportion of undiagnosed keratoconus cases than this [7]. The wide disparity in prevalence rates can be related to variations in place of birth, race, associated conditions, disparity in type of selected sample, and keratoconus diagnostic requirements [8].

Raciality and residency are likely two of the most significant variables affecting the prevalence rate. According to reports from various research studies, the epidemiology of

KC was found to be greater in warm-climate nations like those in the Middle East and Asia than it is in cold-climate nations [9].

The gold standard for diagnosing keratoconus is corneal topography. In comparison to other regions of the world, the authors discovered a significant incidence of keratoconus in this area. Therefore, more research is required to determine the prevalence

of keratoconus in Egypt. Furthermore, one of the advantages of assessing the incidence of KC among those who are about to undergo LASIK surgery is giving ophthalmologists a predictive estimate of detecting KC patients when screening the cases for refractory surgery. Our current study screened for KC between refractory surgery participants.

2. Subjects and methods

2.1. Subjects

The current study was performed in a private center for cataract and refractive surgery at Zagazig, Egypt within a year. 188 individuals selected from those who are about to undergo LASIK surgery.

The Pentacam HR system (Oculus, GmbH, Wetzlar, Germany) was used for the usual ophthalmologic examination and corneal tomographic evaluation of each individual. Additionally, people who wear contacts had not worn them for at least three weeks before the assessment.

Inclusion criteria

Total sample of study: 188 participants (376 eyes) separated into 2 groups according to screening by Pentacam

- Group I: Normal patients. 336 eyes of 168 subjects without any topographic signs of KC.
- Group II: KC patients. 20 participants' 40 eyes each had topographic KC indications (based on the Amsler-Krumeich classification, stages I through III).

Exclusion criteria

- Non-helpful cases.
- Participants younger than 18 years old.
- Cases had opacity of cornea.
- Prior experience with corneal surgery or trauma.

2.2. Study design

A cross-sectional retrospective study.

2.3. Data Collection

Data on the patient's demographics, the topography of their cornea, and their health

were gathered during routine exams to assess whether they were eligible for refractive surgery. The existence or absence of keratoconus was emphasized specifically when identifying the reasons why refractive surgery was not performed. Those who met at least two of the following requirements— 21° corneal

thickness, a posterior elevation greater than 20 μ m, and an inferior-superior (I-S) asymmetry greater than 1.4 D—were deemed to have keratoconus. If one of the following conditions was met in a subject, keratoconus suspect status was assigned: corneal thickness of 25 μ m or I-S asymmetry of greater than 1.6 D (**Figures 1, 2**).

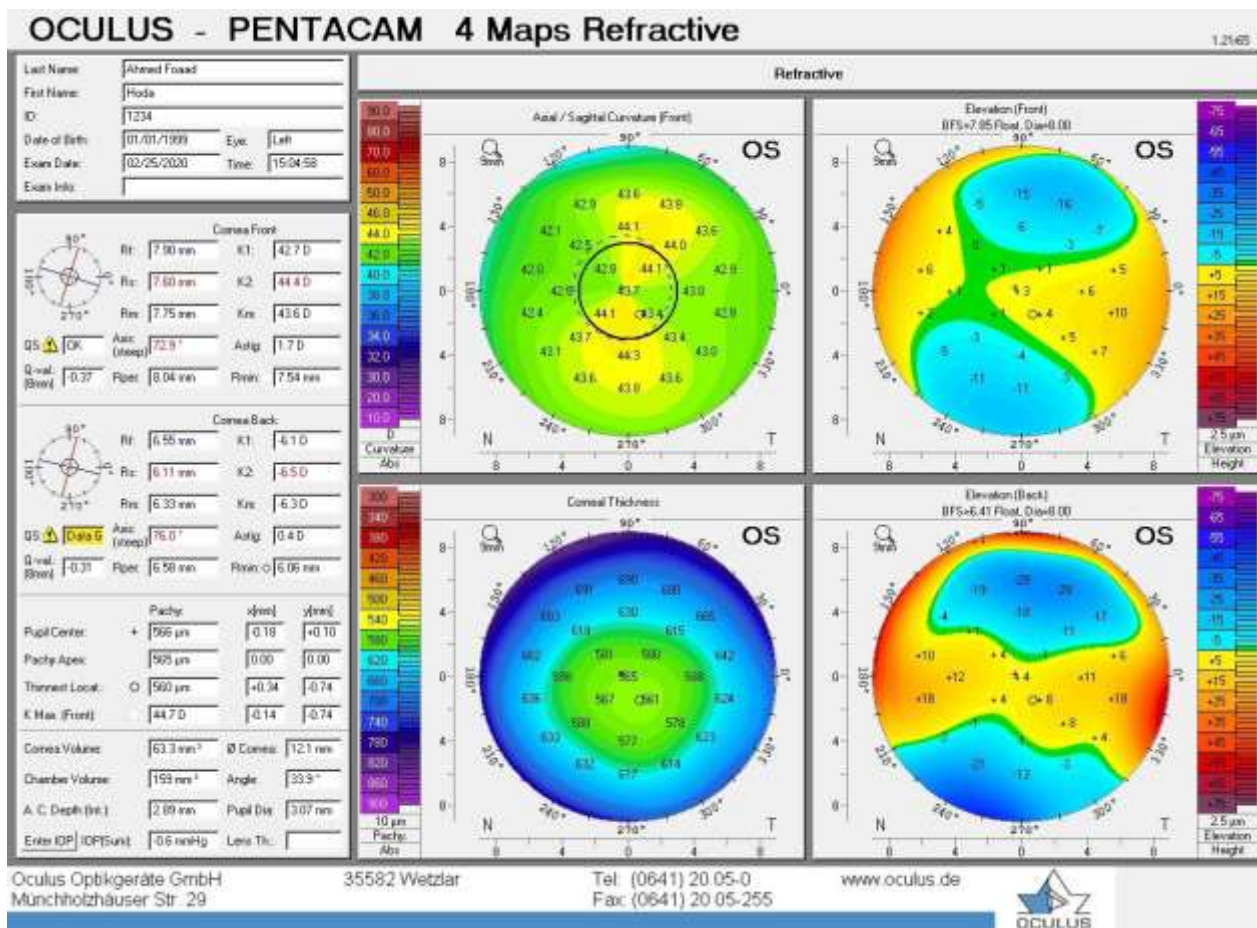


Figure 1: Diagnostic Tool: WaveLight® Oculyzer Printout in normal eye.

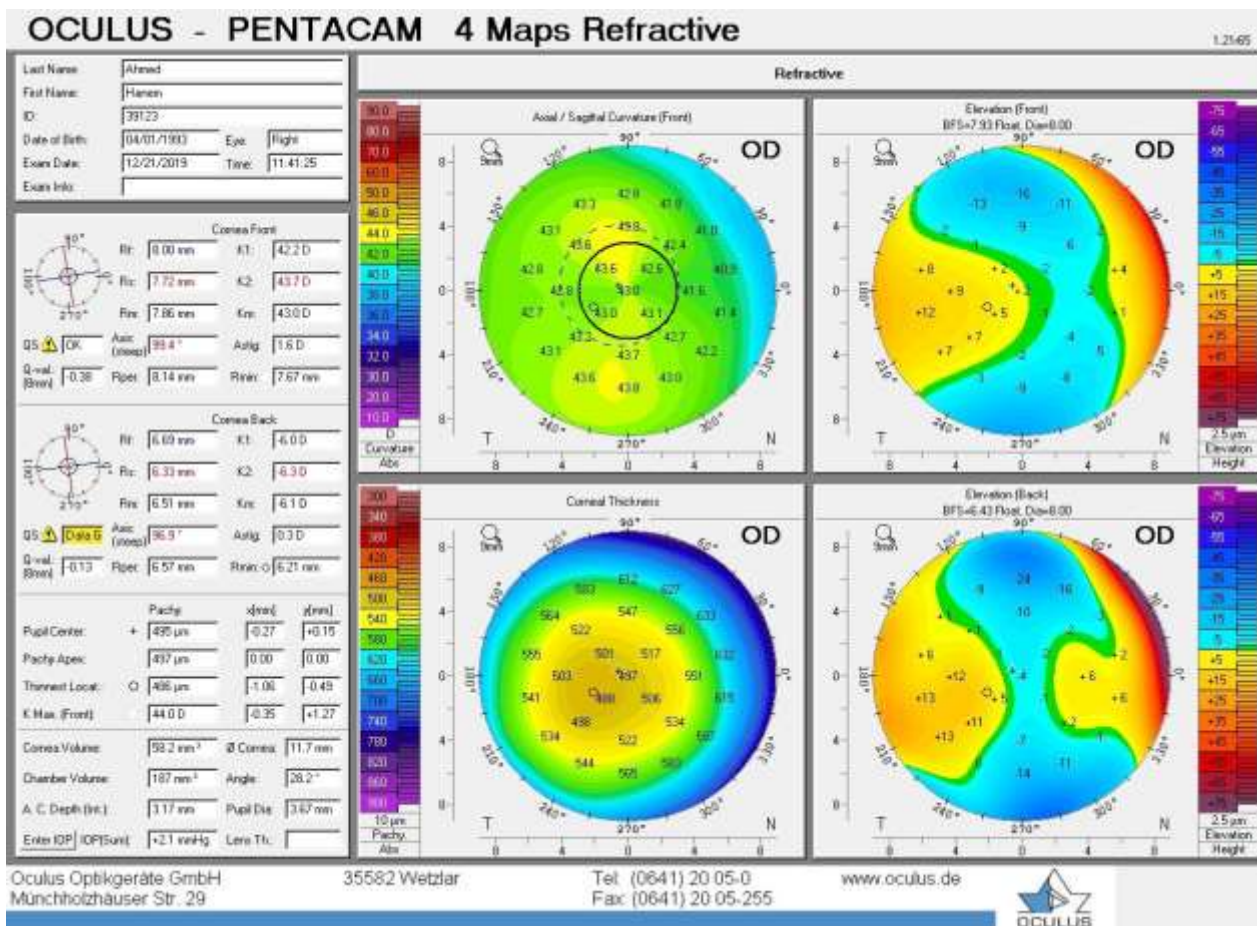


Figure 2: Diagnostic Tool: WaveLight® Oculyzer Printout in Keratoconic eye.

2.4. Analytical statistics

using SPSS version 26, all data were gathered, tabulated, and statistically examined. Categories qualitative data were represented as definite frequencies (number) and relative frequencies (%), while continuous quantitative data were expressed as the mean SD & (range).

3. Results

A total of 20 patients (40 eyes) out of 188 (336 eyes) candidates presenting for LASIK

The Shapiro-Wilk test was used to determine whether continuous data were normal. unbiased samples. To compare two sets of normally distributed data, the student’s t-test was utilized. Chi-square test (2test) was used to compare categorical data.

were diagnosed with KC and prevented from performing LASIK. The study revealed that the

frequency distribution of keratoconus in patients seeking vision correction by LASIK was 11.9%. As shown in Table 1, concerning age and

gender, there was a statistically insignificant difference among the studied cases.

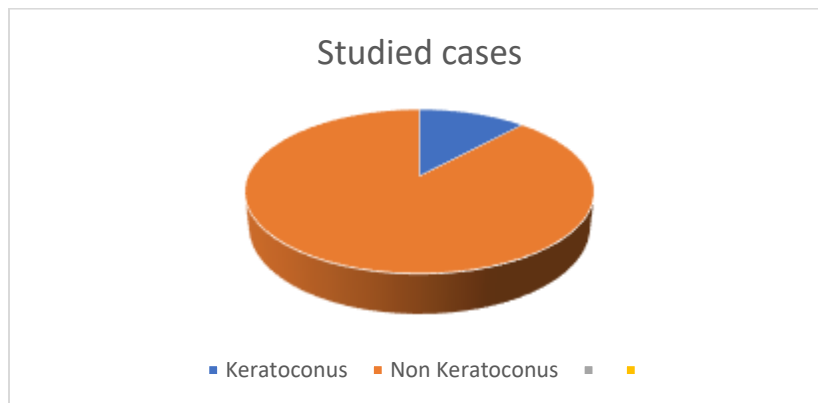


Figure 3: Frequency distribution of keratoconus among patients seeking for LASIK.

Table 1: Basic characteristics of the studied groups.

Variable	keratoconus Group (n=20)	Control Group (n=168)	tests			
			t	P-value		
Age (years) Mean±SD	28.2±8.47	28.89±5.22	-0.524	0.601		
Variable			X ²	P value		
Sex	Female	N	13	126	0.927	0.336
		%	65.0%	75.0%		
	Male	N	7	42		
		%	35.0%	25.0%		

As shown in Table 2, a statistically significant difference was found among the studied cases in terms of different risk factors (family history of keratoconus, eye rubbing, and asthma), as nearly half of the keratoconus group

(45%) had eye rubbing, about 25% of them complained of asthma, and most of the keratoconus group (60%) had a positive family history.

Table 2: Risk factors among the studied groups.

Variable			keratoconus Group (n=20)	Control Group (n=166)	tests	
					X ²	P-value
Eye rubbing	Yes	N	20	8	35.183	<0.001*
		%	45.0%	4.8%		
	No	N	11	160		
		%	55.0%	95.2%		
Family history	positive	N	12	9	53.781	<0.001*
		%	60.0%	5.4%		
	Negative	N	8	159		
		%	40.0%	94.6%		
Asthma	Yes	N	5	4	20.061	<0.001*
		%	25.0%	2.4%		
	No	N	15	164		
		%	75.0%	97.6%		

As shown in Table 3, a high statistically significant difference was found between the studied cases in terms of CCT measures discovered by PENTACAM and OCT; the keratoconus group was shown to have lower values than the control group (488.4, 476.4 versus 542.84 and 527.43, respectively).

Table 3: Comparison of CCT between the study groups using PENTACAM and OCT.

Variable	keratoconus Group (n=40)	Control Group (n=336)	tests	
			t	P value
CCT by PENTACAM Mean±SD	488.4±39.11	542.84±28.88	-7.651	<0.001*
CCT by OCT Mean±SD	476.4±34.57623	527.43±30.95	-6.885	<0.001*

CCT: Central corneal thickness; K: Keratometry-readings; OCT: optical coherence tomography; t: Independent t-Test.

As shown in Table 4, a statistically significant difference was found among the studied cases concerning the mean anterior K values measured by PENTACAM. In

comparison to the control group, the KC group was found to have high values (47.16 vs. 43.61, respectively). The anterior mean K measures identified by OCT also showed a high statistically significant difference between the study groups, with the keratoconus group

showing higher values than the control group (52.94 vs. 48.19, respectively).

As shown in Table 5, the positive family history of KC was significant risk factor for keratoconus.

Table 4: Comparison of K anterior measurements between the study groups using PENTACAM and OCT.

Variable	keratoconus Group (n=40)	Control Group (n=336)	tests	
			t	P value
K anterior by PENTACA] Mean±SD	47.16±3.93974	43.61±1.64	7.470	<0.001*
K anterior by OCT Mean±SD	52.94±4.99	48.19±2.15	7.764	<0.001*

CCT: Central corneal thickness; **K:** Keratometry-readings; **OCT:** optical coherence tomography; **t:** Independent t-Test.

Table 5: Logistic regression analysis of risk factors for keratoconus.

Variable	B	S.E.	Wald	Sig.	95% C.I. for EXP(B)	
					Lower	Upper
Rubbing	0.373	.875	0.181	0.670	0.261	8.073
Family histo	2.803	.789	12.615	0.000	3.512	77.484
Asthma	1.622	.940	2.975	0.085	0.802	31.968

4. Discussion

The epidemiology of keratoconus differs from one place to another in accordance with numerous variables, including the amount of UV rays, altitude, and frequency of consanguinity.¹⁰ Geographic variations entirely affected the overall prevalence of Keratoconus. It is frequently linked to a hot temperature and a population with low socioeconomic status. Additionally, keratoconus growth is

significantly influenced by the frequency of incidents of ocular allergies, which are followed by subsequent eye rubbing [11].

Prior to refractive surgery, LVC candidates must undergo screening in order to rule out any cases diagnosed with KC or subclinical KC. To prevent the possibility of the corneal biomechanical strength being

compromised, KC patients are not candidates for LASIK [12].

The current study demonstrated that the frequency distribution of keratoconus in patients seeking vision correction by LASIK was 11.9%; this was considered high prevalence. Similar results were obtained by Ismail et al. (2020), whose study reported that the prevalence of the disorder in those undergoing refractive surgery was 6.6% and the suspected prevalence was 2.6% [13]. Abd-Elaziz et al. (2022) conducted a study to find out how prevalent KC is among individuals seeking refractory surgery in four governorates in Egypt [14]. Out of 782 patients, 46 were determined to have keratoconus or subclinical keratoconus. A total of nine cases (19.60%) were found in Cairo, 32 (69.60%) in Beni Suef, three (6.50%) on October 6, and two (4.30%) in Giza. The Beni Suef Governorate may have a greater prevalence of keratoconus due to both environmental and genetic reasons. Along with the prevalent custom of family marriage, spending time with UV radiation in the hot weather of Upper Egypt may be the reason for the large number of cases of inadvertently detected keratoconus. This finding is in line with that of Althomali et al. (2018), who conducted research on Saudi Arabian subjects applying for LASIK in Taif [15]. The frequency distribution of KC was 8.59%. It was found that 6.45% of patients had bilateral KC,

while 2.04% had unilateral KC. 65 patients had subclinical keratoconus diagnoses, which corresponds to a 9.46% prevalence rate. 20 incidences of subclinical keratoconus among the 687 individuals were bilateral, and 45 cases (6.55%) were unilateral. This research was conducted in a single facility in the Saudi Arabian region of Taif, which has a high frequency of consanguinity and highs, which resemble our single-center research. Saro et al. (2018) performed a four-year study in Egypt, finding that 1.12% (91/8124 individuals) of the population had KC, with a 95% confidence interval of 0.91–1.3 [16]. Al-Amri et al. (2018) examined keratoconus incidence between refractive surgery subjects in the Asir of Saudi Arabia [17]. They discovered an 18.7% epidemiology of KC. Keratoconus was the leading cause of non-surgery in a total of 547 of 2280 patients (24.0%), making it the most prevalent condition.

Regarding the distribution of gender in terms of the dominance of men or women in keratoconus, studies are divided. Valdez-García et al. (2014) showed that females are more likely to have keratoconus [14], while Millodot et al. (2011) represented the greater frequency of keratoconus in patients who are male [19]. Valdez-García et al. (2014) study stated female individuals are twice as likely to have keratoconus as male patients are (66.6% versus

33.3%) [18]. Further, Millodot et al. (2011) revealed that males have a keratoconus prevalence that is around five times higher than females (4.91% versus 1.07%) [19]. Additionally, Vazirani et al. (2019) noted that neither male nor female were predominant in Keratoconus [20]. The findings of the present study as well showed that there was significant indifference between the studied groups regarding sex.

Current findings clearly revealed that family history of Keratoconus was a significant risk factor for Keratoconus development, as most of the Keratoconus group (60%) had a positive family history. These results were compatible with Gordon-Shaag et al. (2013), who performed a study that revealed a significant relationship between KC and a parent's consanguinity [21]. Furthermore, it offers significant evidence that KC may have a genetic component. After correcting for other characteristics associated with the disease, the results of the study showed that, compared to offspring of unrelated parents, children of consanguineous parents have a four-fold greater chance of KC. Additionally, Al-Amri et al. (2018) demonstrated that patients with a family history of keratoconus were more prevalent in the keratoconus groups than in the normal groups [17].

Sugar et al. (2012) illustrated that consanguinity may make some populations genetically more sensitive to the condition than others, making it easier for environmental triggers such as eye rubbing, atopy, or sun exposure to cause the disease [22]. Assiri et al. (2005) indicated that a combination of consanguinity and endogamy and, in particular, one of these characteristics, excessive sun exposure, may help to explain the high prevalence of KC seen in Saudi Arabia [23]. Gordon-Shaag et al. (2013) showed that the findings support the hypothesis that the oxidative damage that UV light causes may contribute to the disease's aetiology [21]. Wearing sunglasses was beneficial to reduce the risk of developing KC.

In the present study, a statistically significant difference was found among the studied cases concerning mean anterior K values measured by PENTACAM. In comparison to the control group, the KC group was found to have high values (47.16 vs. 43.61, respectively). The anterior mean K measures identified by OCT also showed a high statistically significant difference between the study groups, with the keratoconus group showing higher values than the control group (52.94 vs. 48.19, respectively). This was in accordance with Ismail et al. (2020), who reported that there was a significant difference between the studied

groups concerning the K average, as the healthy group was significantly lower (43.44 ± 3.16) than suspected and Keratoconus (47.0 ± 2.58 and 49.04 ± 4.76 , respectively) [13].

This notwithstanding, our study had many drawbacks, largely due to its retrospective

Conclusion

In conclusion, patients seeking LVC had a high incidence of keratoconus. An essential method

Ethical approval and consent to participate:

The committee of Ethics in Fayoum university hospital & Faculty of Medicine approved this study.

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6. for determining the prevalence of keratoconus in the Egyptian community is the screening of LVC candidates for keratoconus.
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