



Incidence of Keratoconus in Patients Presented to North Eye Center

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Original Article

Abstract

Background: Keratoconus is a bilateral ophthalmic disease that causes blurred vision.

Objective: This study aimed to characterize the incidence of keratoconus in patients at the North Eye Center in Erbil, Iraq, and to analyze the influence of risk factors on outcome.

Methods: This retrospective study examined the clinical records of 144 patients with keratoconus between February 2016 and May 2022. Data on demographics, clinical features, and treatment outcomes were statistically analyzed.

Results: The incidence of keratoconus was 0.85. Known risk factors such as eye rubbing (4.9%), allergies (2.8%), and family history (2.1%), were reported less frequently. Women had worse clinical outcomes (66.7%) than men (14.8%). No association was found between genetics/allergy and prognosis. All patients using contact lenses alone showed 80% stability with disease progression (100%) compared with cross-linking. Later disease onset (>35 years) predicted more severe keratoconus.

Conclusions: The 0.85% incidence underestimates the true rate due to possible underreporting. Female sex and older age of onset are associated with worse outcomes. Further research should clarify uncertain risks. Expansion of diagnostic procedures and education about modifiable risk factors such as eye rubbing may improve long-term prognosis.

Keywords: keratoconus, incidence, cross-sectional study, outcome.

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1. INTRODUCTION

Keratoconus is a corneal abnormality characterized by a conical protrusion, a nomenclature derived from the Greek roots "kerato" and "konos," signifying "cornea" and "cone," respectively (1). The field of keratoconus epidemiology encompasses the examination of the occurrence, frequency, and geographical spread of keratoconus, a progressive ocular disorder that impacts the cornea (2). The incidence of keratoconus refers to the annual occurrence of newly diagnosed cases of this illness. The estimated incidence rate ranges from 1.5 to 25 cases per 100,000 individuals annually. This implies that within a population of one million individuals, an estimated annual incidence of keratoconus would range from approximately 15 to 25 new cases (3). The prevalence of keratoconus describes the proportion of individuals affected by the condition within a specific population at a particular time (4). The estimated prevalence ranges from 2 to 4,790 per 100,000 individuals. This implies that within a population of one million individuals, the estimated prevalence of keratoconus would range from approximately two to four thousand seven hundred and ninety individuals (5). The presence of keratoconus is essential in individuals being considered for refractive surgery, as performing surgery on an eye with undiagnosed keratoconus is a primary factor contributing to the development of postoperative corneal ectasia (6,7). The exact etiology of this progressive, bilateral, and attenuating disease remains elusive (8). However, there is a prevalent belief that genetics substantially influence the development of keratoconus, given that around 20% of patients diagnosed with this disorder may establish a familial connection with a relative who also suffers from a similar ailment (9). The presence of keratoconus within one's family raises the likelihood of developing the condition (10,11). The rates of keratoconus discovery can vary based on the exact kind of investigation utilized and the amount of the sample being examined (12). Corneal topography is widely regarded as the gold standard for identifying and diagnosing keratoconus. Hence, previous research investigating the prevalence of keratoconus among individuals eligible for refractive surgery, who all undergo corneal topography evaluations, carries notable importance (13). In a distinct investigation encompassing a Yemenite populace, the documented prevalence rates of keratoconus and probable keratoconus were 18% and 10%, respectively (14). Numerous research has been conducted worldwide to evaluate the prevalence of keratoconus. The prevalence of keratoconus is believed to be

approximately 0.05%. Nevertheless, there is significant variation in this phenomenon across different geographical regions (15). Regarding the prevalence rate of keratoconus, various research has presented divergent findings across different geographical regions. For instance, the stated prevalence rates of the condition are as follows: 0.0002% in Russia (16), 0.06% in the United States (17), 2.3% in India (18), and 2.5% in Iran (19). The study aimed at determining the incidence of keratoconus and finding the effect of risk factors on the incidence of keratoconus.

2. PATIENTS and METHODS

Study design and setting: The current study design was a retrospective cross-sectional study in which 144 patients presented with keratoconus. The study was conducted at North Eye Center, Erbil, Kurdistan region of Iraq, and carried out from the beginning of February 2016 till the middle of May 2022. We estimated and determined the incidence of keratoconus and the effect of risk factors on the incidence of keratoconus.

Inclusion criteria: The keratoconus survey was performed enrolling all cases who undergo refractive error screening tests. Patients older than 12 and younger than 50 regardless of their gender were included in the study.

Exclusion criteria Patients aged out the included range, having other pathologies rather than keratoconus, and those with missed data were excluded

Method and data collection: The study was conducted at the Department of Ophthalmology in Erbil City. A total of 16894 patients visited the center for refractive error testing only 144 have been proved diagnosed to have keratoconus contributed for 0.85% of this population. All subjects were examined for refractive error screening tests and further evaluations were performed based on Pentacam which provided a more accurate diagnosis for keratoconus suspected cases. We studied patient's files and medical records to obtain the data. The ophthalmologist performed diagnosis using Oculus Pentacam on keratoconus patients and refractive errors were tested by Topcon (KR 800) which is a keratorefractometer, and the cross-linking procedure was conducted by UV-X machine. Data were collected with no personal identity stored or published and both the incidence of keratoconus and the risk factors that affect the incidence of the disease were obtained to provide us with efficient and accurate statistics.

Data management and statistical analysis: Data recorded on a specially designed questionnaire, collected and entered into the computer via Microsoft Excel worksheet (2016) and then analyzed using the Statistical Package for Social Sciences (SPSS) version 28 at a statistical significance level of ≤ 0.05 . Student t-tests Used to compare means while Chi-square tests used to compare frequencies (categorical variables).

Ethical considerations: This study was submitted to the Ethics and Scientific committees of the Ophthalmology Council of the Kurdistan Higher Council of Medical Specialties for scientific and ethical approval. This study was explained, and verbal consent was obtained from each patient. Confidentiality and anonymity of data were ensured.

3. RESULTS

A total of 144 individuals enrolled in our study in which the maximum age group was 48 years and the minimum was 13 years old participant therefore resulted in the Incidence of keratoconus = $144/16894 = 0.85\%$ on average. Most (68.8%) of participants were male while 31.3% identified as female, only 2.8% of them had allergies, the incidence came out in family history with an amount of 2.1% of cases, 4.9% of them involved in eye rubbing, a great amount (45.8%) of cases treated with using eyeglasses following by doctors performed CXL & glasses treatment on 27.1% of cases, 4.2% of them underwent surgery and only 0.7% of patients treated with RGP, for most (58.3%) of cases the vision stayed the same while 37.5% improved and 4.2% of them worsened. All of the previous data are demonstrated in (Table 1 and Figure 1). There was a non-significant statistical relationship between the outcome and allergy, family history, and eye rubber and the p-value was > 0.05 . There was a statistically significant association between gender and vision, majority (85.2%) of the improved group were male while only 14.8% were female, one-third (33.3%) of males were worsened while most (66.7%) of the worsened group were female. The chi-square test was significant and the p-value was 0.002. There was a statistically significant association between treatment plans and vision. 46.4% of the eyeglasses group stayed the same while only 1.2% of RGP and none of the surgery group's vision stayed the same, 38.9% of the eyeglasses group improved while only 1.9% of CXL, PRK & glasses and none of the artisan and RGP cases' vision improved, all (100%) of eyeglass cases worsened while none of other groups' vision worsened. A chi-square test was done and the p-value was 0.008. All are shown in (Table 2) There was a significant

statistical difference in age among outcome categories, the higher the age (mean of 33.00 years) the worse eye vision occurred, younger age (mean of 25.57 years) experienced improved vision and finally no significant change in the vision group included age of (mean of 24.05 years). ANOVA test was accomplished and the p-value was 0.0160 (**Table 3**).

Table 1. Family history, treatment plans, and vision of patients.

Variables	Categories	No.	%
Gender	Male	99	68.8
	Female	45	31.3
Allergy	Yes	4	2.8
	No	140	97.2
Family history	Yes	3	2.1
	No	141	97.9
Eye rubbing	Yes	7	4.9
	No	137	95.1
Treatment plans	Eye glasses	66	45.8
	CXL	18	12.5
	CXL & glasses	39	27.1
	CXL, PRK & glasses	10	6.9
	Surgery	6	4.2
	Artisan	4	2.8
	RGP	1	0.7
State of vision	Stable	84	58.3
	Improved	54	37.5
	Worsened	6	4.2
Total		144	100

Table 2. Association between outcome (vision) and the factors.

Variable	Categories	Vision						P. value
		Same		Improved		Worsened		
		No.	%	No.	%	No.	%	
Gender	Male	51	60.7	46	85.2	2.0	33.3	0.002
	Female	33	39.3	8	14.8	4.0	66.7	
Allergy	Yes	3	3.6	1	1.9	0.0	0.0	0.764
	No	81	96.4	53	98.1	6.0	100	
Family history	Yes	2	2.4	1	1.9	0.0	0	0.915
	No	82	97.6	53	98.1	6.0	100	
Eye rubbing	Yes	6	7.1	1	1.9	0.0	0.0	0.315
	No	78	92.9	53	98.1	6.0	100.0	
Treatment plans	Eyeglasses	39	46.4	21	38.9	6.0	100.0	0.008
	CXL	8	9.5	10	18.5	0.0	0.0	
	CXL & glasses	23	27.4	16	29.6	0.0	0.0	
	CXL, PRK & glasses	9	10.7	1	1.9	0	0.0	
	Surgery	0	0	6	11.1	0	0.0	
	Artisan	4	4.8	0	0.0	0	0.0	
	RGP	1	1.2	0	0.0	0	0.0	
Total		84	100.0	54	100.0	6	100.0	

Table 3. The difference in age among outcome categories.

Outcome	No.	Mean	Standard Deviation	Standard Error	P. value
Same	84	24.05	6.730	0.734	0.016
Improved	54	25.57	8.621	1.173	
Worsened	6	33.00	6.663	2.720	
Total	144	24.99	7.664	0.639	

4. DISCUSSION

The study population consisted of 144 patients with keratoconus. The mean age was 24.99 ± 7.66 years, consistent with the onset of keratoconus in childhood or early adulthood, with continued progression in the third to fourth decade of life (20). Rodriguez-Ausn et al. reported an average age of 16.54 ± 5.68 years (21). This group was predominantly male, with 68.8% males and 31.3% females. These male proportions are consistent with previous studies reporting a sex ratio of 1.5:1 to 3:1 relative to males (20, 22). However, some studies found equal male and female distributions or did not identify gender as a significant risk factor, indicating that this association remains unclear (23) with few patients having a history of them itching (2.8%) or family history of keratoconus (2.1. %) They said. This distribution is lower than the results of most published epidemiological studies which show that atopic disease occurs in approximately 20%–30% of keratoconus cases and 10%–15% have a positive family history (23, 24) therefore allergies and genetics are likely underreported in the current sample. Just under 5% reported a history of habitual eye rubbing. Eye rubbing is estimated to be found in 50–60% of keratoconus sufferers (25), indicating potential underreporting for this recognized hazard component. The low reporting of eye rubbing may also have reduced the potential to stumble on a link with poorer outcomes. Overall, the descriptive facts align with the present literature in terms of demonstrating a typical age of onset in early maturity and predominance amongst males. The quotes of allergic reaction, hereditary factors, and eye rubbing have been lower than expected, primarily based on different studies. Analysis of sex and keratoconus treatment outcomes showed that outcomes in women were significantly worse, with 66.7% of female patients experiencing disease progression resulting in vision compared with only 14.8% of men. Most published studies reported no significant differences in keratoconus features, severity, or treatment outcome between men and women (22,26). For example, Hashemi et al. No correlation has been reported between central corneal thickness, keratometry values, or spherical equivalent refraction and sex in 210 patients with keratoconus (26). However, a few studies reported similarly poor outcomes in women. In 2011, Rodríguez-Ausín P. More than 44,000 Hungarian patients analyzed for contact lens fit reported a significantly higher incidence of keratoconus diagnosis in females than males (57% vs 43%, respectively) (21). The reasons for possible gender differences remain unclear, a controversial

area that needs further research (20). The study showed no significant association between a history of cataracts or family history and the outcome of keratoconus. This is consistent with the results of the existing literature examining the possible genetic consequences of atopy. For example, a review of keratoconus epidemiological studies concluded that the influence of genetic and environmental factors, including atopy, remains unclear, with significant heterogeneity across reports (23). Several studies using different methodologies have concluded that epilepsy may not be completely associated with family history and disease prognosis (27-29). No statistically significant association was found between the frequency of rubbing eye and the outcome of keratoconus treatment. However, several studies have shown that chronic eye rubbing is both a risk factor and an important prognostic factor. McMoneys and Boneham suggested that chronic ocular inflammation contributes to biomechanical corneal weakness (30). Then, Ioannidis et al. conducted a comparative study that reported a history of regular eye rubbing in 73% of patients with keratoconus compared with 32% of controls. The rate of keratoconus progression, defined by increased corneal curvature, was also significantly higher in thick corneal rubber compared with occasional noncorneal rubber at eight years (24). Analysis of clinical course and outcome showed a significant association, with patients who received contact lenses alone having the worst prognosis (100% showing invisible disease progression good material). This makes sense because the lens only slows development and provides refractive correction. A randomized clinical trial showed long-term stability and vision improvement in 80% of keratoconus patients following CXL, with only 58% continuing standard treatment, including lenses (31). Several studies have concluded that CXL prevents disease progression in most patients compared with standard care that includes progression with contact lenses or contact lenses alone (32,33). The present data provide further evidence that CXL should be considered an alternative gold standard procedure for keratoconus stabilization instead of simple vision correction. There are statistically significant differences between the average ages of the strong, improved, and worst outcome groups. Those with disease progression had a remarkably high mean age of 33 ± 6.66 years, while the stable and advanced groups had a mean age of 24.05 and 25.57. Several results show that late-onset keratoconus in elderly patients follows a more aggressive course, consistent with recent studies. Hutchings and others. conducted an evidence-based study showing that age at onset

predicts risk of progression - potentially doubling the chance of progression in early-stage patients who saw them in 35 years (34). Proposed mechanisms for this association include natural biomechanical and microstructural age-related changes superimposed by keratoconus to promote development (35).

5. CONCLUSIONS

In summary, this retrospective study of 144 patients with keratoconus in Iraq reported an incidence of 0.85%. In line with the literature, 68.8% of the men were 24.99 years old. However, known risk factors such as allergies, family history, and eye rubbing were particularly poorly reported, suggesting that the disease may be underdiagnosed and underreported. The study showed that women had worse clinical outcomes. No association between allergy/heritability and prognosis was found. The study provided more support for corneal cross-linking than vision improvement alone in keratoconus stabilization, with 100% disease progression in patients with contact lenses alone. Moreover, older age of onset was associated with more rapid and aggressive keratoconus, especially in those older than 35 years at presentation. This may be related to age-dependent biomechanical corneal changes covered by keratoconus. In conclusion, an incidence rate of 0.85% underestimates the true rate due to the possibility of underdiagnosis. Female gender and later disease onset appear to predict worse outcomes. Further research should clarify the unclear role of risk factors such as tumors and genetics. Expansion of diagnostic procedures and education regarding eye rubs may help long-term outcomes.

Ethical Clearance:

Ethical issues were approved by the authors in accordance with the World Medical Association (WMA) declaration of Helsinki for the Ethical Principles for Medical Research Involving Human Subjects, 2013.

Conflict of interest: Authors declared none

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