



Prevalence of Subclinical Keratoconus in Children with Astigmatism in Iraq

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Abstract

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BACKGROUND: Keratoconus is a progressive ectatic corneal pathology that involves both eyes, its usually asymmetrical, its early diagnosis and treatment are vital for the prevention of ocular morbidity that usually happen if it's not treated.

AIM: The study aims to detect the prevalence of subclinical keratoconus and keratoconus suspect in children with astigmatic error of ≥ 2 Diopters in Diwaniya city, Iraq.

METHODS: This is a cross-sectional, observational study, which investigate all the children aged six to eighteen years with an astigmatic error of ≥ 2 Diopters who attended the ophthalmology department for a routine eye examination during the period from January 2020 to June 2021. All children underwent full eye examination, and corneal imaging study with modern set which is a pentacam with Scheimpflug technology.

RESULTS: we had 488 children participated in our study, the mean age of participants was 12.01 ± 1.24 (range 6–18) years, 255 children were males (52.2%), and 233 were female children (47.7%) and they were divided into two age groups: first one between 6 and 12 years 225 children (46.1%), the second one between 12 and 18 years include 263 children (53.8%). We found 21 children with subclinical keratoconus (4.3%) and 24 children were a keratoconus suspects (4.9%).

CONCLUSION: The prevalence of keratoconus whether subclinical or suspect among the children with astigmatism who enrolled in our study was relatively high, the use of modern imaging technique tests are vital in the diagnosis.

Introduction

Keratoconus is a progressive ectatic corneal disorder, usually bilateral asymmetrical characterized by progressive astigmatism and myopia of different degrees due to continuous thinning of the cornea which has usually resulted in a progressive visual loss [1].

The etiology of keratoconus not fully understood, but different biomechanical, physical, and genetic factors were blamed resulting in alterations in collagen fiber arrangement of the cornea with progressive protrusion to cone like shape, family history is positive in 8–10% [2].

Childhood keratoconus is important because of the fast progression rate and late presentation of the patient to eye care centers, usually the child presents with high myopia and astigmatism which affect his social and educational development and his quality of life.

A few pieces of literatures discuss the epidemiology of keratoconus in children, a similar study in Saudi Arabia was conducted and reported an

incidence of pediatric keratoconus 4.79% [3], another study in done by Al-khoory *et al.* report a relatively low prevalence of 0.53% in children 14 years old or younger [4].

Vernal keratoconjunctivitis is a chronic allergic, inflammatory disease that involves the conjunctiva usually present with severe itching, redness and discharge, and involvement of the cornea in severe cases, the frequent rubbing of the cornea leads to more release of inflammatory mediators such as interleukinin and proteinase which lead to more rubbing and aid in the development and progression of keratoconus [5].

Subclinical keratoconus is defined as a type of keratconus in which the slit lamp and retinoscopic characteristics of the disease were absent, and the diagnosis is challenging, but using the pentacam with Scheimpflug technology aid in the early diagnosis which is very important for early initiation of the treatment plan for the child and avoid complications of late diagnosis [6], [7].

The purpose of our study is to estimate the prevalence of subclinical keratoconus in children with astigmatism ≥ 2 D in Diwaniya city.

Patients and Methods

This is a cross-sectional, observational, study that included all the children aged from six to eighteen with an astigmatic error of ≥ 2 D who attended the ophthalmology department in Diwaniya teaching hospital for a routine eye examination during the period from January 2020 to June 2021; the study adhered to the tenets of (Helsinki declaration) and it as approved by the ethical committee of Diwaniya medical college of medicine, informed consent was taken from all the child parents discussing the research and its potential benefits for the child and the community.

A detailed history was taken from all the patients include the age of the child, gender, ocular symptoms such as decrease or blurred vision, headache, glare, and monocular diplopia, and symptoms of vernal allergic disease were also recorded; all children with a history of eye surgery or trauma or previously diagnosed with keratoconus were excluded from the study, routine eye examination was done for all patients starting with visual acuity examination using a Snellen chart and the best- corrected visual acuity was recorded after subjective refraction done with autorefractometer and objective one done by retinopscoy after cycloplegic dilatation and the results were recorded for each subject.

Slit-lamp biomicroscopy examination was done also to detect the presence or absence of biomicroscopic signs of Keratoconus such as “progressive thinning, Fleischer’s ring, prominent nerves, Vogt’s striae, and apical scars.”

All subjects, then undergo pentacam imaging study using the pentacam instrument with Scheimpflug technology, it measures the anterior segment of the eye with 3D examination of the cornea, the examination done with experienced ophthalmologist masked for the child diagnosis, the child was asked for frequent blinding before the test and to focus at center for proper alignment, the image was captured for bot eyes, then realignment of the test done before each capture, and the test considers valid when comment OK appears in the screen.

All test results were examined by two experienced ophthalmologists, all suspected children were reexamined again using biomicroscopy and refraction is done again to be sure it’s not a case of keracotonus, if there are no clinical signs for keratoconus; either in K-readings or using retinoscope or by biomicroscopic, the diagnosis of the case whether subclinical Keratocous, Keratocous suspect, and normal was done depending on pentacam tomographer results and examining the tomography maps of patients. If two or more abnormal pentacam features were present like Inferior steepening/atypical bow tie with inferior steepness and I-S ratio over 1.4, or

high posterior elevation or high Keratomtric readings dition to classification (KC) by pentacam software analysis, in absence of any clinical signs of KC; either keratometric, retinoscopic or biomicroscopic), we consider the case as subclinical Keratocous, if one feature present we consider the case as Keratocous suspect.

Results

There was 488 children who participated in our study, the mean age of participants was 12.01 ± 1.24 (range 6–18) years, 255 children were males (52.2%) and 233 were a female children (47.7%), and they were divided into 2 age groups: first one between 6 and 12 years 225 children (46.1%) and second one between 12 and 18 years include 263 children (53.8%).

We found 21 children with subclinical keratoconus (4.3%) and 24 children were a keratoconus suspects (4.9%) and 443 children were normal at the examination, the frequency of disease with percentage and CI are shown in Table 1.

Table 1: The classification and frequency of subclinical keratoconus, keratoconus suspects and normal subject

Classification	Frequency	%	CI
Normal subject	433	90.07	87.9–92.1
Keratoconus suspect	24	4.9	3.1–5.84
Subclinical keratoconus	21	4.3	2.87–5.27

We found a significant difference regarding the prevalence of keratoconus suspect among gender ($p = 0.03$); it was more common in male patient (15 male 62%) than female patients (9 female 37%), while in cases with subclinical keratoconus, although it is more common in male too, but it is not statistically significant (12 male 57%) and (9 female 43%) as shown in Table 2.

Table 2: The prevalence of subclinical keratoconus, keratoconus suspect among gender

Gender	Disease	Frequency	%	CI	p value
Male	SKC	12	57	2.4–4.1	NS
	KCS	15	62.3	4.23–6.1	0.03
Female	SKC	9	43	1.1–4.7	NS
	KCS	9	37.7	3.9–4.2	NS

SKC: Subclinical keratoconus, KCS: Keratoconus suspect, NS: Nonsignificant.

We also found a significant difference among the prevalence of both sub clinical keratoconus and keratoconus susupect in the older age group (12–18 years) than younger age group (6–12 years) where ($p < 0.001$), as shown in Table 3.

Table 3: The prevalence of subclinical keratoconus, keratoconus suspect among different age groups

Age group	Disease	Frequency	%	CI	p value
6–12 year	SKC	6	28.6	1.02–3.2	<0.001
	KCS	7	29.1	2.9–4.1	<0.001
12–18 year	SKC	15	71.4	3.2–5.2	<0.001
	KCS	17	70.08%	4.3–6.1	<0.001

*SKC: Subclinical keratoconus, KCS: Keratoconus suspect.

Discussion

This study aimed to determine the prevalence of subclinical keratoconus and suspected keratoconus in the child and adolescent age group (6-18) in Diwaniya region in Iraq which was 4.3%, 4.9%, respectively, using the modern corneal imaging technique with Scheimpflug technology besides clinical examination by an expert ophthalmologist; the result was higher than previous reports on keratoconus prevalence [8], [9], [10], [11], [12], [13], [14], [15], [16], [17].

The first landmark article on keratoconus prevalence was published by Kennedy *et al.* [4] in 1986, the result based on examination by retinoscopy technique to detect irregular scissoring reflex of the cornea of patients with keratoconus over a span of 48 years on the population of Minnesota, USA. The overall prevalence was 0.05% only, and it remained the most cited article in this subject till now, since the introduction of more advanced examination technique the ratio increase; similar study done in our area with the comparable result was done by Torres *et al.* [3] in Saudi Arabia with a prevalence rate of 4.79% among children under 21 years old; however, they depend only on modern examination by imaging tomography not a clinical examination and they don't differentiate suspected from subclinical cases of keratoconus like in our study.

Another recent study from Netherland [18] show an increase incidence of keratoconus in the general population to be 0.23% depending on analyzing records from the insurance health system in contrast to our study which depends on clinical examination and corneal imaging study also to increase the detected subjects and made the ratio increase.

The prevalence of keratoconus is varied among areas and populations; it might be due to genetics, ethnic, diagnostic, and environmental reasons [9], [12], [14], [18], [19]; in 2000, Pearson *et al.* [15] suggested ethnic variations in the prevalence of keratoconus for the first time, in their study, a fourfold increase in the prevalence among Asian people (0.26%) than Caucasian (0.05%) however a lot of pieces literatures [9], [12], [18], [19].

It shows an increased prevalence of keratoconus among people in the middle east region which might be due to ethnic cause or it related to increasing incidence of allergic disorders and spring catarrh., in our study (27%) of our patient with keratoconus has a positive history and examination for VKH which higher than in the other subjects (8.3%) which might report a relation between frequent eye rubbing in early childhood and the development of keratoconus which is not proved till now and need more investigations.

Our study shows an increased prevalence of keratoconus among male subjects, similar study

show also increase prevalence in male compared to female [15], while other studies show that female has more prevalence rate [20], [21] and other researchers found no gender differences [8], [20].

Furthermore, in our research, we divide the research population into two age groups to focus on the increased prevalence among older children who will be advised to undergo screening programs for keratoconus more frequently than younger kids; the prevalence was much higher in the older age group and its statistically significant, similar study done by Awwad *et al.* [22] show the same high prevalence among the older children.

Our study has some limitations to acknowledge; it's a cross-section study, while a cohort type of research study be more informative about the nature of the disease and its progression, also we use a clinical-based sample, not a population-based sample which would be better in assessing a prevalence of a disease, although the high prevalence rate among those kids who attend the ophthalmology department with astigmatism in Diwaniya city will raise a flag to start adequate population-based research and cooperate the results of this study [23].

Another limitation of every study using a human interface to assess the clinical outcome; there was some discrepancy between our examiners about some query cases, and we judged the tomography results to be the final decision.

Keratoconus in a child is more aggressive and fast progress than adult; this might be due to structural liability of collagen fibers in child cornea, so early diagnosis is vital with proper selection of treatment plan to prevent deterioration and ocular morbidity.

Conclusion

Keratoconus is a serious disease especially in children, so early detection is important to prevent complications, introduction of modern imaging study is vital to achieving this goal.

The prevalence of this disease among children with astigmatism is high which might need a school-based screening program for early detection.

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