

## **A Retrospective Study on keratoconus patients living in the central division, Fiji, 2015 – 2019.**

**Vinod Kumar**

*SAERA. School of Advanced Education Research and Accreditation*

### **ABSTRACT**

**Purpose:** To understand the severity of keratoconus patients living in the central division of Fiji.

**Methods:** A total of sixty patients who attended to private clinic in Suva (Fiji) were reviewed. The severity of KCN was graded into three (3) groups from “Mild” (Group I, KCN <45 D), to “Moderate” (Group II, KCN 45 to 52 D) and “Severe” (Group III, KCN >52 D). Refraction was determined by using objective and subjective criteria. Visual acuity was determined by using Snellen chart, converted into LogMAR scale. Corneal curvature was measured by using corneal topography. The severity of KCN is classified based on the CLEK study.

**Results:** A total of 55 patients with KCN were analysed, with a mean age of  $25.01 \pm 7.8$  years. At the time of diagnosis, the severity of KCN was 36.3%, 43.6% and 20% in Groups I, II, and III, respectively. Mean BCVA with glasses was  $0.22 \pm 0.29$  and with CL was  $0.11 \pm 0.12$  LogMAR. We found a statistically significant differences in the severity of KCN in those using spectacles compared to those using contact lenses in Group II ( $P=0.046$ ) and a significant difference of visual outcomes in those using glasses compared to those using contact lenses is ( $P=0.009$ ).

**Conclusion:** Significant vision improvement was seen when prescribing contact lenses compared to spectacles. In Fiji, private practice optometrists should consider practising RGP contact lenses for better visual outcome in KCN patients.

**Keywords:** *Keratoconus, Severity, Glasses, Contact lens.*

## LIST OF ABBREVIATIONS

**CL:** Contact Lens

**Dsph:** Diopter in spherical power

**D:** Diopters

**KCN:** Keratoconus

**LogMAR:** Logarithm of Minimum Angle Resolution

**VI:** Visual impairment

**VA:** Visual acuity

**SPSS:** Statistical Package for social sciences

**RGP:** Rigid Gas Permeable lens

**CLEK:** Collaborative Longitudinal Evaluation of keratoconus

**BCVA:** Best corrected visual acuity

**CL BCVA:** Contact lens best corrected visual acuity

**C3R:** Collagen cross-linking

## INTRODUCTION

The cornea is a major refractive component of the human eye: Keratoconus is one of its clinical disorders. In this disorder, the cornea is conical in its shape, affects the central area usually bilateral, and deforms as parenchymal opacification and thinning (Lang, 2006). Progressive decreased vision is observed in early adolescence and continues into middle age. Chronic progressive irregular astigmatism results due to paracentral thinning and bulging of the cornea (thinning near the apex of protrusion), vertical tension lines in the posterior cornea (Vogt striae), irregular corneal retinoscopic

reflex (Scissor reflex), and egg-shaped mires on keratometry. Inferior steepening can be noted on corneal topographic evaluation. It is well established that the keratoconus is usually bilateral but often asymmetric (Ehlers and Shah, 2010). Many studies report that this condition starts at adolescence and stops at the third or fourth decade of life (Hashemi et al., 2019; Papali'i-Curtin et al., 2019).

Worldwide, the incidence of keratoconus (KCN) varies from region to region, with a global estimation between 50 and 230 per 100,000 people in the general population (Al-Amri, 2018; Mohd-Ali, 2012). The percentage of Visual impairment (VI) stands between 2.3% (Mohd-Ali, 2012; Jonas, 2009) in India, 8.59 to 9.46% in Saudi Arabia (Althomali, 2018) and 8.8 to 54.4% in New Zealand (Edwards, 2001). Since VI due to KCN is potentially treatable and avoidable, early detection leads to visual aids such as glasses and contact lenses (CL) (El Rami et al., 2015). Also, it provides a decent opportunity to reduce its progression utilizing surgical interventions like Collagen cross-linking (C3R) and Corneal transplant (El Rami et al., 2015) (**Table 1**).

**Table 1.**

*Prevalence and incidence of KCN in countries.*

S. No	Reference	Country	Incidence (Units)	Prevalence (Units)
1	Jonas et al. (2009)	INDIA		2,300
2	Pearson et al. (2000)	UK	4.5 to 19.6	57,229
3	Kennedy et al. (1986)	USA	2.0	54.5

It was found that the usual onset of KCN starts at puberty until early adulthood (El Rami et al., 2015). Occasionally KCN is associated with trisomy 21 or Down syndrome, atopic dermatitis and connective-tissue disorder such as Marfan syndrome (Lang, 2006). The Clinical signs identify with slit lamp and corneal topography, the differential diagnosis of KCN such as keratoglobus, pellucid marginal degeneration and Terrien's marginal degeneration (Rabinowitz, 1998), which can be noticed in day to day clinic.

According to world population review (2018), the nation of Fiji has comprised over 332 islands, although only 110 of those are inhabited. Fiji is located in Melanesia in the South Pacific Ocean, about 1,300 miles northeast from New Zealand. In 2018, Fiji had an estimated population of almost 889,953 people, which ranks 161st in the world (Fiji Bureau of Statistics, 2018). The previous study mentioned population ranking according to the human development index rating (ranked 86th among 169 countries). The majority of the population (837,000) lives on the main islands of Viti Levu (79.1%) and Vanua Levu (16.1%). Ethnically, 56.8% of inhabitants are Melanesian, and 37.5% are Indian, with 49.3% living in rural areas and 28.7% age below 40 years (Ramke et al., 2012).

The most common cause factor for visual impairment in Fiji is diabetes. Previous studies reported in South Pacific islands did a population-based survey in 2002, and they found unrecognized diabetics (population: 837,300) is about 53% according to the Human Development Index rated Fiji (Brain et al., 2011). Knowing the fact that Eyecare facilities in Pacific islands like Fiji are still maintained poorly, yet there are some studies

reported by the New Zealand group in Late adults (Brain et al., 2011; Toit et al., 2008). This study aims to describe the severity of KCN in patients living in the central division of Fiji. The outcomes of the study could inform about the clinical decision making in the detection of normal and abnormal cases in early diagnosis of corneal anomalies and to suggest the initiation of public health preventive measures for the population in this region.

## MATERIAL AND METHOD

### Study Design: Retrospective study

**Study Area:** Razak Optometrist, Suva, Fiji island.

**Methods:** This retrospective study was based at the private optometry practice in Suva, Fiji. A total of 60 patients diagnosed with keratoconus were identified and evaluated during a four-year period, from 2015 to 2019. Five (5) patients were excluded due to missing information such as topography and aided visual acuity. Unaided and aided visual acuity were assessed from Snellen chart 3M (projector illuminated chart). Diagnosis of KCN was based on the visual acuity, scissor reflex, slit lamp findings and corneal topography (PCT 110, Optopol, Nidek). For baseline reference, we have taken the North American Collaborative Longitudinal Evaluation of keratoconus (CLEK) study for grading KCN (Mohd-Ali et al., 2012). The severity of KCN is determined based on corneal curvature, mean, power and new topography and categorised into mild, moderate and advanced. The KCN of each eye was classified, in diopters according to CLEK study grading. Mild  $\leq 45D$ , Moderate 45-52D and Severe 52D (Zadnik et al., 1996).

Mild to moderate cases prescribed spectacles, RGP (PMMA), Rose K and those identified with advanced KCN referred for surgery.

**Exclusion criteria:** A history of any ocular surgery, corneal infections, amblyopia, trauma or any retinal abnormalities and incomplete records referring to individual's data were excluded.

**Hypothesis:** The keratoconus levels in the study population expected to be equal or more than moderate levels.

## STATISTICAL ANALYSIS

Descriptive statistics performed by using IBM Statistical Package for Social Sciences (SPSS) 20.0 version. Non-parametric test such as the Kolmogorov-Smirnov (K-S) test used to compare the normality of data. Kruskal-Wallis test used to compare the distribution between aided visual acuity among three groups. Wilcoxon signed rank test used to compare the visual improvement between glasses versus contact lenses in three grades. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

Glasses were prescribed to the patients with early KCN and RGP contact lenses were prescribed in moderate to severe cases. In our study the mean age was  $25.01 \pm 7.8$  years range from (10 to 40 years old). Among 55 patients, 30 were males and 25 females. Most of the patients were identified to have bilateral keratoconus (92%). All the parameters were calculated and analysed only for the right eye. **Figure 1** shows the severity of all three, whereas **Table 2** and

**3** show the mean and standard deviation of K values in all three groups. There are 12 males and 8 females in Group I with an average mean K of  $43.35 \pm 1.33$  D. In Group II, there are 12 males and 12 females with an average mean K of  $48.53 \pm 2.50$  D. In Group III, there are 6 males and 5 females identified with an average mean K of  $55.82 \pm 2.43$  D. The mean topography cylindrical values were  $-5.16 \pm 3.76$  Dsph. The mean best correct visual acuity (BCVA) is  $0.22 \pm 0.29$ , and spherical equivalent values are  $-4.47 \pm 4.09$ . The BCVA with RGP contact lenses recorded as  $0.11 \pm 0.12$ .

Figure 1.

*Distribution of K severity among three groups in central division, Fiji, 2015-2019*

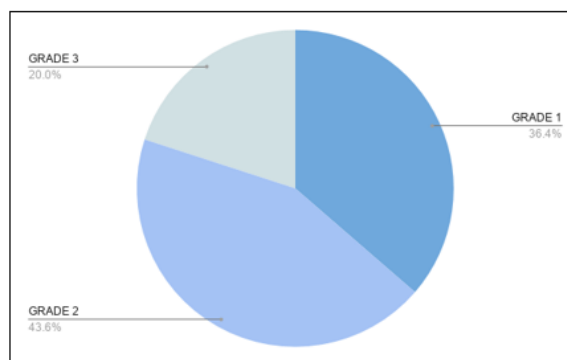


Table 2.

*Mean  $\pm$  Standard deviation values of K-readings in male and female among the three groups in central division*

Gender	Total subjects (n)	No. subjects (n)	Grade 1	No. subjects (n)	Grade 2	No. subjects (n)	Grade 3
Males	30	12	42.85 $\pm$ 1.644	12	49.22 $\pm$ 2.06	06	55.71 $\pm$ 2.55
Females	25	8	44.10 $\pm$ 1.29	12	47.84 $\pm$ 5.16	05	55.95 $\pm$ 2.57

**Table 3.**

*Mean+/- standard deviations of K readings among the three groups in central division, Fiji, 2015-2019*

Total patients	Grade 1	Grade 2	Grade 3
55	43.35 ± 1.33	48.53 ± 2.50	55.82 ± 2.43

*The BCVA irrespective of glasses or contact lenses in all three grades based on K severity were compared and found there are no statistically significant differences,  $P > 0.193$ ,  $P > 0.117$ . We compared BCVA between glasses versus contact lenses, and we found statistically significant differences,  $P \leq 0.009$ . As shown in **Table 4**, BCVA between glasses versus contact lenses were compared in each grade and found statistically significant differences in Group II  $P \leq 0.046$ . Indeed, the severity of Group II is higher than Group I and III, **Table 5**.*

**Table 4.**

*BCVA in patients using glasses and contact lenses in the three K severity groups*

Severity of K	BCVA with Glasses	BCVA with Contact Lenses	Significance
Grade 1	0.13(6/7.5)	–	
Grade 2	0.27(6/9.5)	0.1(6/7.5)	$p < 0.046$
Grade 3	0.26(6/9.5)	0.14(6/7.5)	$p > 0.068$

**Table 5.**

*Unaided and aided Visual acuity measurement in patient using glasses and contact lenses*

Group	No. patients	CL taken	Glasses taken	UN VA	BCVA with Glasses	BCVA with CL
Grade 1	20	0	20	0.67(6/24)	0.13(6/7.5)	–
Grade 2	24	7	17	0.94(6/48)	0.27(6/9.5)	0.1(6/7.5)
Grade 3	11	5	6	1.1(6/75)	0.26(6/9.5)	0.14(6/7.5)

## DISCUSSION

Our study describes the retrospective data on KCN eyes among those presented to a private clinic in Suva from 2015 to 2019. The majority of patients reported symptoms like decreased distance vision, frequent change in glasses prescription, image distortion, itching sensation, headache and glare problem. We observed that habitual rubbing due to itching is the common cause among most of the patients — clinical signs recorded using slit-lamp bio microscope. Most of the patients were found to have Vogt's striae (47%) or Fleischer's ring (36%), then ectasia (10%) and finally corneal scarring (7%). We found no history of prior ophthalmic consultation before attending the clinic. Based on our data we found Mild KCN 36.3%, Moderate was 43.6% and Severe was 20% at first visit. Among 55 patients, forty-three (78%) were prescribed glasses and only twelve patients (21%) fitted with RGP contact lenses. This shows a lack of awareness or reduced availability of RGP contact lenses in this country.

Subsequently, previous studies defined KCN as an asymmetric, progressive, non-inflammatory condition with multiple



abnormal corneal signs and visual symptoms, while primary aetiology remains unknown (Mohd-Ali, Abdu, Yean Yaw and Mohidin, 2012). Few authors observed that KCN occurs at a younger age and usually is progressing to an advanced stage by the time of diagnosis, as the condition progresses rapidly due to the abnormal biomechanics in children's eyes (Hassan et al., 2019).

Few studies reported that KCN is more prevalent during the second and third decade of life and less common in older age groups (Rafati et al., 2019). Similarly, in our study, we noticed that the mean age of the patients was  $25.01 \pm 7.8$  years, compared to Patel and McGhee's study (2013), which reported  $17.1 \pm 5.6$  years. However, other studies showed a similar mean age:  $21.46 \pm 6.17$  and  $20.2 \pm 6.4$  years in Asian countries (Mohd-Ali et al., 2012; Saini et al., 2004). These observations show that KCN usually progresses rapidly with severe at a younger age. It was noticed that the mean age in our study is higher compared to other Asian studies due to the delayed approach to an eye specialist.

In our study, we used the classification provided by the North American Collaborative Longitudinal Evaluation of Keratoconus CLEK (Zadnik et al., 1996). That classification defines less than 45D as mild Keratoconus, 45-52D as moderate and higher than 52D as severe. Our results show that Group II (43.6%) is more severe than Grade I (36.4%) and Grade III (20.0%). Most KCN patients were males in our study. Similarly, other studies (Mohd-Ali et al., 2012; Rafati et al., 2019; Saini et al., 2004) also documented the same, whereas our study shows no difference between both genders. Most of the patients had bilateral keratoconus and the data was recorded only

for the right eye. Our study is the first one to assess the severity of KCN in Fiji retrospectively. Hence, more prospective studies need to encourage for explaining possible factors associated with KCN.

From the results, we identified that BCVA differed by one line comparing glasses and contact lens irrespective of severity ( $P < 0.046$ ). Out of fifty-five patients, 21% of contact lens wearers had BCVA of 6/7.5, and 78% of spectacle wearers had BCVA 6/9.5. As per Agrawal (2011), contact lens wearers had a BCVA of 59%, which was 6/12 or better whereas BCVA with spectacle wearers is 30%. The possible reason could be a low sample size when compared to their study, where they included 189 subjects, and ours were fifty-five only. Therefore, larger sample size and prospective studies may provide a favourable result.

Previous studies reported that atopy is the primary factor behind the etiology of KCN (Mohd-Ali et al., 2012; Patel and McGhee, 2013). In our study, we observed that no patient had a history of any systemic illness. Most of the patients were found to be bilateral keratoconus, with a higher incidence in males than in females. Significant vision improvement was seen when prescribing contact lenses. In Fiji, private practice optometrist should consider practice with RGP contact lenses for better visual outcome in KCN patients.

Furthermore, prospective studies are required to identify the association between keratoconus and causative factors in this specific population. Early eye screenings, detection and treatment of early KCN is essential as early detection and appropriate management can improve the quality of life of patients with KCN. Eyecare professionals need to maintain more cautious towards the

eye abnormalities in growing young adults. Hence, we began to observe the characteristics of KCN through the records of patients who attended a private clinic in Suva, Fiji Islands. In the future, there is a scope of creating awareness among the eye care community, specifically in Fiji and other Pacific islands.

Since our study is retrospective in nature, there are certain limitations to observe the systemic and environmental factors to assess KCN. We have also not collected information on the use of the prescribed treatment, and therefore we assume that individuals have exposed to the benefits of using this treatment.

In Fiji, private practice optometrist should consider practising the RGP contact lens for better visual outcome in KCN patients. Furthermore, prospective studies are required to identify the association between Keratoconus and causative factors in this specific population.

## CONCLUSION

The present study evaluated a sample of fifty-five patients with KCN in the population of Fiji, most of them in their mid-twenties. Bilateral KCN was present in 92% of patients, being the most common group those with moderate KCN. It was observed a greater visual improvement in patients wearing contact lenses instead of glasses. RGP contact lenses are specially recommended in moderate and severe cases of KCN. Likely most of the patients did not opt for contact lenses due to socio-economic factors, their occupation and dislike to wear contact lenses. To up bring awareness about this, eye care professionals and government of Fiji need to conduct more educational

programmes at schools and universities and also educating parents, distributing brochures and advertising through social media.

Furthermore, prospective studies are required to identify the association between keratoconus and causative factors in this specific population. All in all, optometrists need to start practising (RGP) contact lenses in order to improve the quality of life of KCN patients.

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