

Correlation of Corneal Topographic Parameters with Visual Acuity in Patients with Keratoconus: A Cross-Sectional Observational Study.

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Abstract

Background

Keratoconus is a progressive corneal ectatic disorder characterized by thinning, steepening, irregular astigmatism, and reduced visual acuity. Corneal topography provides quantitative indices for assessing structural severity and functional impact.

Objectives

To assess the correlation of corneal topographic parameters with best-corrected visual acuity (BCVA) in patients with keratoconus

Methods

This hospital-based cross-sectional observational study included 100 consecutively enrolled patients with keratoconus at Rajiv Gandhi Institute of Medical Sciences, Adilabad, from August 2025 to January 2026. One eye per patient was analysed. BCVA was recorded in logMAR units. Keratometric, pachymetric, astigmatic, and elevation parameters were assessed by corneal topography. Pearson correlation analysis evaluated associations with BCVA.

Results

Mean age was 23.6 ± 6.8 years; 58.0% were male. Mild, moderate, and severe keratoconus accounted for 26.0%, 44.0%, and 30.0%, respectively. Mean BCVA was 0.42 ± 0.28 logMAR, Kmax 56.9 ± 8.4 D, and thinnest pachymetry 439.5 ± 46.2 μ m. BCVA worsened from 0.18 ± 0.10 logMAR in mild disease to 0.68 ± 0.27 logMAR in severe disease ($p < 0.001$). Kmax had the strongest positive correlation with BCVA ($r = 0.71$, $p < 0.001$), whereas thinnest pachymetry had the strongest negative correlation ($r = -0.66$, $p < 0.001$). K2 ($r = 0.64$), posterior elevation ($r = 0.62$), anterior elevation ($r = 0.57$), central corneal thickness ($r = -0.54$), K1 ($r = 0.52$), and corneal astigmatism ($r = 0.48$) were also significant (all $p < 0.001$).

Conclusion

Greater corneal steepening and thinning were significantly associated with poorer BCVA. Kmax and thinnest pachymetry showed the strongest correlations and may serve as useful structural indicators during assessment and follow-up.

Recommendations

Routine topographic monitoring, particularly Kmax and pachymetry, should support severity grading, follow-up, visual rehabilitation, and timely referral for cross-linking when clinically indicated.

Keywords: Keratoconus; Corneal topography; Visual acuity; Kmax; Pachymetry; Corneal astigmatism

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Introduction

Keratoconus is a bilateral, usually asymmetric, progressive corneal ectatic disorder in which stromal thinning and anterior protrusion produce irregular astigmatism, myopia, and reduced optical quality [1,2]. The disease typically begins during adolescence or early adulthood and progresses variably, especially in younger patients [3,4]. Visual complaints range

from frequent changes in spectacle prescription to glare, ghosting, monocular diplopia, and reduced best-corrected visual acuity. Although keratoconus has long been described as a non-inflammatory ectasia, contemporary literature recognizes a multifactorial background involving genetic susceptibility, biochemical imbalance, biomechanical weakening, environmental exposure, eye rubbing, allergy, and atopy [4,5]. These mechanisms ultimately alter the curvature and thickness

profile of the cornea, producing functional impairment that differs across patients even within similar clinical stages.

The epidemiological burden of keratoconus varies across regions because of differences in diagnostic criteria, imaging access, ethnicity, age distribution, and referral patterns. Systematic evidence suggests that eye rubbing, family history, allergy, asthma, and eczema are important risk factors [5]. A nationwide registration study also showed that keratoconus is more common in younger age groups than older estimates suggested, reflecting improved diagnostic detection through corneal imaging [6]. In tertiary eye care settings, patients often present after visual symptoms develop, and this creates a need to link structural indices with functional visual loss. Such structure-function assessment is particularly important in clinical decision-making because management options differ across early, moderate, and advanced disease.

Corneal topography and tomography have transformed keratoconus evaluation by allowing objective assessment of anterior curvature, posterior elevation, pachymetric distribution, and cone morphology [3,7]. Traditional keratometric indices such as flat keratometry, steep keratometry, corneal cylinder, and maximum keratometry are widely used to estimate corneal steepening, whereas pachymetric parameters quantify stromal thinning. Modern grading systems also incorporate anterior and posterior curvature around the thinnest point, thinnest pachymetry, and distance visual acuity, emphasizing that anatomical and functional parameters should be interpreted together [7]. Studies from the Collaborative Longitudinal Evaluation of Keratoconus project showed that corneal curvature, scarring, and visual acuity change over time, supporting the clinical relevance of repeated structural and functional measurements [8-10].

The relationship between topographic parameters and visual acuity is clinically meaningful but not fully linear. Visual acuity can worsen with increasing Kmax, irregular astigmatism, coma-like aberrations, and corneal thinning, but some patients maintain useful corrected vision despite advanced curvature if the cone is decentered or optical correction remains effective [11-14]. Therefore, local data from different clinical settings help clarify which measurable parameters are most closely related to visual acuity. The present study was conducted with the objective of evaluating the correlation of corneal topographic parameters, including keratometric, elevation, astigmatic, and pachymetric indices, with best-corrected visual acuity in patients with keratoconus attending Rajiv Gandhi Institute of Medical Sciences, Adilabad, Telangana, India.

Methodology

Study design and setting

This hospital-based cross-sectional observational study was conducted from August 2025 to January 2026 in the Department of Ophthalmology, Rajiv Gandhi Institute of Medical Sciences (RIMS), Adilabad, Telangana, India. RIMS is a government medical college and teaching hospital serving Adilabad and surrounding districts and provides outpatient, inpatient, emergency, diagnostic, medical, and surgical care through major clinical specialties, including General Medicine, General Surgery, Obstetrics and Gynaecology, Paediatrics, Orthopaedics, Dermatology, Respiratory Medicine, Psychiatry, Otorhinolaryngology, Ophthalmology, Dentistry, Anaesthesiology, Radiology, Pathology, Microbiology, and Biochemistry. The Ophthalmology department provides comprehensive clinical evaluation, refraction, slit-lamp examination, corneal assessment and imaging, and medical and surgical eye care. The cross-sectional design was selected to examine the relationship between corneal structural parameters and visual function at the time of clinical presentation.

Study population and participant selection

Patients attending the Ophthalmology outpatient service during the study period who had clinical and topographic evidence of keratoconus were assessed for eligibility. A consecutive sampling approach was used: patients meeting the eligibility criteria were enrolled sequentially until the required sample size was achieved. Patients of either sex were eligible. Previous corneal surgery or corneal collagen cross-linking, active ocular infection, corneal opacity unrelated to keratoconus, ocular trauma, other ectatic corneal disorders, glaucoma, retinal pathology, incomplete clinical records, or poor-quality topographic scans were exclusion criteria. One eye per patient was included to avoid inter-eye correlation; when both eyes were eligible, the eye with better-quality topographic acquisition and complete clinical data was selected according to the predefined analysis rule.

Bias: Selection bias was reduced by consecutive enrolment of eligible patients during the defined study period and by applying the same inclusion and exclusion criteria to all participants. Measurement bias was minimized through a uniform ophthalmic assessment protocol, standardized BCVA recording in logMAR units, and acquisition of corneal topographic parameters using the same clinical workflow. Poor-quality scans were excluded according to predefined criteria. Inter-eye dependence was avoided by analysing only one eye per patient. Data were

checked for completeness before analysis, and the investigators used prespecified definitions and statistical methods to limit differential classification and analytical bias.

Study size

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The sample size was estimated for the primary objective of detecting a correlation between corneal topographic parameters and BCVA. Assuming a minimum clinically relevant correlation coefficient of $r = 0.30$, a two-sided α of 0.05, and 80% power, the Fisher z-transformation approach gave a minimum requirement of approximately 85 participants. The target was increased to 100 to provide allowance for exclusions related to incomplete records or inadequate topographic image quality and to improve the precision of the correlation estimates.

Clinical assessment and variables

All patients underwent detailed ophthalmic assessment, including demographic data collection, history, slit-lamp examination, refraction, and visual acuity testing. Best-corrected visual acuity was converted into logMAR units for statistical analysis. Corneal topography was used to record flat keratometry, steep keratometry, maximum keratometry, corneal astigmatism, central corneal thickness, thinnest pachymetry, anterior elevation, and posterior elevation. Keratoconus severity was categorized as mild, moderate, or severe based on topographic severity and keratometric pattern, consistent with established concepts that combine curvature and pachymetric changes in disease staging [3,7].

Statistical analysis

Continuous variables were summarized as mean $\pm$ standard deviation and range, while categorical variables were presented

as frequency and percentage. Differences in mean BCVA across mild, moderate, and severe keratoconus groups were assessed using one-way analysis of variance. Pearson correlation coefficients (r) were calculated to quantify the direction and strength of the linear association between each continuous corneal topographic parameter and BCVA logMAR. Because higher logMAR values indicate poorer vision, a positive r denotes worsening BCVA with increasing parameter values, whereas a negative r denotes worsening BCVA with decreasing thickness. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

Ethical considerations

The study was conducted after approval from the Institutional Ethics Committee of Rajiv Gandhi Institute of Medical Sciences, Adilabad, and Telangana, India. Written informed consent was obtained where applicable. Patient identity was kept confidential, and anonymized data were used for analysis.

Results

Participant flow: During the study period, 100 potentially eligible patients with clinical and topographic evidence of keratoconus were examined for eligibility. All 100 fulfilled the study criteria, consented to participation where applicable, and were included. No participant was excluded after enrolment because the selected study eye had complete clinical information and acceptable topographic image quality. Therefore, 100 patients contributed one study eye each and all 100 were included in the final analysis. The analysed sample comprised 58 males and 42 females, with a mean age of 23.6 ± 6.8 years; 26 patients had mild, 44 moderate, and 30 severe keratoconus (Table 1).

Figure 1. Participant flow through the study

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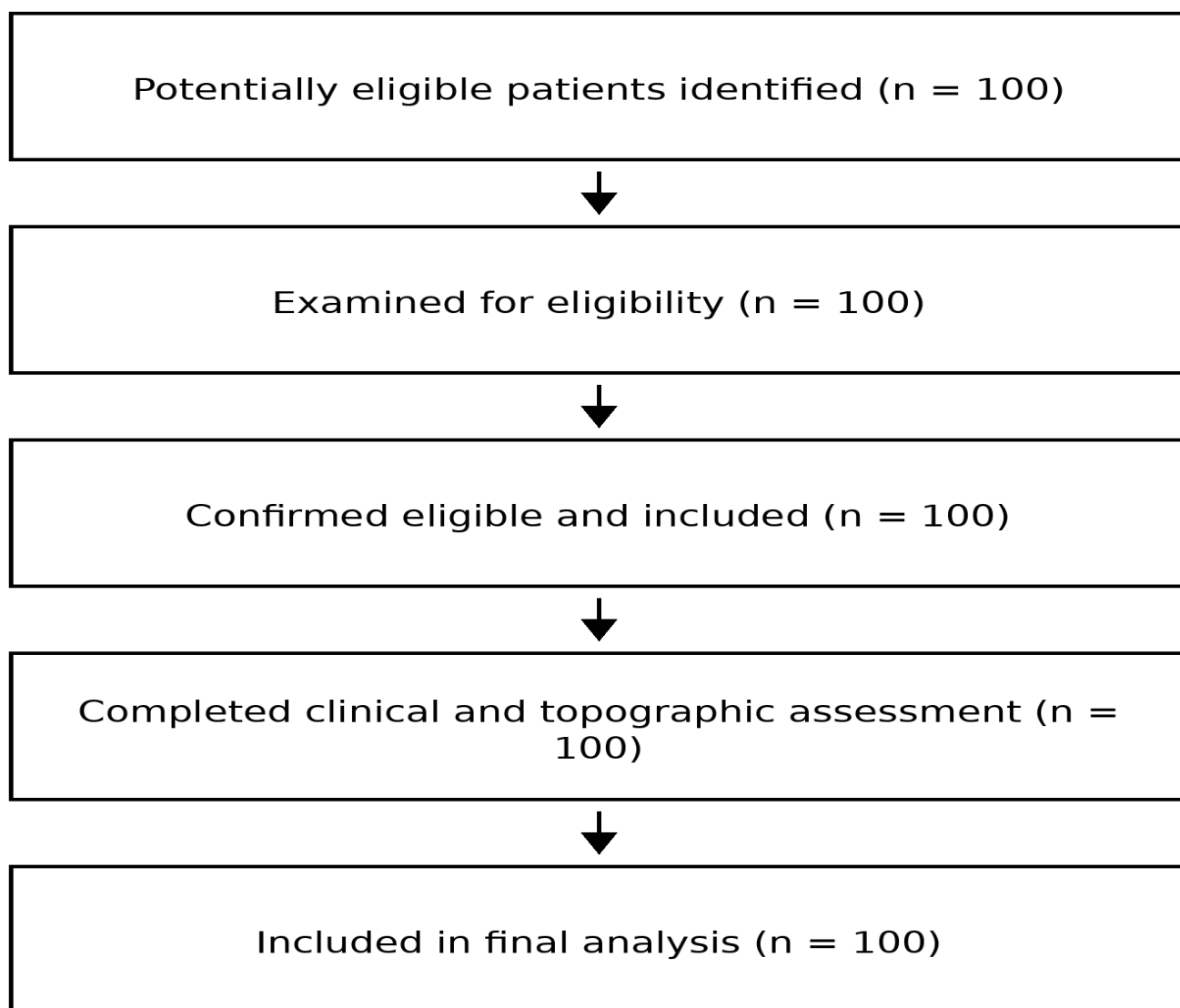


Table 1: Baseline demographic and clinical characteristics of patients with keratoconus

Variable	Number of patients	Percentage
Age group		
≤20 years	28	28.0
21–30 years	46	46.0
31–40 years	22	22.0
>40 years	4	4.0
Sex		
Male	58	58.0
Female	42	42.0
Laterality		
Right eye analysed	52	52.0
Left eye analysed	48	48.0
Severity of keratoconus		
Mild	26	26.0
Moderate	44	44.0
Severe	30	30.0

The mean best-corrected visual acuity was 0.42 ± 0.28 logMAR. The mean flat keratometry value was 48.2 ± 5.6 D, while the mean steep keratometry value was 52.6 ± 6.8 D. The mean maximum keratometry was 56.9 ± 8.4 D. The mean corneal

astigmatism was 4.4 ± 2.6 D. The mean central corneal thickness was 457.8 ± 42.6 μm , and the mean thinnest pachymetry was 439.5 ± 46.2 μm . The distribution of visual and topographic parameters is shown in Table 2.

Table 2: Visual acuity and corneal topographic parameters

Parameter	Mean $\pm$ SD	Range
BCVA, logMAR	0.42 ± 0.28	0.00–1.20
Flat keratometry, K1 (D)	48.2 ± 5.6	40.8–63.5
Steep keratometry, K2 (D)	52.6 ± 6.8	43.2–70.4
Maximum keratometry, Kmax (D)	56.9 ± 8.4	45.6–78.2
Corneal astigmatism (D)	4.4 ± 2.6	0.8–12.6
Central corneal thickness (μm)	457.8 ± 42.6	358–536
Thinnest pachymetry (μm)	439.5 ± 46.2	326–518
Anterior elevation (μm)	28.6 ± 14.8	8–68
Posterior elevation (μm)	56.4 ± 25.2	18–128

Visual acuity showed progressive deterioration with increasing keratoconus severity. Patients with mild keratoconus had better BCVA compared with those with moderate and severe keratoconus. The mean BCVA was 0.18 ± 0.10 logMAR in mild

keratoconus, 0.39 ± 0.19 logMAR in moderate keratoconus, and 0.68 ± 0.27 logMAR in severe keratoconus. The difference in visual acuity across severity groups was statistically significant (Table 3).

Table 3: Visual acuity according to keratoconus severity

Severity of keratoconus	Number of patients	BCVA, logMAR Mean $\pm$ SD	Interpretation
Mild	26	0.18 $\pm$ 0.10	Better visual acuity
Moderate	44	0.39 $\pm$ 0.19	Moderate reduction
Severe	30	0.68 $\pm$ 0.27	Marked reduction
Overall comparison		p<0.001	Significant

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Correlation analysis demonstrated a significant association between corneal topographic parameters and visual acuity. Since higher logMAR values indicate poorer visual acuity, positive correlations suggest worsening vision with increasing topographic severity. BCVA showed a strong positive

correlation with Kmax, steep keratometry, anterior elevation, posterior elevation, and corneal astigmatism. A significant negative correlation was observed between BCVA and pachymetric parameters, indicating that thinner corneas were associated with poorer visual acuity (Table 4).

Table 4: Correlation of corneal topographic parameters with BCVA logMAR

Topographic parameter	Correlation coefficient (r) with BCVA logMAR	p-value	Interpretation
Flat keratometry, K1	0.52	<0.001	Moderate positive correlation
Steep keratometry, K2	0.64	<0.001	Strong positive correlation
Maximum keratometry, Kmax	0.71	<0.001	Strong positive correlation
Corneal astigmatism	0.48	<0.001	Moderate positive correlation
Anterior elevation	0.57	<0.001	Moderate positive correlation
Posterior elevation	0.62	<0.001	Strong positive correlation
Central corneal thickness	-0.54	<0.001	Moderate negative correlation
Thinnest pachymetry	-0.66	<0.001	Strong negative correlation

Among all analysed parameters, Kmax showed the strongest positive correlation with BCVA logMAR, suggesting that increasing corneal steepening was closely associated with worsening visual acuity. Thinnest pachymetry also demonstrated a strong inverse correlation with visual acuity, indicating that progressive corneal thinning was related to poorer visual outcome. These findings suggest that both anterior curvature changes and pachymetric reduction contribute significantly to visual impairment in patients with keratoconus.

Discussion

The present study evaluated the relationship between corneal topographic parameters and BCVA in 100 patients with keratoconus. The mean age was 23.6 $\pm$ 6.8 years; 58.0% were male, and the largest age group was 21–30 years (46.0%). Moderate and severe disease together accounted for 74.0% of the cohort (44.0% and 30.0%, respectively). This age profile is consistent with the recognized tendency of keratoconus to manifest during adolescence and early adulthood [1,2,6]. The male predominance has also been described in several clinical

datasets, although sex distribution varies by population, referral patterns, and diagnostic access [5,6].

A clear severity-related decline in visual acuity was observed. Mean BCVA worsened from 0.18 $\pm$ 0.10 logMAR in mild keratoconus to 0.39 $\pm$ 0.19 logMAR in moderate disease and 0.68 $\pm$ 0.27 logMAR in severe disease, with a statistically significant overall difference (p < 0.001). This gradient supports the clinical concept that progressive corneal ectasia produces increasing optical distortion. The CLEK study demonstrated that keratoconus is associated with changes in visual acuity, corneal curvature, and vision-specific function over time [8,9]. Corneal scarring is an additional contributor to visual loss in advanced disease, while irregular astigmatism and higher-order aberrations can reduce best-corrected vision even in the absence of scarring [10,14].

Kmax showed the strongest positive correlation with BCVA logMAR (r = 0.71, p < 0.001), followed by steep keratometry (r = 0.64, p < 0.001) and posterior elevation (r = 0.62, p < 0.001). Flat keratometry (r = 0.52), anterior elevation (r = 0.57), and corneal astigmatism (r = 0.48) were also significantly associated

with poorer BCVA (all $p < 0.001$). These findings indicate that increasing corneal steepening and geometric distortion are closely related to functional visual loss. Similar structure-function relationships have been reported for refractive, topographic, pachymetric, and

aberrometric variables in keratoconus [12]. Kmax remains clinically useful as a marker of focal cone steepening, but differences in cone location, astigmatic regularity, epithelial compensation, scarring, and higher-order aberrations mean that it should be interpreted with other corneal and visual parameters rather than in isolation.

Pachymetric variables also showed clinically relevant associations. Thinnest pachymetry demonstrated a strong inverse correlation with BCVA logMAR ($r = -0.66$, $p < 0.001$), stronger than the inverse correlation for central corneal thickness ($r = -0.54$, $p < 0.001$). Thus, lower corneal thickness, particularly at the thinnest point, was associated with poorer visual acuity. This agrees with tomographic concepts emphasizing the thinnest point, posterior curvature, and pachymetric distribution in keratoconus staging [7,13]. Anterior elevation ($r = 0.57$, $p < 0.001$) and posterior elevation ($r = 0.62$, $p < 0.001$) were likewise related to poorer BCVA, reinforcing that keratoconus is a three-dimensional ectatic process rather than solely an anterior curvature disorder.

Taken together, the correlation pattern indicates that visual impairment in this cohort reflected the combined effects of corneal steepening, elevation change, astigmatism, and thinning. The strongest associations were observed for Kmax ($r = 0.71$) and thinnest pachymetry ($r = -0.66$), while all eight assessed topographic parameters were statistically significant at $p < 0.001$. These findings provide regional evidence from a tertiary-care setting in Telangana and support integrated interpretation of BCVA with keratometric, elevation, and pachymetric measurements during grading, counselling, and follow-up.

Generalizability

Because this was a single-centre tertiary-care study from Telangana, findings are most generalizable to similar hospital-based keratoconus populations. Wider applicability to community settings and other regions requires multicentre studies with larger samples, longitudinal follow-up, and diverse demographic representation across India.

Conclusion

In patients with keratoconus, poorer BCVA was significantly associated with greater corneal steepening and reduced corneal thickness. Kmax had the strongest positive correlation with BCVA logMAR ($r = 0.71$, $p < 0.001$), while thinnest pachymetry had the strongest negative correlation ($r = -0.66$, $p < 0.001$). These two parameters, interpreted alongside other topographic findings, provide useful structural information for clinical severity assessment and follow-up.

Limitations

This study was conducted at a single tertiary-care institution with a sample size of 100 patients, which limits broader population-level inference. The cross-sectional design prevents assessment of progression over time. Contact lens-corrected visual acuity, epithelial thickness mapping, corneal biomechanics, and higher-order aberration analysis were not included. Device-specific variability also affects direct comparison with studies using other topographic or tomographic systems.

Recommendations

Patients with suspected keratoconus should undergo early visual acuity assessment with detailed corneal topography or tomography to identify corneal steepening, thinning, and elevation abnormalities. Kmax and thinnest pachymetry should be monitored regularly because these parameters showed strong association with visual impairment. Patients with progressive steepening, pachymetric thinning, or declining best-corrected visual acuity require closer follow-up and timely referral for corneal collagen cross-linking. Visual rehabilitation should be individualized using spectacles, rigid gas-permeable lenses, scleral lenses, or surgical options according to disease severity. Tertiary centres should maintain standardized topographic documentation to support grading, counselling, treatment planning, and follow-up comparison.

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Abbreviations

BCVA - Best-corrected visual acuity;
CCT - Central corneal thickness;
D - Dioptre;
K1 - Flat keratometry;
K2 - Steep keratometry;
Kmax - Maximum keratometry;
logMAR - Logarithm of the minimum angle of resolution;
RIMS - Rajiv Gandhi Institute of Medical Sciences;
SD - Standard deviation.

Source of Funding

The study had no funding.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Soumya Jawaji contributed to the concept and design of the study, clinical evaluation, corneal topographic assessment, interpretation of results, review of literature, and preparation of the first draft of the manuscript. Prashanthi P. contributed to study design, data collection, visual acuity assessment, topographic interpretation, statistical interpretation, manuscript drafting, and critical revision of the manuscript. Anisha Kumari Garipelli contributed to clinical assessment, data verification, results analysis, literature review, manuscript revision, and final approval of the manuscript.

Data Availability

Data are available from the corresponding author upon reasonable request.

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References

1. Rabinowitz YS. Keratoconus. *Surv Ophthalmol*. 1998 Jan-Feb;42(4):297-319. doi:10.1016/S0039-6257(97)00119-7. PMID: 9493273. [https://doi.org/10.1016/S0039-6257\(97\)00119-7](https://doi.org/10.1016/S0039-6257(97)00119-7)
2. Romero-Jiménez M, Santodomingo-Rubido J, Wolffsohn JS. Keratoconus: a review. *Cont Lens Anterior Eye*. 2010 Aug;33(4):157-166; quiz 205. doi:10.1016/j.clae.2010.04.006. PMID: 20537579. <https://doi.org/10.1016/j.clae.2010.04.006>
3. Gomes JAP, Tan D, Rapuano CJ, Belin MW, Ambrósio R Jr, Guell JL, et al. Global consensus on keratoconus and ectatic diseases. *Cornea*. 2015 Apr;34(4):359-369. doi:10.1097/ICO.0000000000000408. PMID: 25738235. <https://doi.org/10.1097/ICO.0000000000000408>
4. Mas Tur V, MacGregor C, Jayaswal R, O'Brart D, Maycock N. A review of keratoconus: diagnosis,

pathophysiology, and genetics. *Surv Ophthalmol.* 2017 Nov-Dec;62(6):770-783.

doi:10.1016/j.survophthal.2017.06.009. PMID: 28688894.

<https://doi.org/10.1016/j.survophthal.2017.06.009>

5. Hashemi H, Heydarian S, Hooshmand E, Saatchi M, Yekta A, Aghamirsalim M, et al. The prevalence and risk factors for keratoconus: a systematic review and meta-analysis. *Cornea.* 2020 Feb;39(2):263-270. doi:10.1097/ICO.0000000000002150. PMID: 31498247.

<https://doi.org/10.1097/ICO.0000000000002150>

6. Godefrooij DA, de Wit GA, Uiterwaal CS, Imhof SM, Wisse RPL. Age-specific incidence and prevalence of keratoconus: a nationwide registration study. *Am J Ophthalmol.* 2017 Mar;175:169-172. doi:10.1016/j.ajo.2016.12.015. PMID: 28039037.

<https://doi.org/10.1016/j.ajo.2016.12.015>

7. Belin MW, Duncan JK. Keratoconus: The ABCD Grading System. *Klin Monbl Augenheilkd.* 2016 Jun;233(6):701-707. doi:10.1055/s-0042-100626. PMID: 26789119.

<https://doi.org/10.1055/s-0042-100626>

8. Zadnik K, Barr JT, Edrington TB, Everett DF, Jameson M, McMahon TT, et al. Baseline findings in the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study. *Invest Ophthalmol Vis Sci.* 1998 Dec;39(13):2537-2546. PMID: 9856763.

9. Wagner H, Barr JT, Zadnik K; Collaborative Longitudinal Evaluation of Keratoconus Study Group. Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study: methods and findings to date. *Cont Lens Anterior Eye.* 2007 Sep;30(4):223-232.

doi:10.1016/j.clae.2007.03.001. PMID: 17481941.

<https://doi.org/10.1016/j.clae.2007.03.001>

10. Davis LJ, Schechtman KB, Wilson BS, Rosenstiel CE, Riley CH, Libassi DP, et al. Longitudinal changes in visual acuity in keratoconus. *Invest Ophthalmol Vis Sci.* 2006 Feb;47(2):489-500. doi:10.1167/iovs.05-0817. PMID: 16431941.

<https://doi.org/10.1167/iovs.05-0381>

11. McMahon TT, Edrington TB, Szcotka-Flynn L, Olafsson HE, Davis LJ, Schechtman KB. Longitudinal changes in corneal curvature in keratoconus. *Cornea.* 2006 Apr;25(3):296-305. PMID: 16633030.

<https://doi.org/10.1097/01.ico.0000178728.57435.df>

12. Bayraktar Bilen N, Hepsen IF, Arce CG. Correlation between visual function and refractive, topographic, pachymetric and aberrometric data in eyes with keratoconus. *Int J Ophthalmol.* 2016 Aug 18;9(8):1127-1133. doi:10.18240/ijo.2016.08.07. PMID: 27588266.

<https://doi.org/10.18240/ijo.2016.08.07>

13. Piñero DP, Alió JL, Alesón A, Vergara ME, Miranda M. Corneal volume, pachymetry, and correlation of anterior and posterior corneal shape in subclinical and different stages of clinical keratoconus. *J Cataract Refract Surg.* 2010 May;36(5):814-825. doi:10.1016/j.jcrs.2009.11.012. PMID: 20457375.

<https://doi.org/10.1016/j.jcrs.2009.11.012>

14. Alió JL, Shabayek MH. Corneal higher order aberrations: a method to grade keratoconus. *J Refract Surg.* 2006 Jun;22(6):539-545. doi:10.3928/1081-597X-20060601-05. PMID: 16805116.

<https://doi.org/10.3928/1081-597X-20060601-05>



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