Original Research

CLINICAL CHARACTERISTICS AND VISUAL OUTCOMES OF KERATOCONUS PATIENTS TREATED WITH SPECIALTY CONTACT LENSES IN A TERTIARY EYE CARE CENTRE

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ABSTRACT

Purpose: To assess the clinical and demographic profile of keratoconus(KC) and to evaluate the improvement in visual acuity with specialty contact lenses in patients attending a tertiary eye hospital in south India.

Methods: This prospective clinical study included 204 eyes of 102 patients diagnosed as keratoconus attended at contact lens clinic of Regional Institute of Ophthalmology, Trivandrum. A thorough clinical examination was done including slit lamp examination, retinoscopy and Computerised corneal topography. Contact lens trial was done with specialty contact lenses like Rigid gas permeable lens (RGP), RoseK, mini-scleral and scleral lenses and visual acuity was recorded.

Results: The mean age of presentation was 24. 27 ± 6.6 with a male predominance and bilateral involvement in 94.12%(96) of cases. Allergic conjunctivitis and eye rubbing are the two important predisposing factors recorded in 61.8%(63) and 65.7%(67) of the study population respectively. The most important clinical sign leading to reference to the tertiary centre was presence of refractive error with visual acuity did not improve to 6/6. Rigid Gas permeable (RGP) lenses were the most commonly prescribed type. Only 68.1%(139) eyes achieved visual acuity LogMAR less than 0.50 with spectacles, while 99%(202) achieved this with contact lenses. No significant association was found between severity of keratoconus and age, sex or eye rubbing.

Conclusion: Specialty contact lenses provide a superior visual acuity than spectacles in Keratoconus patients. This study identifies the presence of keratoconus in young adults, the importance of screening for early detection of the disease and the management of ocular surface factors to prevent the progression of ectasia.

Keywords: Keratoconus, Specialty Contact Lenses, Rigid Gas Permeable Lenses, Scleral Lenses, Corneal Topography, Allergic Conjunctivitis, Eye Rubbing.

INTRODUCTION

Keratoconus(KC) is a bilateral non inflammatory ectatic disease of the cornea characterised by progressive thinning and protrusion of the central and paracentral cornea.[1] Visual impairment in keratoconus is due to the irregular astigmatism caused by changes in the curvature of the cornea, which reduces the quality of life in affected individuals. The disease is multifactorial in origin and affects adolescents and young adults.

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 08-05-2026
Date Acceptance: 26-05-2026
Date of Publication: 01-06-2026

https://doi.org/10.65605/a-jmrhs.2026.v04.i02.pp686-692

The prevalence of the disease varies according to the geographical region, with a pooled global prevalence of 289.1 per 100,000 persons, with an annual incidence of 4.0 per 100,000 person-years.[2] A large multi-institutional study from India reported a prevalence of 0.62%, and a population-based study from rural Central India reported a slightly higher prevalence of keratoconus 2.3% (±0.2%), among individuals aged 30 years and above.[3,4]

Keratoconus is also correlated with eye rubbing and ocular surface diseases like allergic conjunctivitis, which may accelerate the progression of the disease and cause contact lens intolerance.[5] The objectives of the treatment are to stabilise the cornea to prevent further progression of protrusion and thinning and to restore visual acuity. The visual rehabilitation can be achieved by spectacles in early cases, but needs contact lenses if the spectacle corrected vision is inadequate due to irregular astigmatism. Specialty contact lenses, such as rigid gas permeable lenses, RoseK lenses, miniscleral

and scleral lenses, improve the quality of vision and decrease higher-order aberrations.[6]

Aim of the Study

Our study aimed to assess the clinical and demographic profile of keratoconus patients presented in the cornea department of a tertiary eye hospital and to assess visual outcome with specialty contact lenses. This study also helps us to assess the severity of the disease at presentation and the possible risk factors and to develop preventive strategies.

MATERIALS & METHODS

This is a prospective clinical study conducted at the Regional Institute of Ophthalmology (RIO), Trivandrum, a tertiary eye care centre in South India. The study was approved by the Institutional Ethics Committee and was conducted in accordance with the principles stated in the Declaration of Helsinki. All successive patients from 09-08-2024 to 13-01-2026 as keratoconus who needed contact lens fitting for visual rehabilitation, and those who fulfilled the inclusion and exclusion criteria were selected for the study. Written informed consent from patients or consent from a legal guardian was obtained for all patients. Patients with ectatic corneal diseases other than keratoconus and pre-existing vision loss were excluded from the study. Detailed history, including demographic factors, history of allergic conjunctivitis, allergic rhinitis and duration of decreased vision were noted. A thorough ocular examination was performed, which included examination of the anterior and posterior segments and retinoscopy. The diagnosis of keratoconus was made by a combination of clinical examination and computerised corneal topography. Patients were evaluated for typical clinical findings on slit lamp examination, like Fleischer's ring, Munson's sign, Rizutti's sign, Stromal thinning and apical scarring.

Corneal topography was evaluated for the presence of an asymmetric bow-tie pattern and satisfaction of quantitative keratoconus indices. The topographic values like Steepk, FlatK, MeanK and thinnest pachymetry were noted. The severity of the disease was determined using the Amsler-Krumeich classification system. The disease was considered as unilateral when KC was confirmed clinically or topographically in one eye, and the other eye had 6/6 vision and no evidence of ectasia, even in Topography.

Visual Acuity was assessed by Snellen's chart for each eye separately and recorded in LogMAR at three occasions: baseline uncorrected, visual acuity with spectacle correction, and with a well fitted contact lense. Some patients with mild keratoconus were treated with spectacles only. The trial fitting of contact lenses was done based on the keratometry reading and Topography. Schirmer's test to assess dry eye was done for all patients before the contact lens trial. If the patients had associated allergic conjunctivitis or decreased Schirmer's value, treatments were given for the same, and after controlling these ocular conditions taken up for a contact lens trial. The type of contact lens used in each case, rigid gas-permeable, Rose-K, scleral or Mini scleral were also recorded. After one month of use, the visual acuity with the contact lens was reassessed and taken as final visual acuity with lens.

Statistical Analysis

Data analysis was performed using SPSS version 27.0. Quantitative variables were expressed as mean ± SD and categorical variables as frequencies. The Chi-square ($\chi 2$) test was used to assess the associations between grade of keratoconus and various other factors. Statistical significance was set as $p<0.05$.

RESULTS

This study included 204 eyes of 102 patients. Among 204 eyes, 198 eyes had keratoconus or subclinical keratoconus, and the rest of the 6 eyes had no signs of keratoconus clinically or topographically. Only well fitted contact lenses after one month of use, either regularly or occasionally, were taken for analysis. The background characteristics of the patients are given in the Table:1. The lowest age is 8 years, and the highest age is 45 at the time of presentation. More than three-quarters of the entire population is below 30 years old. The mean age was 24. 27 ± 6.6 and a slightly male predominance, 68.63% (70) of them were males and 94.12%(96) cases were bilateral. Only 5.88%(6) patients had unilateral keratoconus.

Regarding the occupational data, 51% (52) were students who are visually impaired by keratoconus during a period which demands high-quality vision for studies and classroom participation. Those who are not working also include who temporarily quit the job for treatment. Assessing the reason for patients referred to tertiary centre suspecting keratoconus helps to take necessary steps for early referral and detection of the disease.

Characteristics		Count(n)	Percentage(%)
Age in years	<10	1	0.98
	10 - 19	27	26.47
	20 - 29	51	50
	30-39	21	20.59
	>40	2	1.96
	Mean ± SD	24.3 ± 6.6	
Sex distribution	Male	70	68.6
	Female	32	31.4
Occupational status	Student	52	51.0
	Working	39	38.2

	Not working	11	10.8
Primary Reason for reference	Refractive error in which Visual acuity is not improving to 6/6	45	44.1
	Presence of Keratoconus signs (other than scissoring reflex)	39	38.2
	Scissoring reflex detected during retinoscopy	15	14.7
	Routine School screening	3	2.9
Duration between the onset of decreased vision and referral	<6months	45	44.1
	6months to 1 year	12	11.8
	>1year - <3years	16	15.7
	3 - 5 years	9	8.8
	>5years	20	19.6

Table: 1 Percentage distribution of the sample according to background characteristics (n=102)

The clinical detection of early cases of keratoconus is difficult because it may mimic myopia and astigmatism in the initial stages. According to our study, the spectacle corrected visual acuity not improving up to 6/6, the presence of scissoring reflex during retinoscopy and Rizutti's sign were the most common signs to guide the treating doctor to suspect keratoconus. Nearly 20%(20) of people experienced decreased vision more than 5 years before coming to our centre. The increased duration between the onset of decreased vision and the referral to a specialty centre indicates the delay in diagnosis of keratoconus. This delay can decrease the treatment options drastically, because the only available treatment option to prevent the progression of the disease is corneal collagen cross-linking, which needs a minimum corneal thickness of 400 microns.

Selected Ocular Surface and Systemic Variables	Count(n=102)	Percentage (%)
History of recurrent allergic rhinitis	51	50.0
History of eye rubbing	67	65.7
Atopic conjunctivitis	4	3.9
Limbal stem cell deficiency	2	1.96
Allergic conjunctivitis	63	61.8
Decreased Schirmer values	31	30.4

Table:2 Ocular Surface and Behavioural factors in Keratoconus patients

The associated ocular surface changes were investigated based on history and clinical examination. Allergic conjunctivitis 61.8% (63) and eye rubbing 65.7% (67) were the two important behavioural and ocular surface changes obtained as in the Table 2. Presence of allergic rhinitis is also very important as it can trigger the recurrences of allergic conjunctivitis and thereby rubbing and progression of the disease. The reasons for eye rubbing were assessed, 45.1% (46) were due to itching, 13.7% (14) were due to temporary improvement in vision caused by alteration of the cone while rubbing, 6.9% (7) were due to discomfort, and 34.3% (35) had no history of eye rubbing.

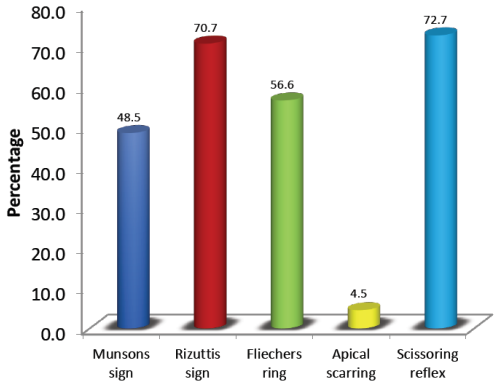

Figure 1: The bar chart showing the percentage distribution of clinical signs in slit lamp examination and retinoscopy, calculated based on eyes with keratoconus(n=198)

Among the clinical signs assessed, the most common was scissoring reflex 72.7%(144) during retinoscopy. Other clinical signs as shown in Figure:1. The severity of keratoconus was assessed by Amsler- Krumeich

classification based on keratometry, astigmatism, transparency, and corneal thickness(Table 3). Most of the patients, 66.1% (131), had grade 1 or 2 keratoconus suggestive of early detection in majority of the cases and corneal collagen cross-linking (CXL) is possible in these eyes to prevent progression. The distribution of keratometry and pachymetry readings are shown in the Table 4 and 5.

Amsler-Krumeich Grading	Count (n=198)	Percentage (%)
Grade 1	63	31.8
Grade 2	68	34.3
Grade 3	19	9.6
Grade 4	48	24.2
Total number of keratoconus eyes	198	

Table 3: Distribution of the keratoconus according to Amsler- Krumeich grading

	Mean ± SD	Median (IQR)	Minimum	Maximum
Steep K	52 ± 6.9	50 (47.48 - 55.65)	41.5	78.5
Flat K	48.1 ± 5.6	46.68 (44.32 - 49.79)	41.0	76.5
K Average	50 ± 6.1	48.34 (46.15 - 52.45)	42.1	77.5

Table 4: Distribution of keratometry in dioptre values based on Topography

Mean Pachymetry ± SD	423.2 ± 63.4
Median (IQR) pachymetry	433 (393 - 464.5)
Minimum	220.0
Maximum	564.0

Table 5: Pachymetry pattern in keratoconus patients in micrometre

Among 172 eyes treated with contact lenses(Figure:2), the most common was rigid gas permeable lense in 55.4%(113). This study compared visual Acuity in LogMAR across uncorrected, spectacle corrected and contact lens-corrected conditions. Visual acuity is classified according to the WHO classification of blindness. Only 68.1%(139) reached a vision in the category <0.5 LogMAR with spectacles, while 99%(202) improved the same category with contact lenses. Even though there is a drastic improvement in vision with contact lens the long term adherence and tolerance to the contact lens, especially in the presence of ocular surface conditions like allergic conjunctivitis, is a limitation.

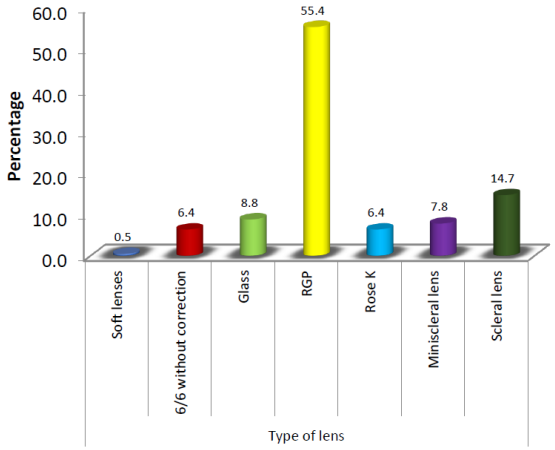

Figure 2: Distribution of the patients according to the type of visual rehabilitation given (n=204)

Visual acuity based on the WHO classification for blindness in LogMAR	Uncorrected vision	Vision with spectacles	Vision with contact lens
0.00 - 0.50	50(24.5%)	139(68.1%)	202(99.0%)
0.52 - 1.0	75(36.8%)	41(20.1%)	2(1%)
1.02 - 1.3	39(19.1%)	9(4.4%)	0
>1.3	40(19.6%)	15(7.4%)	0

Table 6: Percentage distribution of visual rehabilitation uncorrected, spectacle corrected and with contact lens (n=204)

The association between keratoconus grading and other factors were assessed by the Chi- Square test. No association between the severity of keratoconus and age, gender, presence of allergic conjunctivitis or eye rubbing was made out(Table:7).

		Grade 1	Grade 2	Grade 3	Grade 4	χ2	p
Age	<30	15 (28.3)	16 (30.2)	5 (9.4)	17 (32.1)	5.2	0.519
	30 - 40	39 (36.8)	36 (34)	9 (8.5)	22 (20.8)		
	>40	9 (23.1)	16 (41)	5 (12.8)	9 (23.1)		
Sex	Male	41 (29.9)	48 (35)	13 (9.5)	35 (25.5)	0.88	0.830
	Female	22 (36.1)	20 (32.8)	6 (9.8)	13 (21.3)		
Allergic conjunctivitis	Present	38 (30.4)	46 (36.8)	12 (9.6)	29 (23.2)	0.96	0.810
	Absent	25 (34.2)	22 (30.1)	7 (9.6)	19 (26)		
History of eye rubbing	Yes	39 (29.8)	49 (37.4)	15 (11.5)	28 (21.4)	4.27	0.234
	No	24 (35.8)	19 (28.4)	4 (6)	20 (29.9)		

Table 7: Association of Keratoconus severity grading based on Amsler- Krumeich classification with age, sex, presence of allergic conjunctivitis and eye rubbing

DISCUSSION

This study reinforces the understanding that the Keratoconus predominantly affect young adults in their most productive years and highlights the importance of early detection and treatment to decrease the visual morbidity. The mean age is 24.3±6.6, most of them were students and a male preponderance[7]. The majority have bilateral disease similar to previous reports[8,9,10]. The impact of the disease process and the loss of working days for treatment can affect their academic performance and future.

The low percentage of reference from school screening 2.9% (3) programs suggests a decreased detection rate or that the disease manifests after the age of school screening. Keratoconus can develop even after 15 years, and it is necessary to conduct screening programmes at colleges or increase the awareness among the public about keratoconus.

Another important point during screening is to detect the children with allergic rhinitis or allergic conjunctivitis and treat accordingly to prevent eye rubbing and subsequent development of keratoconus in those who have genetic predisposition.

Age of onset may be earlier than age of presentation because during the initial years, patients must be diagnosed as having refractive error and given spectacles for correction. Around 60% (57) of the patients had history of decreased vision less than one year before referral.

The spectacle corrected visual acuity, which is not improving up to 6/6 44.1% (45), and the presence of keratoconus signs 38.2% (39) were the important factors which guide the treating doctor to suspect keratoconus. Optometrists have an important role in detecting the disease by noting the scissoring reflex during retinoscopy.

Allergic conjunctivitis 61.8% (63) and eye rubbing 65.7% (67) were the most important risk factors, which are already known[11,12] and require frequent evaluation of vision in the presence of these conditions. Studies failed to find a significant association between the eye rubbing and the severity of KC at the time of clinical presentation similar to our result.[13]

In our study, many of them had allergic rhinitis, showed a resolution of allergic conjunctivitis only after treating the rhinitis. Controlling allergic conjunctivitis is very important for long-term contact lens tolerance also. The episodes of rhinitis precipitate the allergic conjunctivitis and Eye rubbing, which again cause progression of the disease. All these should be controlled before going for contact lens trial, corneal collagen crosslinking and other surgical modalities in keratoconus patients.

The increased duration between the onset of decreased vision and the referral to a specialty centre indicates the delay in diagnosis of keratoconus. In our study 19.6% (20) had more than 5 years history of decreased vision. Most of our patients 66.1% (131), had grade 1 or 2 keratoconus according to the Amsler–Krumeich grading system with adequate thickness for cross-linking and decrease the need for surgical interventions like keratoplasty [14]. But 24.2% (48) were in grade 4, indicate the need for development of early detection and referral strategies.

The maximum recorded Steep K of 78.5 D represents an extreme form of ectasia that is often difficult to fit with any contact lens other than scleral lenses.[15] Even though the lenses were well fitted, the long term tolerance may not be possible in advanced ectasia.

Spectacle correction in a keratoconus patient may not be adequate due to irregular astigmatism. But the quality of vision drastically improves with specialty contact lenses, even in advanced cases.[15] The scleral lens provides good visual acuity and wearing comfort in an irregular and steep cornea without altering corneal physiology. RGP remains the gold standard for mild to moderate cases, if not fitting well, in our study the other options were RoseK, mini scleral and scleral lenses. These lenses provide good vision and increase the quality of life in these young individuals and decrease the need for keratoplasty. Scleral contact lenses provide a good visual acuity in very advanced cases, even with apical scarring and can be given if it is well fitted and has tolerance. In a scleral lens, a fluid reservoir between the cornea and the lens fills the irregularities of the

cornea and provide a better vision and comfort even in advanced cases. In our study 99% of eyes visual acuity improved to 6/18 or better with specialised lenses which is comparable with other studies.[15]

The absence of a statistically significant association between disease severity and demographic variables, ocular surface factors or eye rubbing may indicate that progression of the disease is not influenced by these factors. Hence, further studies are needed to assess the genomic and biomechanical influences. Das et al. found that while the second and third decades of life are the most common times for presentation, disease severity was distributed across age groups without a strict linear correlation to age.[16] Khor et al. from an Asian population study observed that while there is often a male predominance, the actual severity of the cone did not differ significantly between genders.[17] The eye rubbing might trigger the disease, but the eventual grade or severity may be determined more by the patient's underlying corneal biomechanics or genetics.

The disparity between uncorrected vision, spectacle corrected vision and contact lens corrected vision indicate the importance of specialty contact lenses in managing keratoconus. Our results are comparable with previous studies[18] which demonstrated that spectacles provide functional vision in keratoconus, often fail to address the higher order aberrations that can be reduced by contact lenses.[19,20]

CONCLUSION

This study highlights the role of specialty contact lenses in the visual rehabilitation of keratoconus patients in tertiary eye care setting. Our study also confirms that keratoconus predominantly affects young adults and students during their most productive academic and professional years. The high frequency of allergic conjunctivitis and eye rubbing confirms that, these are modifiable risk factors. Adequate control of these factors are also important for long term success of keratoconus treatment. But the ultimate phenotypic severity is likely to be controlled by intrinsic corneal biomechanics and genetic predisposition. The observed delay in diagnosis represents a significant clinical challenge. Such delays limit the treatment options like corneal collagen cross linking which requires a minimum pachymetry threshold. There is an urgent need for enhanced treatment protocols. Integration of retinoscopy and corneal topography in school and primary health care screening is another option to bridge the gap between primary screening and reference to a tertiary centre. Further studies are needed to assess the long term tolerance of contact lenses, to find out underlying genomic markers that influence the progression and to redefine personalised treatment strategies.

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How to cite this article: Dr. Bini S.T., Dr. Arya A.R., Dr. Mini Mathew, CLINICAL CHARACTERISTICS AND VISUAL OUTCOMES OF KERATOCONUS PATIENTS TREATED WITH SPECIALTY CONTACT LENSES IN A TERTIARY EYE CARE CENTRE, Asian J. Med. Res. Health Sci., 2026; 4 (2):686-692.
Source of Support: Nil, Conflicts of Interest: None declared.