Rose K Lenses for Keratoconus—An Indian Experience

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Aim: To describe initial lens selection and our experience of Rose K lens fitting in keratoconus in Indian eyes.

Methods: Retrospective study of patients who underwent the Rose K contact lens (CL) trial during a 6-month period from July 2007 to December 2007 in a tertiary eye care centre in South India. We obtained data on patient demographics, prefitting refraction and best spectacle-corrected visual acuity, corneal topography data whenever available, number of trials performed, CL parameters, and vision with final CL. The base curve (BC) of the CL and the topographic indices were analyzed to find the correlation. If the coefficient of correlation was significant, the relationship was further examined using multiple regression analysis. A "*P*" value of <0.05 was considered statistically significant.

Results: One hundred twenty-eight eyes of 80 patients who underwent the Rose K trial were included in the study. The group included 50 male patients and the mean age was 21.92 ± 7.14 years. The mean spherical refractive power was −6.11 ± 5.76 diopter (range: 0 to −20.00 diopter) and mean cylinder was −4.29 ± 3.46 diopter (range: 0 to −22). The mean number of CL trial performed was 1.73 ± 0.9 (range: 1–5). All patients were fitted with the standard Rose K lens with diameter 8.7 mm. The mean BC of the lens was 6.3 ± 6.02 mm, and the mean power was −11.4 ± 5.78. The 5-mm average K was the best predictor of the BC of the Rose K lens in all grades of keratoconus.

Conclusions: Selecting the BC of the initial trial lens based on the 5-mm average K on the axial map can reduce the complexity and chair time in fitting Rose K lenses in keratoconic eyes.

Key Words: Keratoconus—Corneal topography—Rose K lens fitting.

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Keratoconus is a noninflammatory progressive condition of the cornea characterized by corneal ectasia and thinning, which results in irregular astigmatism and decrease in vision.[1] The irregular astigmatism that results from altered corneal shape in keratoconus often necessitate the use of rigid gas-permeable (RGP) lenses for visual rehabilitation in these patients.[2–4] Fitting RGP lenses in keratoconus is challenging[5–7] and becomes more challenging and less successful especially as the severity of the cone increases, which necessitates special designs and more chair time.[8] The incidence and severity of keratoconus were found to be more in Asians compared with whites.[9,10] There are three different contact lens (CL)-fitting techniques in keratoconus: apical clearance, apical bearing, and three-point touch, the latter being the most widely accepted.[5]

Different CL designs are available based on one of these fitting techniques, and of these, Rose K lens is a proprietary lens design introduced by Paul Rose from New Zealand.[11,12] The Rose K lens design has up to six different curves across the back surface and a decreasing optic zone as the base curve (BC) steepens, so as to align the back surface of the lens as accurately as possible with the shape of the keratoconic cornea. It has been reported that Rose K lenses improve the quality of vision and CL-wear comfort in patients with keratoconus.[13] The success rate of Rose K lens fitting in patients with keratoconus was shown to be greater than 90%, and this can delay the need for penetrating keratoplasty.[13]

The use of corneal topography in RGP lens fitting in keratoconus has been reported earlier.[14,15] Compared with instantaneous map, simulated Keratometry value on axial map was found to better predict the BC of RGP lenses.[16,17] There is no standard protocol to select the BC of the Rose K lens based on the axial map data in different grades of keratoconus. Our aim is to describe our experience with Rose K lens fitting in keratoconus in Indian eyes and to propose guidelines for the selection of the initial trial lens BC.

MATERIALS AND METHODS

A retrospective review was performed on the medical records of patients with keratoconus who underwent Rose K lens trial between July 2007 and December 2007 at the Bausch & Lomb Contact Lens Center, LV Prasad Eye Institute, Hyderabad. Those patients who were successfully fitted and dispensed with Rose K lens were included in the study. A diagnostic CL-fitting method was used to finalize the CL parameters. The fitting procedure was determined by the Rose K fitting guide. The BC of the initial trial lens was selected as 0.2 mm steeper than the average simulated keratometry (Sim K) value. After giving an adaptation period of 30 min, the dynamic and static fit was assessed. In dynamic fit assessment, the lens fit was considered to be acceptable when the lens was centered adequately on the cornea with good postblink movement, with good stability on different gaze movements, and provide comfortable wearing period. In static fit, the goal was to achieve a "light feather touch" in the centre with midperipheral bearing and peripheral clearance. The trial was repeated until we achieved an acceptable dynamic and static fit. After finding the optimal lens fit, the final power was calculated after performing a spherical over refraction over the trial lens.

The data collected include patient demographic, unaided and best spectacle-corrected LogMAR visual acuity, subjective refraction in spherocylindrical form, corneal topography data (Orbscan 11z), the number of trials performed to finalize the CL parameters,

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TABLE 1. *Data of Eyes With and Without Corneal Topography*

	Eyes with topography data (N = 94)	Eyes without topography data (N = 34)	P
Age (yr)	21.51 ± 6.67	23.34 ± 8.5	0.224[a]
Gender (male, female)	39, 19	16, 12	0.195[b]
Rose K BC (D)	52.38 ± 5.086	57.9 ± 5.43	0.000[a]
CL power (D)	−10.16 ± 5.36	−15.61 ± 5.22	0.000[a]
Refraction spherical (D)	−5.53 ± 5.33	−9.50 ± 7.10	0.016[a]
Refraction cylindrical (D)	−4.30 ± 2.67	−4.21 ± 6.55	0.961[a]
No. trials	1.58 ± 0.784	2.24 ± 1.09	0.000[a]
BCVA	0.12 ± 0.12	0.15 ± 0.12	0.219[a]

[a]Independent *t* test.

[b]Fisher exact test.

BCVA indicates best spectacle-corrected LogMAR visual acuity.

the final Rose K lens specifications, and the CL-corrected visual acuity with the Rose K lens that was dispensed to the patient.

The data were entered in SPSS 16 GP for statistical analysis. Descriptive statistics was performed to report the demographic data, refraction, topography, and CL parameters. The keratoconus was subgrouped based on the keratometry value as mild (average Sim K: <45 diopter [D]), moderate (average Sim K: 45–52 D), advanced (average Sim K: 52–62 D), and severe (average Sim K: >62 D) based on the keratometry value. The D value of K readings was converted to radius of curvature in millimeter using the keratometric assumption that the index of refraction of the cornea is 1.3375. The BC of the CL and the various topographic indices, such as Sim K steep, Sim K flat, average Sim K, 3-mm K, and 5-mm K, were analyzed to find the relation. If the coefficient of correlation was significant, such variables were further studied in multivariate regression analysis to find out the best predictor of the BC.

RESULTS

One hundred twenty-eight eyes of 80 patients were included in this retrospective study. The mean age of the patients was 21.92 ± 7.15 (range: 12–45) years, and 50 were male patients. The refraction showed a mean sphere of −6.11 ± 5.76 D (range: 0 to −20.00 D) and cylinder of −4.29 ± 3.46 D (range: 0 to −22.00 D). The mean number of trials performed in each eye was 1.73 ± 0.9 (range: 1–5). The mean BC of the final Rose K lens was 53.63 ± 5.64 D (range: 44.37–66.17 D), and power was −11.40 ± 5.78 D (range: −2.50 to −23.50 D). The vision was improved from 0.62 (prefitting best spectacle-corrected LogMAR visual acuity) to 0.12 with the final Rose K lens in LogMAR visual acuity (paired *t* test, $P = 0.0001$).

Topographic data were available in 94 of 128 eyes. The corneal topography missing group showed more severe keratoconus and required more trials and steeper BC lenses (Table 1). Those eyes, with topography data, were classified as mild (N = 8), moderate (N = 35), advanced (N = 40), and severe (N = 11) grades of keratoconus based on the average keratometry value (Table 2).

In all grades of keratoconus, 5-mm average keratometry value (5-mm K) was found to have a strong correlation (Pearson correlation coefficient, $r = >0.7$) with the BC of final Rose K lens (Table 3). By using multiple regression analysis, a significant model emerged, and the significant variables are listed in Table 4.

DISCUSSION

Although the best available management option for the visual rehabilitation in keratoconus is RGP CL, the fitting of RGP lenses in these eyes with altered corneal topography is challenging and require more chair time,[18] often necessitating a considered choice among different CL designs.[6,19–22]

Rose K lenses were initially claimed to have 80% to 90% first-fit success rate initially,[11] but further clinical studies showed that on average, three diagnostic lenses were required per eye to get the optimal Rose K fit in keratoconic eyes. The success rate of Rose K lens fitting in keratoconus was reported to be more than 90%.[13,16] In our series, we could fit Rose K lenses in all grades of keratoconus, and there was no significant difference in the number of trials performed in different grades ($P = 0.569$). The average number of trials taken to finalize Rose K lens parameters was 1.73 ± 0.9 (range: 1–5), and in 95% of cases, the final fit was achieved within first three trials, which was similar to the previously reported data.[13]

Corneal topography is a helpful tool for the selection of the BC of RGP lens, which will reduce the chair time in CL fitting in keratoconus.[14] Our study also reports that the number of trials required to finalize the fit was less in eyes that have topography data compared with eyes those do not have it (Table 1, $P = 0.000$). There are few anecdotal reports on selection of the BC of the CL based on corneal topography in keratoconus fitting. In one study using EyeSys videokeratoscope, it was found that the BC of the RGP lens was best correlated with central 3-mm flat keratometry

TABLE 2. *The Topographic Data and Contact Lens Parameters of Different Grades of Keratoconus*

	Mild (N = 8)	Moderate (N = 35)	Advanced (N = 40)	Severe (N = 11)
Gender (male, female)	4, 1	17, 9	14, 16	6, 3
Age (yr)	20.75 ± 4.59	21.54 ± 6.22	21.78 ± 5.98	21.64 ± 11.85
Refraction spherical (D)	−1.19 ± 3.78	−4.41 ± 4.26	−6.48 ± 4.63	−9.85 ± 4.47
Refraction cylindrical (D)	−3.34 ± 1.37	−3.85 ± 3.41	−4.52 ± 2.59	−4.5 ± 2.33
Sim K steep (D)	45.61 ± 2.22	52.03 ± 2.89	58.70 ± 2.73	63.08 ± 3.74
Sim K flat (D)	41.38 ± 0.88	45.78 ± 1.99	52.11 ± 2.87	61.36 ± 3.80
3-mm K (D)	43.49 ± 0.99	48.20 ± 2.06	52.52 ± 2.64	59.97 ± 1.84
5-mm K (D)	42.69 ± 0.79	45.81 ± 1.95	47.90 ± 2.40	52.53 ± 2.40
CL BC (D)	45.24 ± 0.86	50.24 ± 3.24	52.99 ± 4.08	58.60 ± 2.95
CL power (D)	−5.00 ± 2.93	−7.90 ± 3.63	−10.48 ± 5.12	−16.34 ± 3.92
No. trials	1.25 ± 0.46	1.54 ± 0.74	1.50 ± 0.68	1.73 ± 1.0

TABLE 3. *Correlation of Corneal Topographic Indices With BC of Rose K Lens*

	Mild		Moderate		Advanced		Severe	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*
Sim K steep (D)	0.426	0.292	0.06	0.732	0.424	0.006	0.180	0.597
Sim K flat (D)	−0.921	0.001	0.312	0.068	0.17	0.293	−0.448	0.167
Average Sim K (D)	0.046	0.914	0.211	0.224	0.396	0.011	−0.29	0.387
0.2 mm steeper than average Sim K (D)	0.046	0.914	0.211	0.224	0.396	0.011	−0.290	0.387
3-mm K (D)	0.346	0.401	0.534	0.001	0.641	0.000	0.502	0.116
5-mm K (D)	0.71	0.049	0.754	0.000	0.752	0.000	0.820	0.002

r indicates Pearson coefficient of correlation.

reading.[14] In another study using Orbscan, the axial map was found to be more useful than the instantaneous map[16] in selecting the BC of Rose K lens. However, there are no reports on how the selection varies in different grades of keratoconus based on the different indices in the axial map.

Our study showed that the flat Sim K ($r = -0.921$) and 5-mm average K ($r = 0.71$) showed a strong correlation with the BC of the Rose K lenses fitted in mild keratoconus eyes, whereas 5-mm average K showed strong correlation in all other grades of keratoconus ($r > 0.7$). Multiple regression analysis showed that the 5-mm average K is the best predictor of the final Rose K BC. Based on the results of our study, we recommend that by selecting the initial trial lens BC based on the 5-mm average K, we can reduce the number of trial lenses and shorten the chair time in fitting Rose K lenses in keratoconic eyes.

CONCLUSIONS

Our study showed that the Rose K lens design is useful in the management of all grades of keratoconus and the 5-mm average K reading on axial map is the best predictor of the final BC of the Rose K lenses. Thus, selection of Rose K lens BC based on 5-mm average K on axial map will reduce the complexity and chair time in fitting CL in keratoconic eyes.

TABLE 4. *Multiple Regression Analysis of Topographic Indices With BC*

Keratoconus grade	Predictor variables	β	*P*
Mild	Sim K flat	−0.754	0.001
	5-mm K	0.358	0.026
Moderate	3-mm K	−0.191	0.330
	5-mm K	0.907	0.000
Advanced	3-mm K	−0.341	0.325
	5-mm K	0.967	0.000
	Sim K steep	0.186	0.274
	Average Sim k	0.013	0.951
	0.2 mm steeper than average Sim K	0.013	0.951
Severe	5-mm K	0.820	0.002

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