

LITERATURE REVIEW

Efficacy and Safety Comparison among Rigid Gas Permeable Contact Lens Correction for Keratoconus

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ABSTRACT

Background: Rigid gas-permeable contact lenses (RGP CL) are commonly used to manage moderate to severe keratoconus. The range of RGP CL type currently available for the successful optical correction of keratoconus has greatly expanded. We compared the efficacy and safety of available RGP CL based on visual acuity (VA), keratometry, comfort score, and adverse event.

Methods: Literature search on RGP CL and keratoconus retrieved 37 citations from 2010-2015. Nine articles were selected as relevant to our purpose.

Results: All studies showed improvement of VA following RGP CL wearing. Greatest improvement was seen in Rose K CL (.5 - .36) in naïve CL patient and Twinbel bevel toric in refitting CL patient (.22). All studies reported lower mean ΔK post fitting RGP CL than pre-fitting. Greatest difference of mean ΔK pre and post-fitting was observed in YK lens (.72). The most comfortable lens was Rose K (91.5%) followed by Soper CL (87.9%) and Twinbel bevel toric (64.4%). Punctuate corneal staining found in a considerable amount with YK lens patient.

Conclusion: Among 5 types of RGP CL available now for keratoconus, Rose K provided greatest BCVA improvement in naïve CL patient whereas Twinbel bevel toric in refitting patient. YK lens gave greater changes in keratometry post-fitting RGP CL. The most comfortable lens for patient is Rose K lens. The most common adverse event of CL wear is punctuate corneal staining in YK lens patient.

Keywords: rigid gas permeable contact lens, keratoconus

Keratoconus is a non-inflammatory corneal disease associated with a cone-shaped protrusion and progressive corneal thinning which leads to protrusion of the thinned cornea, high myopia, and irregular astigmatism, thus affecting visual quality.^{1,2} Keratoconus is a disease which may have a marked impact on the quality of life because it usually affects young adults

in their active years and has a lifetime management.^{3,4}

Management of keratoconus depends on the disease severity. The correction of optical error by a mostly high irregular corneal surface is important, with respect to quality of life and ability to work. This can be achieved by spectacles for early disease with low amounts of irregular astigmatism. For mild, moderate, and advanced keratoconus,

contact lens (CL) can be used and keratoplasty can be performed in patients who can no longer be successfully fitted with CL or in whom corneal scarring precludes good vision. Contact lens is the most common and successful treatment option for early to advanced cases of keratoconus, which provides good visual acuity and keratoconus progression control.^{1,5,6} Rigid gas-permeable contact lens (RGP CL) are most commonly used in the management of moderate to severe keratoconus and preferably RGP trial should be conducted as a first lens whenever possible.^{1,7} The range of RGP CL modalities currently available for the successful optical correction of keratoconus is greatly expanded. Some of the available RGP CLs now are Soper CL, Rose K CL, YK lens, Twinbel bevel toric CL, and pancorneal CL.

Fitting RGP CL in keratoconus patients determined the success of keratoconus management but as the severity of keratoconus increases, the corneal apex become steeper and fitting the CL becomes more challenging. There are three different types of CL fitting philosophies in keratoconus include apical clearance, apical bearing, light feather touch or three point touch.⁷ The three point touch is the most common fitting style in keratoconus.^{8,9}

There is no consensus yet about the type of RGP CL and fitting type that should be chosen for the first choice in treating keratoconus patient. This condition raises a question about which type of RGP CL is better and also which type of fitting is the most effective and efficient in keratoconus patients.

In this review, we compared the efficacy and safety of available RGP CL types based on visual acuity, keratometry, comfort score, and adverse event as an outcome. We also summarized the most effective and efficient way of fitting type in keratoconus patients who received RGP CL.

MATERIAL AND METHOD

Literature search was conducted from MEDLINE database using Pubmed for articles by

entering keywords: RGP CL and keratoconus. Only articles in English were selected. Reference lists from the included studies were also checked for relevant articles.

An initial screening was performed by reviewing abstracts to choose articles that were related to the study purpose from achieved articles based on keyword. The complete studies related to the accepted abstracts were then screened based on the inclusion and exclusion criteria. Inclusion criteria were all studies (interventional or observational) that reported outcomes of visual acuity and or keratometry in keratoconus eyes fitted with RGP CL. Exclusion criteria were studies with secondary keratoconus, studies which did not mention type of RGP CL used, studies which done after patient had another treatment for keratoconus beside spectacle or CL, full text article could not be accessed. Restriction for publication date was the last 6 years (2010-2015).

All studies then were rated according to the level of evidence. Level of evidence was assigned based on the study design and methodological quality. Level I rating was assigned to systematic review of randomized trial. Level II rating was assigned to properly conduct, well designed, randomized controlled trials and observational study with dramatic effect. Level III rating was assigned to well-designed controlled trials without randomization or well-designed cohort or case control analytic studies, preferably more than one center. Level IV rating was assigned to non-analytic studies such as descriptive studies, case reports or case series, and survey series. Level V was assigned to expert opinion.

The extracted information included author, year of publication, level of evidence, number of sample, type of RGP CL used, subject's gender, mean subjects's age distribution, follow-up time. Outcomes of this review are visual acuity, keratometry, comfort score and adverse event. Articles are presented in the table and narrated form.

Naïve contact lens patient is patient without any CL keratoconus treatment history while refitting contact lens patient is patient who have history of CL usage for keratoconus

but change the type of CL due to discomfort or visual disturbances issue. Best spectacle and best contact lens corrected visual acuity was converted to LogMar. Keratometry is defined as K-max and K-min, measured by keratometry manual, automated keratometry or videokeratography and converted to Dioptre. K-minimum represents the minimum radius of the curvature, which is equal to the steepest curvature anywhere on the cornea. K-maximum represents the maximum radius of the curvature, which is equal to the flattest curvature anywhere on the cornea. Fitting style is fitting approaches that based in the relationship between the central corneal curvature and the CL back optic zone radius. It can be classified as apical clearance, apical bearing or three-point touch.

RESULTS

Using the searching strategies mentioned above, we found thirty seven articles related to the search term published between 2010 to 2015. Five articles were not published in English. Twenty three articles were excluded: 21 articles did not meet the inclusion criteria, 2 articles could not be accessed. Nine articles were reviewed in this paper. Only one study was a randomized trial (level of

evidence III) and the others were prospective, case series, and retrospective studies (level of evidence III or IV). The characteristic data of the reviewed articles are presented in Table 1.

Of all the 9 reviewed studies, there were 5 types of RGP CL studied in this literature review. Four studies discussed about Rose K, 1 study about Soper CL, 1 study about Twinbel bevel toric, 2 studies about YK lens, and 2 studies about pancorneal RGP CL. Eight from nine studies compared the visual acuity (VA) pre and post-fitting RGP CL. Five studies provided BSCVA (best spectacle corrected visual acuity) pre-RGP CL fitting because they included with naïve CL where 3 other studies provided BCCLVA (best corrected contact lens visual acuity) because they included patient who needed refitting the CL into the RGP CL. In naïve CL patients, all studies showed improvement of VA following RGP CL wearing with varies follow up mean time. Greater improvement was seen in Rose K CL (.5 - .36), followed by YK lens (.45), and then Soper CL (.34). In refitting CL patients, all studies showed improvement of VA following RGP CL refitting with varies follow up mean time with greater improvement was found in Twinbel bevel toric (.22), Pancorneal CL (.06), and YK lens (.016). Previous prescribed

Table 1. Characteristics data of the reviewed studies

No	Author	Year	Level of Evidence	Subject (eyes)	Type of RGP CL	Gender	Mean Age (years)	Outcomes	Follow Up (months)
1	Raghav G et al ¹²	2015	II	30	Rose K	12 F, 18 M	21.9±5.57	VA, Sim K, comfort score, schirmer, glare, contrast, no trial lens	3
				30	Soper	14 F, 16 M (p=.79)	19.7±4.29 (p=.1)		
2	Preeji M et al ¹⁶	2013	IV	128	Rose K	30 F (37.5%) 50 M (62.5%)	21.92±7.14	VA, topographic, fitting method, no of trial lens	N/A
3	Burcu K et al ¹⁷	2014	IV	74	Rose K	17 F (38.6%) 27 M (61.4%)	24.5 (15-38)	VA, CL wear time, complication	at least 12
4	Fernando J et al ¹⁵	2013	IV	77	Rose K	N/A	35.9±9.4	VA, keratometry, no of wearing hour, biomicroscopic complication	at least 6
5	Ryoji Y et al ¹⁸	2013	IV	9	Twinbel bevel toric	3 F (50%) 3 M (50%)	43.7±13.9	VA, static contrast sensitivity, subjective symptom	13.4-27.9
6	Joon Seo et al ¹⁰	2010	IV	77	YK lens	40 F (51.9%) 37 M (48.1%)	25.4±6.8	VA, topographic indices	22.6±10.8
7	Young S et al ¹⁴	2010	III	129	YK lens	26 F (38%) 42 M (62%)	22.34±9.82	VA, comfort, mean wearing time, ocular tissue changes	17.5±13.8
8	Sizar K et al ¹¹	2011	III	30	Pancorneal CL	9 F (50%) 9 M (50%)	48	VA, corneal topography	2-44
9	Wishal D et al ¹³	2014	IV	31	Pancorneal CL	13 F (42%) 18 M (58%)	26.9±9.4	Corneal topography	6-19

N/A: not available; RGP CL: rigid gas permeable contact lens; F: female; M: male; VA: visual acuity

Table 2. Mean comparison of VA following RGP CL

No	Author	Subject (eyes)	RGP CL	BSCVA Pre-RGP CL (logMar)	Follow Up Time (months)	BCCLVA Post-RGP CL (logMar)	Δ Improvement of Mean BCVA
in naïve patient							
1	Raghav G et al ¹²	30	Rose K	.53±.34	3	.06±.09 (p<.01)	.47
		30	Soper CL	.43±.23		.09±.1 (P<.01)	.34
						(P=.23)	
2	Preeji M et al ¹⁶	128	Rose K	.62	N/A	.12 (p<.01)	.5
3	Burcu K et al ¹⁷	74	Rose K	.50	min 12	.1	.4
4	Fernando J et al ¹⁹	77	Rose K	.40±.26	14.3±3.8	.04±.07	.36
5	Young S et al ²²	129	YK lens	.65±.5	17.5±13.8	.2±.1 (p=0.001)	.45
in refitting patient							
1	Ryoji Y et al ¹⁸	9	Twinbel bevel toric	.23±.51	13.3±1.4	.01±.4 (p=.044)	.22
2	Joon Seo et al ¹⁰	77	YK lens	-0.16±0.065	22.6	-0.032±0.10	.016
3	Sizar K et al ¹¹	30	Pancorneal CL	.22±.8	22	.14±.7 (p=0.007)	.06

N/A: not available; RGP CL: rigid gas permeable contact lens; BSCVA: best spectacle corrected visual acuity; BCCLVA: best corrected contact lens visual acuity

lens in Ryoji Y et al¹⁸ study were spherical RGP, Rose K, and Aphex KC. Study by Joon Seo et al¹⁰ was quite interesting, the BCCLVA pre-fitting was already in the best state but after refitting, the BCCLVA still showed minor improvement. Joon Seo et al²¹ did not mention previous prescribed lens in their study. Previous contact lens in Sizar K et al¹¹ were soft CL, scleral CL, RGP 12 mm and conventional RGP. The reason of refitting in these studies were found to be either discomfort or visual impairment. The naïve CL VA showed greater improvement compared to patient who needed refitting RGP CL. The mean improvement of BSCVA and BCCLVA can be seen in Table 2.

In terms of keratometry as an outcome, only 4 out of 9 studies showed keratometry pre and post-fitting RGP CL and compared it. The keratometry measurement was done

1 hour after RGP CL removal in Joo Seo et al¹⁰ and directly after RGP CL removal in Sizar K et al¹¹. Two studies by Raghav G et al¹² and Wishal D et al¹³ was done in naïve CL patient while 2 studies by Joon Seo et al¹⁰ and Sizar K et al¹¹ done in refitting patient. All studies reported lower mean ΔK post-fitting RGP CL than pre-fitting. From Table 3, we can see that the greater difference of mean ΔK pre and post-fitting RGP CL was observed in YK lens (.72), followed by Rose K (.46), Pancorneal CL (.38, .12), and Soper CL (.22). This can be seen in Table 3.

From 2 studies mentioned about comfort score as their outcome, we can see that the most comfortable lens was Rose K (91.5%) followed by Soper CL (87.9%) and Twinbel bevel toric (64.4%). Study by Joon Seo et al¹⁰ and Young S et al¹⁴ mentioned about proportion of self reported comfortable

Table 3. Keratometry following RGP CL

No	Author	Subject (eyes)	RGP CL	Pre-RGP CL (D)		Mean ΔK Pre-RGP CL	Follow Up Time (months)	Post-RGP CL (D)		Mean ΔK Post-RGP CL	Difference in Mean ΔK Pre & Post-RGP CL
				K-max	K-min			K-max	K-min		
1	Raghav G et al ³⁰	30	Rose K	56.72±4.54	50.77±3.21	5.95	3	56.27±4.29 (p=0.43)	50.78±3.19 (p=0.99)	5.49	.46
		30	Soper	55.5±3.88	50.48±2.71	5.02	3	55.5±3.88 (p=0.99)	50.7±3.45 (p=0.99)	4.8	.22
2	Joon So et al ¹⁰	77	YK lens	54.23±5.37	48.56±3.58	5.67	22.6	53.09±4.96 (p=0.003)	48.14±3.42 (p=0.101)	4.95	.72
3	Sizar K et al ¹¹	30	Pancorneal CL	49.75	48.37	1.38	22	50	49	1	.38
4	Wishal D et al ¹³	31	Pancorneal CL	49±3.5	45.38±3.87	3.62	11	48.62±4	45.12±4.25	3.5	.12

RGP CL: rigid gas permeable contact lens

Table 4. Comfort score following RGP CL usage

No	Authors	RGP CL	Subject (eyes)	Follow Up (months)	Comfort (% from maximal comfortable score)	Mean Duration of Wear (hours/day)
1	Raghav G et al ¹²	Rose K	30	3	30/33 (91.5%)	N/A
		Soper	30	3	29/33 (87.9%)	N/A
					(p<0.001)	
2	Burcu K et al ¹⁷	Rose K	17	at least 12	N/A	9.7±0.88
3	Fernando J et al ¹⁵	Rose K	77	at least 6	N/A	11.1±1.5
4	Ryoji Y et al ¹⁸	Twinbel	9	13.4 – 27.9	16.2/25 (64.4%)	N/A
5	Joon Seo et al ¹⁰	YK lens	77	22.6±10.8	N/A	11.6±3
6	Young S et al ¹⁴	YK lens	129	17.5±13.8	N/A	12.1

N/A: not available; RGP CL: rigid gas permeable contact lens

among their patients who used YK lens. In Joon Seo et al¹⁰ study: 87% comfortable, 9.1% slightly uncomfortable, 3.9% uncomfortable. In Young S et al¹⁴ study: 23.3% very comfortable, 66.7% comfortable, 7.8% mildly irritating, 1.5% irritating, 0.7% very irritating. We can see from both studies mentioned, most of patients (87% and 90%) who used YK lens agreed that this CL was comfortable to use. Four studies mentioned also about the mean duration of wear of CL. The hours/day was higher in YK lens (11.6-12.1) compared to Rose K (9.7-11.1). This can be seen in Table 4.

Adverse event such as punctate corneal staining is happened quite a lot in YK lens patient compared to any other lens and any other complication. Epithelial erosion also happened in 1:3 patient who fitted by Twinbel bevel toric. Other complication that was found in Fernando J et al¹⁵ study was neovascularization, staining, and injection. In YK lens, beside punctate corneal staining, other adverse events reported were corneal scarring and full thickness epithelial defect. Sizar K et al¹¹ in their study also

reported there were 6.7% patient who was intolerant with Pancorneal CL, but they did not explain it further. This can be seen in Table 5.

Four out of 9 studies mentioned that they used three point touch fitting style with special attention to light feather touch in their study. Raghav G et al¹² and Preeji M et al¹⁶ stated that they only need 1-2 fitting trial to fit the Rose K in their study while Soper CL needed 3-4 fitting trial. This can be seen in Table 6.

DISCUSSION

Spectacles are useful in the early stages of keratoconus when the astigmatism is mild. In the earliest stages patients may achieve satisfactory visual acuity using spectacles (visual acuity ≤ 0.3), however, as the corneal surface becomes more distorted, spectacles correction becomes progressively unsuccessful.¹⁹ With moderate-advanced keratoconus, spectacles play a very limited role and CL become necessary for improving the vision and play

Table 5. Adverse event following RGP CL usage

No	Authors	RGP CL	Subject (eyes)	Follow Up (months)	Adverse Event Reported
1	Burcu K et al ¹⁷	Rose K	17	at least 12	None
2	Fernando J et al ¹⁵	Rose K	77	at least 6	Neovascularization gr I: 5.2% Staining gr I: 19.5%; gr II: 5.2% Injection gr I: 6.5%
3	Ryoji Y et al ¹⁸	Twinbel	9	13.4 – 27.9	Epithel erosion: 33.3%
4	Joon Seo et al ¹⁰	YK lens	77	22.6±10.8	Punctuate corneal staining: 41.5% Corneal scarring: 3.9%
5	Young S et al ¹⁴	YK lens	129	17.5±13.8	Punctuate corneal staining: 4.7% Full thickness epithel defet: 1.6%
6	Sizar K et al ¹¹	Pancorneal CL	30	3	Intolerance: 6.7%

RGP CL: rigid gas permeable contact lens

Table 6. Fitting style in RGP CL

No	Authors	Type of RGP CL	Subject (eyes)	Fitting Style	No of Trials (times)
1	Raghav G et al ¹²	Rose K Soper	30 30	N/A	2±0.59 3.43±0.82 (p<0.001)
2	Preeji M et al ¹⁶	Rose K	128	three point touch	1.73±0.9
3	Fernando J et al ¹⁵	Rose K	77	three point touch	N/A
4	Joon Seo et al ¹⁰	YK lens	77	three point touch	N/A
5	Young Seok et al ¹⁴	YK lens	129	three point touch	N/A

N/A: not available; RGP CL: rigid gas permeable contact lens

a major role.⁷ We can see from Table 2 that all BSCVA is >0.3; that means all patients are candidate for RGP CL fitting. From Table 2, all BCCLVA is <0.3, that means patients had minimal VA disturbance using their old lenses, but they were refitted into another type RGP CL because of discomfort issue.

Despite the fact that several types of lenses can be applied in the treatment of keratoconus, RGP CL are generally preferable since irregular astigmatism can be better corrected with these.¹⁷ Rigid gas permeable CL provides better vision by making most of the induced anterior corneal surface aberrations by replacing the irregular keratoconic corneal surface with the smooth, regular refractive surfaces of the RGP CL and liquid tear-lens.^{11,20}

In terms of VA for naïve CL keratoconus patients, Rose K lens gave greatest improvement from mean best spectacle corrected VA to mean best contact lens corrected VA (.5 - .36). Betts et al²¹ also found that Rose K lens had 76% success rate in lens fitting. These lenses have proven to be effective in the correction of corneal aberrations such as vertical coma and secondary astigmatism, achieving a BCCLVA of 20/30 in average and corneal aberrations compatible with a corneal pattern of healthy population and low reduction of contrast sensitivity compared to conventional RGP CL. When Betts et al²¹ compared Rose K lenses with conventional RGP CL in terms of visual quality, life quality, and comfort, they successfully implemented Rose K to

90% of the patients with keratoconus who had applied to their clinic and 72% of them preferred Rose K lenses instead of previous lenses and 87% of the patients, to whom these lenses were implemented, wanted to continue wearing Rose K lenses. Jain and Sukhija²² stated that Rose K was successfully implemented in 97% of their patients and 94.7% of them achieved 6/12 or better VA. It has been reported that Rose K lenses improve the quality of vision and CL-wear comfort in patients with keratoconus. Rose K showed provide a better fit for the cones in moderate-to-severe keratoconus (keratometric value was >52.0 D). This is due to the possibility of applying Rose K to steeper corneas because of the characteristics of its rear surface and its smaller diameter.¹⁶ 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, seen in Figure 1.



Fig 1. Rose K ideal fit and design. OZ: Optical zone.¹⁶

In refitting patient group, Twinbel bevel toric CL patients showed greater improvement (.22) compared to Pancorneal CL and YK lens. This correlates with its multicurve design that incorporates a flat central curve and, at the back side, three intermediate curves with a bevel toric design, seen in Figure 2. This design contributes to the stability of lens centering and improves lens fitting at the periphery of the keratoconic cornea. The keratoconic cornea is ellipse shaped with eccentric decentralization,²³ which results in an increase in the difference in radius of curvature between the vertical and horizontal directions at the peripher. This difference affects the fitting of the bevel area, with a decrease in bevel width being apparent by slit lamp observation

with fluorescein staining. In severe cases of keratoconus, the peripheral cornea in the flatter meridian direction makes marked contact with the edges of the lens, often resulting in the development of corneal epithelial disorders.²³ Such inadequate fitting also reduces tear volume under the lens at the bevel zone and results in a sensation of discomfort. The steep bevel of the Twinbel bevel toric fits the steeper meridian at the peripheral cornea, whereas its flat bevel also fits with the flatter meridian at the peripheral cornea. The rotation of Twinbel bevel toric is often observed during continuous rapid blinking, but the orientation of the lens returns immediately to an adequate position and is stable during normal blinking. In Ryoji et al¹⁸, all keratoconus patients were satisfied with the fit of the Twinbel bevel toric and did not drop out of the study before the final visit.

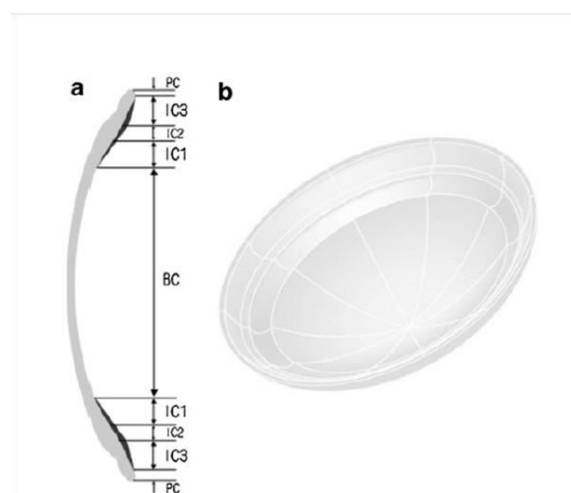


Fig 2. Twinbel bevel toric design. **a)** Bevel design; BC: base curve; IC: intermediated curve; PC: peripheral curve; the gray shape indicates the design of the large (flat) radius of bevel curvature, and the black sharp shape indicates the small (steep) radius of bevel curvature. **b)** Three dimensional diagram.¹⁸

In keratoconus eyes, RGP CL were not only hoped to improve BCCLVA but also to reduce the eccentricity and the steepness of the cornea because of reverse geometry effect. In this literature review, we calculated the mean ΔK pre-RGP CL (dioptre) by diminishing K-max and K-min post-fitting. A greater mean difference meaning that K-max is decreased meanwhile the K-min is

stabilized. From Table 3 & 4, the YK lens gave greater mean difference between ΔK pre and post RGP CL.

YK lens are multicurve RGP lenses. The YK lens has the advantage of readily changeable parameters and its sagittal height is higher so there were minimal contact at the apex, enabling patients with advanced keratoconus to wear the lens more comfortably. These lenses may also reduce the possible contributions to the progression of keratoconus on a short term basis, like our literature review found.²⁴ The optical zone diameter (OZD) in other lenses is typically equal to the base curve radius (BCR) in millimeters. The OZD of the YK lens is also directly proportional, but not equal, to the BCR. The smaller OZD is to minimize mid-peripheral lens impingement as well as pooling or bubbles at the base of the cone, however, it has the possibility to produce visual disturbances such as monocular diplopia, glare, and image distortion.²⁵ Compared to Rose K, the optical zone of the YK lens is larger for the same base curve.¹⁸ The peripheral lens design of the YK lens has various curves blended into a smooth continuum to form a controlled aspheric peripheral lens geometry and to provide the desired peripheral clearance for the flat mid-peripheral and peripheral cornea, seen in Figure 3. The YK lens periphery can be adjusted from the standard clearance of the diagnostic lens to a flatter-than-standard clearance (looser peripheral fit) or a steeper-than-standard (tighter peripheral fit) to accommodate various keratoconus topographies.¹⁴

In terms of comfort in this literature review, we tried to calculate the percentages based on the maximum comfort of different self assessment. This may be not accurate, but we could describe that in this literature review, Rose K users had higher comfort score than other RGP CL. We believe that the increased comfort with Rose K lens is due to the improved multicurve design of Rose K and also due to the ability of the edge design to be further modified. Similar self-reported comfort has also been demonstrated with the use of Rose K CL by

other studies.²¹ The high gas permeability (higher Dk) of the Rose K is also contributed to symptom-free CL wearing period.



Fig 3. YK lens ideal fit²²

Another important factor with regard to CL wear in keratoconus patients is the safety of wearing the lens for extended periods.²⁶ The number of hours each day that a CL is worn tends to be greater for keratoconus patients than for other individuals because of the lack of any other way (spectacles or soft CL) to achieve the quality of vision conferred by an RGP CL in the presence of corneal distortion and irregular astigmatism. Moreover, given that the onset of keratoconus occurs during puberty, lens wearing can be required over most of a lifetime. The safety of CL wear in terms of corneal health is thus an important issue in patients with keratoconus.⁹

In this literature review, punctuate corneal staining and epithelial erosion are the most common reported adverse event related to RGP CL fitting and usage. Close alignment between the inner surface of the CL and the surface of the cornea is believed to be the cause of the corneal epithelial disorders and subjective complaints such as discomfort and pain associated with lens wear in individuals with keratoconus. Direct abrasion caused by movement of the lens in the elevated region of the corneal surface at the apex may thus lead to epithelial disorders such as erosion or superficial punctate keratopathy.²⁷ Epithelial trauma also associated with the type of fitting style used for fitting

the RGP CL. McMonnies²⁷ stated that depending on the degree of contact, apical support fittings, including the three-point touch, are likely to induce epithelial trauma in the cone apex compared with apical clearance fitting. Meanwhile, Barr and Schoessler²⁸ found that 31% of keratoconus eyes fitted with flat CL have corneal scarring, whereas only 9% of eyes fitted with steep CL have scars. These data may suggest that there is an increased risk of scarring with apical touch fitting.

Classically, three RGP CLs fitting approaches have been described in keratoconus patient: apical clearance, apical touch, and three point touch. Each has their advantages and disadvantages.⁸ Differences between fitting approaches are based in the relationship between the central corneal curvature and the CL back optic zone radius (BOZR).⁸ In this literature review, 4 studies used three point touch style. In this divided support fitting style, the lens bearing is shared between the apex and the midperipheral cornea, seen in Figure 4. Three point is minimal apical touch and two areas of peripheral or mid-peripheral contact. This helps in minimizing the risk of apical scarring as well as facilitates the tear exchange resulted in reduced fluid exchange and decreased oxygen tension in the corneal epithelium.¹² In this literature review, we found that 4 out of 9 studies used three-point touch fitting style. This style is the most preferred type of lens fitting. It provides good vision, better comfort and prolonged wearing time. This

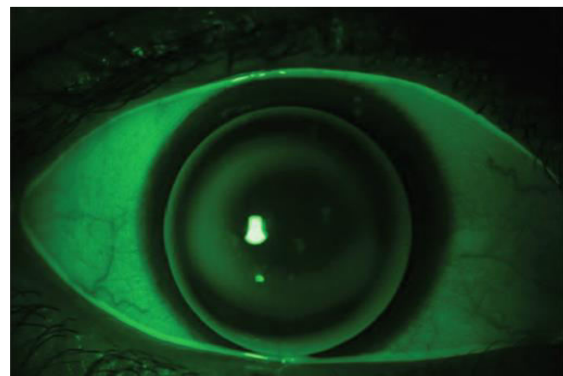


Fig 4. Three point touch style. Diffuse fluorescein in the centre and midperiphery on either side depicting the divided touch.¹²

type of fitting useful for larger cone such as ovale or sagging cone but timing for follow up is critical to monitor the area of central touch.¹²

To our knowledge, there were no other literature reviews that describe and compare the type of RGP CL being used for keratoconus. Limitation of this literature review is the variation of fitting method being used in each study, since the criterion for successful fitting are often subjective and the parameter of fitted cornea is vary greatly. Another limitation is review about comfort score which were obtained by different self-assessment questionnaire. The wide range of follow up between studies is also being a great concern for this literature review.

CONCLUSION

This literature review has compared 5 types of rigid gas permeable contact lens (RGP CL) that are available now for keratoconus treatment. They are Soper CL, Rose K CL, YK lens, Twinbel bevel toric CL, and pancorneal CL. Comparison of their efficacy and safety was concluded as follows: 1) in naïve contact lens patient, Rose K lens gave better best corrected contact lens visual acuity; 2) in refitting contact lens patient, Twinbel bevel toric lens gave better best corrected contact lens visual acuity; 3) YK lens gave greater changes in keratometry post fitting RGP CL; 4) the most comfortable lens for patient is Rose K lens; 5) the most comon adverse event after fitting and CL usage is punctuate corneal staining in YK lens patient; and 6) the most common and acceptable fitting style in keratoconus is three point touch technique.

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