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Comparison of visual results of RGP contact lenses in keratoconus subgroups: Cone type, cone location, severity of the disease

RGP kontakt lenslerin görsel sonuçlarının keratokonus alt gruplarında karşılaştırılması: Kon tipi, kon lokasyonu, hastalığın şiddeti

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Abstract

Aim: It is aimed to evaluate the visual performance of Rose K and Conflex Air rigid gas-permeable (RGP) contact lenses in keratoconus subgroups according to cone types, cone location, and severity of keratoconus.

Materials and Methods: Seventy-five eyes of 75 participants were included in this retrospective study. Each participant received a full ophthalmologic examination involving refraction, uncorrected visual acuity (UCVA), best spectacle corrected visual acuity (BCVA), slit-lamp biomicroscopy-fundoscopy, break-up time (BUT), corneal topography, best contact lens corrected visual acuity (BCLCVA).

Results: The mean age was 25.9±8.3 years (range 18-53). Rose K was fitted for 36 eyes and Conflex Air was fitted for 39 eyes. In Rose K group; the mean logMAR UCVA, BCVA, BCLCVA were 0.90±0.33 (range 0.30-1.30), 0.55±0.28 (range 0.22-1.30), 0.14±0.12 (range 0-0.40). In Conflex Air group; the mean logMAR UCVA, BCVA, BCLCVA were 0.89±0.38 (range 0.30-1.30), 0.47±0.24 (range: 0-1.30), 0.08±0.09 (range 0-0.40). There were significant increases in visual acuities with contact lenses in both groups ($p<0.05$).

Conclusion: Both contact lenses may improve visual acuity in patients with all subtypes of keratoconus. Rose K contact lens may be better in globus type of keratoconus then oval type.

Keywords: Contact lens, rigid gas permeable contact lens, keratoconus.

Öz

Amaç: *Rose K ve Conflex Air sert gaz geçirgen kontakt lenslerinin görsel performansını keratokonus alt gruplarındaki kon tipi, kon lokasyonu, hastalık şiddetinin değerlendirilmesi amaçlandı.*

Gereç ve Yöntem: *Yetmiş beş hastanın 75 gözü geriye dönük çalışmaya dahil edildi. Her hastaya refraksiyon, düzeltilmemiş görme keskinliğ, gözlükle en iyi düzeltilmiş görme keskinliği, yarıklı-lamba biyomikroskopisi-fundoskopisi, göz yaşı kırılma zamanı, korneal topografi, kontakt lens ile en iyi düzeltilmiş görme keskinliğini içeren tam bir oftalmolojik muayene yapıldı.*

Bulgular: *Ortalama yaş 25.9±8.3 (aralık 18-53) idi. Otuz altı göze Rose K, 39 göze Conflex Air uygulandı. Rose K grubunda; ortalama logMAR UCVA, BCVA, BCLCVA 0.90±0.33 (aralık 0.30-1.30), 0.55±0.28 (aralık 0.22-1.30), 0.14±0.12 (aralık 0-0.40) idi. Conflex Air grubunda; ortalama logMAR UCVA, BCVA, BCLCVA 0.89±0.38 (aralık 0.30-1.30), 0.47±0.24 (aralık 0-1.30), 0.08±0.09 (aralık 0-0.40) idi. Tüm hasta gruplarında görme keskinliğinde kontakt lensler ile anlamlı artış tespit edildi ($p<0.05$).*

Sonuç: *Her iki kontakt lens belki de tüm keratokonus altgruplarında görme keskinliğini arttırmaktadır. Rose K lensi belki de globus tipi keratokonusta oval tipe göre daha başarılıdır.*

Anahtar Sözcükler: *Kontakt lens, sert gaz geçirgen kontakt lens, keratokonus.*

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Introduction

In the management of visual symptoms of keratoconus there are several options such as spectacles, contact lenses, and surgical options (1). In early stage of the disease, spectacles are enough for many cases. However, whit the progression of the disease elevated levels of aberrations makes it difficult for subjects to achieve excellent optical and visual performance with traditional spectacles(2).

Contact lenses have some advantages over spectacle corrections (3,4). There are several options such as rigid gas-permeable (RGP) contact lenses (5), hybrid contact lenses (6), piggyback lenses (7) and scleral contact lenses (8). RGP lenses are traditionally first choice because of their success in improving visual acuity (9) RPG lenses improve visual acuity by their refractive power and also by flattening the anterior cornea, increasing the thinnest corneal thickness, and reducing anterior surface high-order aberrations(3,4). Previous studies showed that RGP contact lenses provide a significant improvement in visual acuity compared to spectacles-corrected visual acuity in patients with high corneal astigmatism (10), and keratoconus (11). Previous studies also showed that an appropriate use of RGP contact lenses contributes to good vision-related quality of life for keratoconic patients (9).

Clinical characteristics of Keratoconus are not the same in every patient. Patients may divided according to cone type (oval, nipple, globus), cone location (central, paracentral), and severity of the disease (mild, moderate, advance). Since visual results of RGP contact lenses have not yet been compared in different subtypes of keratoconus, with the present research we aimed to present visual results of two different RGP contact lenses, Rose K (Menicon Co. Ltd., Nagoya, Japan) and Conflex Air 100 UV (Wöhlk Contactlinsen GmbH, Schönkirchen, Germany), and compare the results in subtypes of the disease.

Materials and Methods

In this retrospective study, we reviewed the records of patients with keratoconus who were fitted RGP lenses between June 2014 and December 2015. Written informed consent was obtained from all patients before the contact lenses fit. The study adhered to the tenets of the Declaration of Helsinki and local ethic committee approval was obtained. To be included in the study, each patient was required to have all of the following criteria: age≥18 years, a diagnosis of keratoconus detected by thorough topographic evaluation in conjunction with the clinical examination.

Patients were not included in the study if they had a history of ocular surgery, history of ocular trauma, any ocular disease (e.g., active ocular infection, clinically significant nuclear sclerosis/cataract, retinal diseases) that might affect the results, and break-up time BUT under 10 seconds.

Data collected from the patients' records included; age, gender, refractive errors, BUT, mean-steep-flat keratometric measurements and cone type-location from Sirius (Schwind eye-tech-solutions GmbH & Co. KG, Kleinostheim, Germany) scan, uncorrected visual acuity (UCVA), best spectacle corrected visual acuity (BCVA), best contact lens corrected visual acuity (BCLCVA), base curve (BC), and prescribed contact lens diopter.

All participant underwent a standardized ophthalmologic examination including refraction, visual acuity (Bailey-Lovie chart from 4 meters under photopic (85 cd/m^2) luminance), slit-lamp biomicroscopy-fundoscopy, BUT, and corneal topography via Sirius.

After UCVA and BCVA were measured, contact lens was fitted as provided in its technical fitting guide and manufacturer's specifications were followed. A dedicated set of lenses is needed for this purpose in different base curves and different peripheral radii with power. The lens was allowed to settle for approximately 30 min. and then the movement, rotation, and centration were checked with a slit-lamp. After correct fit and patient comfort were achieved, residual refractive error was measured via retinoscopy. Then over-refraction was performed with correcting spectacle lenses and contact lenses were prescribed. BCLCVA was measured a week later at the first visit of patients.

In this study, according to the topographic map, cone location was classified as central (if the highest power was located in central 2 mm) and paracentral (if the highest power was located out of central 2 mm). Keratoconus classified based on the mean K reading on corneal topography, the patients were classified as mild in cases with K value less than 45 D, moderate in cases with K value between 45 and 52 D, and advance in cases with K value more than 52 D (12). Cone type was classified as oval, nipple or globus according to the topographic map (its size and location). Nipple cone is characterized by its small size (5 mm) and steep curvature. The apical center is often either central or paracentral and commonly displaced inferonasally. Oval cone is larger (5–6 mm), ellipsoid, and commonly displaced inferotemporally. Globus cone is the largest (>6 mm) and may involve over 75% of the cornea (13).

Primary outcome measures included UCVA, BCVA, BCLCVA.

Statistical Analysis

Visual acuity was converted to the logarithm of the minimum angle of resolution (logMAR) for statistical analysis. Categorical variables were presented as numbers and percentages, while numerical variables were expressed as the mean and standard deviation. The Kolmogorov–Smirnov test was applied to assess the normal distribution of data. The outcomes were compared

using appropriate tests (paired-samples *t* test, independent-samples *t* test, and one-way ANOVA). The Statistical Package for the Social Sciences version 23 (SPSS, Chicago, IL, USA) was used for data analysis, for which values of $p < .05$ were considered to be statistically significant.

Results

Demographic Characteristics

The study sample consisted of 75 eyes of 75 participants (30 females and 45 males), all of whom were Caucasian. The mean age was 25.9±8.3 years (range: 18 to 53).

Rose K was fitted for 36 eyes of 36 participants (15 females and 21 males). The mean base curve (BC) was 6.78±0.40 (range: 5.60 to 7.50). The mean spherical power (D) of prescribed contact lens was -5.56±3.57 (range: -18 to 1).

Conflex Air was fitted for 39 eyes of 39 participants (15 females and 24 males). The mean base curve (BC) was 7.38±0.55 (range: 6.00 to 8.60). The mean spherical power (D) of prescribed contact lens was -2.37±2.63 (range: -11 to 4).

Table-1 shows participants' demographic characteristics.

Table-1. Demographic Information of the Population Enrolled in the Study.

Parameter	Rose K	Conflex Air 100 UV
Age		
(mean±sd)	27.4±8.8	24.6±7.8
(min./max.)	18 / 53	18 / 51
Refractive error (D)	n=29	n=33
Spherical		
(mean±sd)	-4.13±3.17	-3.40±4.01
(min./max.)	-11 / 1.50	-11 / 4.50
Cylindrical		
(mean±sd)	-4.17±3.06	-4.13±2.05
(min./max.)	-10 / 3.75	-8.50 / -0.50
Keratometry (D)	n=36	n=39
Flat		
(mean±sd)	47.60±2.68	46.76±3.50
(min./max.)	41.62 / 55.43	42.30 / 59.11
Steep		
(mean±sd)	51.96±4.06	50.33±4.17
(min./max.)	42.79 / 61.11	44.10 / 61.73
SimK		
(mean±sd)	49.68±3.14	48.48±3.71
(min./max.)	43.62 / 58.08	43.47 / 60.39

D: diopter, sd: standard deviation

Visual Acuity

Table-2 and 3 shows the visual acuities. BCLCVA with Rose K and with Conflex Air were better than BCVA in all cone types, cone location subgroups, and severity of keratoconus subgroups (Table-2,3).

In Rose K group; when we divided the patients to subgroups according to cone type; there was a significant difference in BCLCVA between groups (p=.034, one-way ANOVA). Post hoc Tukey test showed that BCLCVA was significantly better in globus type than oval type (p=.026). When we divided the patients to subgroups according to cone location; there was no significant difference in BCLCVA between groups (p=.559). When we divided the patients to subgroups according to severity of keratoconus; there was no significant difference in BCLCVA between groups (p=.904).

Table-2. Visual Acuity Results of Rose K Contact Lens (logMAR, mean±sd, min./max.)

	UCVA	BCVA	BCLCVA	*p* values (BCVA vs BCLCVA)
All eyes that Rose K fitted (n=36)	0.90±0.33 0.30/1.30	0.55±0.28 0.22/1.30	0.14±0.12 0.00/0.40	.000*
Cone Types				
Oval (n=8, 22.2%)	0.89±0.32 0.40/1.30	0.47±0.35 0.22/1.30	0.22±0.15 0.00/0.40	.046*
Nipple (n=20, 55.6%)	0.86±0.35 0.30/1.30	0.64±0.27 0.22/1.30	0.14±0.09 0.00/0.30	.000*
Globus (n=8, 22.2%)	1.05±0.31 0.50/1.30	0.44±0.13 0.30/0.70	0.07±0.10 0.00/0.22	.000*
Cone Location				
Central (n=25, 69.4%)	0.93±0.34 0.30/1.30	0.58±0.27 0.22/1.30	0.14±0.10 0.00/0.30	.000*
Paracentral (n=11, 30.6%)	0.85±0.34 0.40/1.30	0.49±0.30 0.22/1.30	0.16±0.15 0.00/0.40	.003*
Severity of Keratoconus				
Mild (n=2, 5.6%)	0.85±0.64 0.40/1.30	0.76±0.76 0.22/1.30	0.11±0.16 0.00/0.22	.020*
Moderate (n=27, 75%)	0.88±0.33 0.30/1.30	0.50±0.24 0.22/1.30	0.14±0.13 0.00/0.40	.000*
Advanced (n=7, 19.4%)	1.04±0.27 0.70/1.30	0.71±0.23 0.40/1.00	0.15±0.09 0.00/0.22	.001*

*Significant difference (paired-samples *t* test)

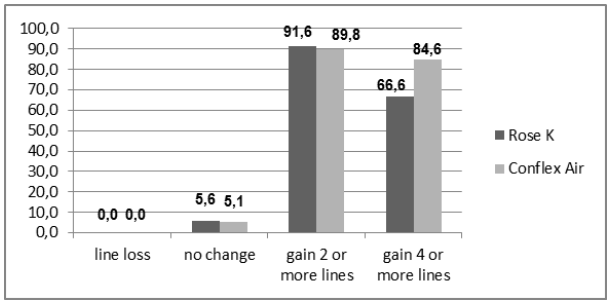

Figure-1. Line gains in Snellen with contact lenses (BCLCVA vs BCVA).

In Conflex Air group; When we divided the patients to subgroups according to cone type; there was no significant difference in BCLCVA between groups (p=.058). When we divided the patients to subgroups according to cone location; there was no significant difference in BCLCVA between groups (p=.294). When

we divided the patients to subgroups according to severity of keratoconus; there was no significant difference in BCLCVA between groups (p=.316).

The mean line gain was 4.22±2.10 (range: 0-9) in Rose K group and it was 4.79±2.16 (range: 0-9) in Conflex Air group (Figure-1).

Table-3. Visual Acuity Results of Conflex Air contact lens (logMAR, mean±sd, min./max.)

	UCVA	BCVA	BCLCVA	*p* values (BCVA vs BCLCVA)
All eyes that Conflex Air fitted (n=39)	0.89±0.38 0.30/1.30	0.47±0.24 0.00/1.30	0.08±0.09 0.00/0.40	.000*
Cone Types				
Oval (n=13, 33.3%)	0.82±0.40 0.30/1.30	0.44±0.13 0.20/0.70	0.05±0.05 0.00/0.10	.000*
Nipple (n=19, 48.7%)	0.87±0.35 0.40/1.30	0.40±0.21 0.00/0.70	0.08±0.10 0.00/0.40	.000*
Globus (n=7, 17.9%)	1.06±0.41 0.40/1.30	0.76±0.30 0.30/1.30	0.15±0.12 0.00/0.30	.007*
Cone Location				
Central (n=30, 76.9%)	0.81±0.36 0.30/1.30	0.53±0.22 0.20/1.30	0.07±0.07 0.00/0.22	.000*
Paracentral (n=9, 23.1%)	1.13±0.34 0.40/1.30	0.30±0.23 0.00/0.70	0.11±0.15 0.00/0.40	.044*
Severity of Keratoconus				
Mild (n=7, 17.9%)	1.17±0.34 0.40/1.30	0.41±0.35 0.00/0.90	0.07±0.08 0.00/0.22	.039*
Moderate (n=25, 64.1%)	0.76±0.34 0.30/1.30	0.43±0.16 0.10/0.70	0.07±0.09 0.00/0.40	.000*
Advanced (n=7, 17.9%)	1.06±0.34 0.50/1.30	0.69±0.30 0.40/1.30	0.13±0.10 0.00/0.30	.005*

*****Significant difference (paired-samples *t* test)

Discussion

Contact lenses have an important role in the management of visual symptoms of patients with keratoconus. The purpose of fitting contact lenses in such patients is to improve visual acuity with comfort (6). It is well known that RPG contact lenses produce good visual acuity results and improve patients' quality of life (9). Nejabat et al. (14) fitted Conflex RGP contact lens to 156 eyes and reported that visual acuity with contact lens was improved 0.3 logMAR over best-spectacle corrected visual acuity. The number of eyes with 20/40 or better corrected vision was 153 eyes (98.1%) with RGP fitting (14). Fernandez-Velazquez (15) fitted Rose K2 RGP contact lens to 77 eyes and reported that visual acuity with contact lens was improved to 0.40±0.26 logMAR from 0.04±0.07 logMAR with spectacles. Similarly in this study, visual acuity was improved to 0.14±0.12 logMAR with contact lens from 0.55±0.28 logMAR with spectacles in Rose K group. Visual acuity was improved to 0.08±0.09 logMAR with contact lens from 0.47±0.24 logMAR with spectacles in Conflex Air group. The visual acuities significantly improved with both contact lenses over standard spectacles corrections.

Nejabat et al (14). reported that cone location has no effect on the RGP corrected visual acuities in patients with keratoconus. Similarly, in our study there was no difference in BCLCVA with Conflex Air between cone types subgroup. However; our study showed that Rose K contact lens was more successful in globus type keratoconus than oval cone type. BCLCVA with Rose K was higher in globus cone then oval cone. There was no difference between other subtypes for both lenses (cone location and severity of keratoconus).

The mean line gain was higher in Conflex Air group. Also 84.6% of eyes gains 4 or more lines in Conflex Air group over 66.6% of eyes gains 4 or more lines in Rose K group. However there were more advance keratoconic patients in Rose K group then Conflex Air group. There were 7 mild cases (17.9%) in Conflex Air group over only 2 mild cases (5.6%) in Rose K group.

The limitation of this study is that the study does not show the lens behaviors over the long term. The strongest aspect of the study is that being first report in the literature that examines the visual results of Rose K and Conflex Air RGP contact lens in different subtypes (cone type, cone location, severity of keratoconus) of keratoconus.

Conclusion

In sum, both contact lenses may improve visual acuity in patients with all subtypes of keratoconus. Rose K contact lens may be better in globus type of keratoconus then oval type. Further studies with long follow-up period that compared the different contact lenses are needed.

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