OPTICAL QUALITY AND VISUAL PERFORMANCE WITH A NEW SILICONE HYDROGEL CONTACT LENS FITTED ON IRREGULAR CORNEAS

Giancarlo Montani, Optom, FIACLE, FBCLA

Course of Optics and Optometry Università del Salento, Lecce, Italy

Miguel Romero-Jiménez

BSc, MSc, PhD. Ophthalmology Service, MGR Doctores. Madrid, Spain

The authors have no commercial intererest in any of the products used in the study

Giancarlo Montani, Optom, FIACLE, FBCLA

Course of Optics and Optometry Università del Salento, Lecce, Italy

Miguel Romero-Jiménez

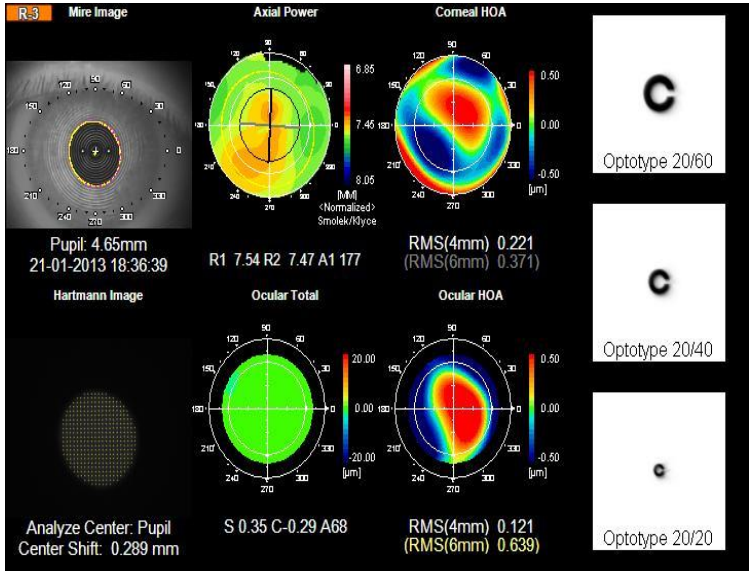
BSc, MSc, PhD. Ophthalmology Service, MGR Doctores. Madrid, Spain

Introduction

With Irregular corneas (ICs) optical quality of retinal images is impared by:

Lower order aberrations (LOAs) – sphero-cylindrical errors

Higher order aberrations (HOAs) – coma, trifoil, spherical aberration



Maeda N, Fujikado T, Kuroda T, et al. Wavefront aberrations measured with Hartmann-Shack sensor in patients with keratoconus. Ophthalmology 2002;109:1996 –2003.

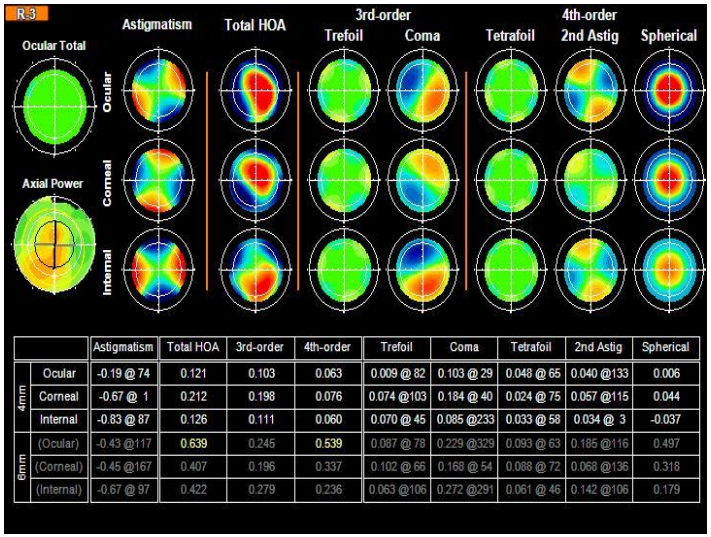
Shah S, Naroo S, Hosking S, et al. Nidek OPD-scan analysis of normal, keratoconic, and penetrating keratoplasty eyes. J Refract Surg 2003;19(suppl):S255–9.

Introduction

Eyes with ICs presents HOAs approximately 5.5 times more than normal ones.

Vertical coma is the dominant HOAs in eyes with keratoconus

Trefoil, spherical aberration and coma are the dominant HOAs in PK eyes

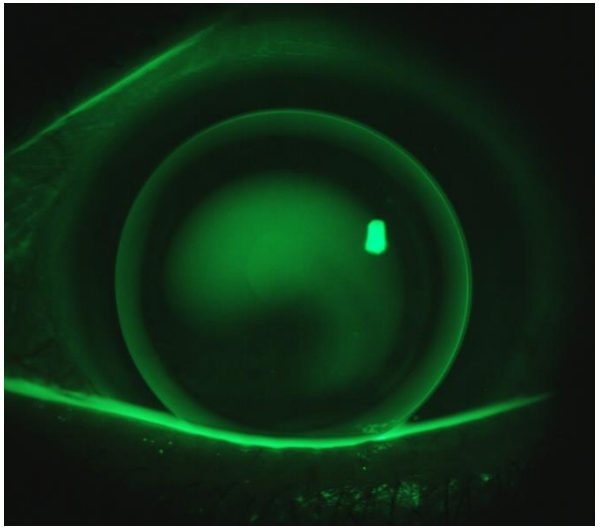


		Astigmatism	Total HOA	3rd-order	4th-order	Trefoil	Coma	Tetrafoil	2nd Astig	Spherical
4mm	Ocular	-0.19 @ 74	0.121	0.103	0.063	0.009 @ 82	0.103 @ 29	0.048 @ 65	0.040 @133	0.006
	Corneal	-0.67 @ 1	0.212	0.198	0.076	0.074 @103	0.184 @ 40	0.024 @ 75	0.057 @115	0.044
	Internal	-0.83 @ 87	0.126	0.111	0.060	0.070 @ 45	0.085 @233	0.033 @ 58	0.034 @ 3	-0.037
6mm	(Ocular)	-0.43 @117	0.639	0.245	0.539	0.087 @ 78	0.229 @329	0.093 @ 63	0.185 @116	0.497
	(Corneal)	-0.45 @167	0.407	0.196	0.337	0.102 @ 66	0.168 @ 54	0.088 @ 72	0.068 @136	0.318
	(Internal)	-0.67 @ 97	0.422	0.279	0.236	0.063 @106	0.272 @291	0.061 @ 46	0.142 @106	0.179

Pantanelli S. et all- Characterizing the Wave Aberration in Eyes with Keratoconus or Penetrating Keratoplasty Using a High–Dynamic Range Wavefront Sensor– Ophthalmology; 2007;114:2013–2021.

Introduction

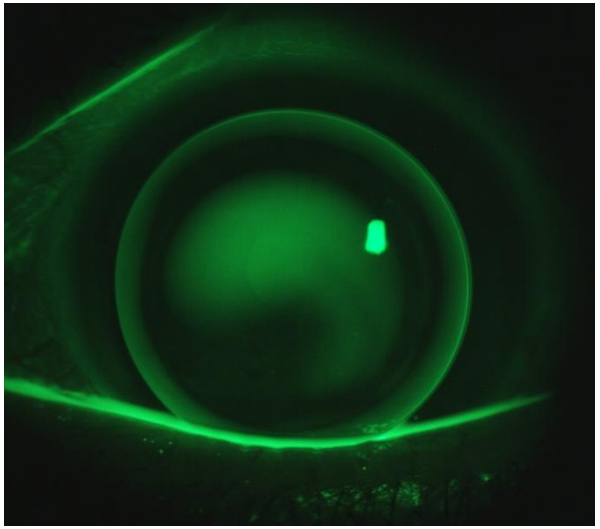
Rigid gas permeable (RGP) contact lenses are considered the primary visual correction tool for ICs as the tear lens that is formed behind the posterior lens surface optically neutralizes the anterior corneal surface with drastically reduction of HOAs arising from that surface.



Fernando J. Fernandez-Velazquez-Kerasoft IC compared to Rose-K in the management of corneal ectasias-Contact Lens & Anterior Eye 35 (2012) 175– 179
Amit Jinabhai et all-Visual Acuity and Ocular Aberrations With Different Rigid Gas Permeable Lens Fittings in Keratoconus-Eye & Contact Lens 2010;4: 233237

Introduction

However, several studies have shown that residual HOAs persist even with RGP lenses on-eye which are typically attributed to the posterior corneal surface.

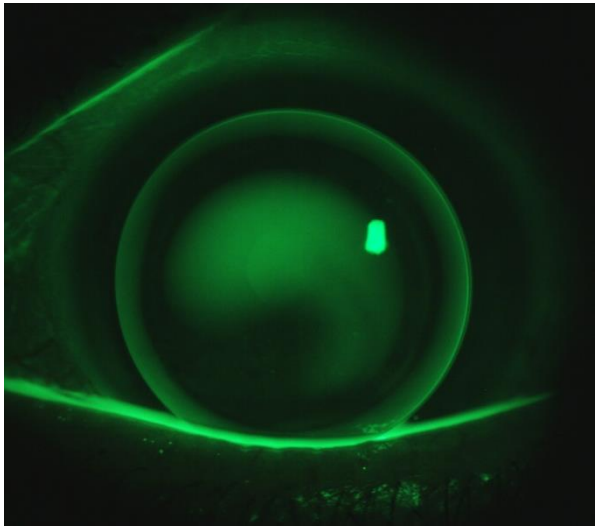


Marsack JD, Parker KE, Pesudovs K & Applegate RA.-Uncorrected wavefront error and visual performance during RGP wear in keratoconus. Optom Vis Sci 2007; 84: 463–70.

Negishi K, Kumanomido T, Utsumi Y & Tsubota K. Effect of higher-order aberrations on visual function in keratoconic eyes with a rigid gas permeable contact lens. Am J Ophthalmol 2007; 144: 924–9

Introduction

Even with the variety of designs currently available RGP lenses can be difficult to fit on some ICs with patients sometimes experiencing discomfort, instable lenses or fluctuating visual acuity.



White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Amit Jinabhai et all-Visual performance and optical quality with soft lenses in keratoconus patients -Ophthalmic Physiol Opt 2012, 32, 100–116

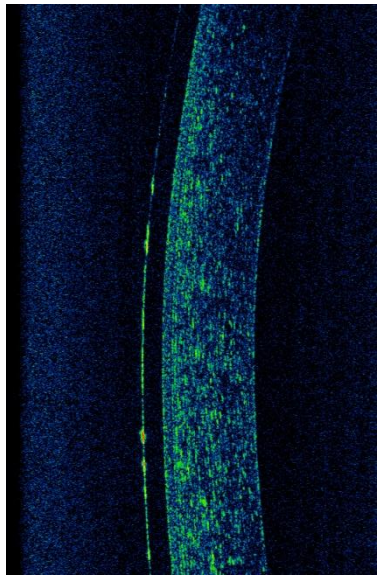
Introduction

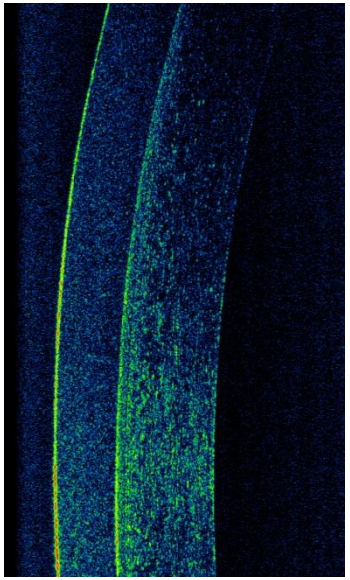
In cases of RGP CLs intolerance other solutions like RGP scleral and semi-scleral lenses, hybrid lenses or piggy backing systems can be used to increase comfort and stability of vision.

White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Amit Jinabhai et all-Visual performance and optical quality with soft lenses in keratoconus patients -Ophthalmic Physiol Opt 2012, 32, 100–116

Introduction

Also soft contact lenses, with an increased central thickness, starting from 0.35mm, compared to conventional designs, represent an effective solution for ICs.

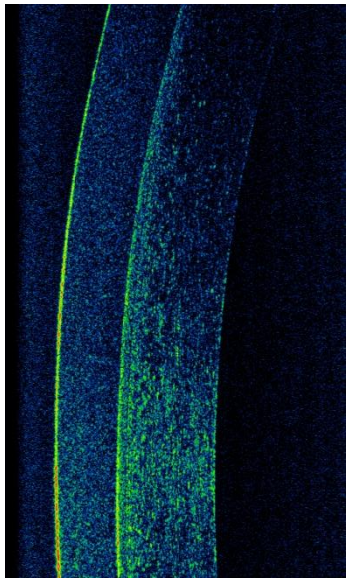




White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Ömür Ö. Uçakhan- KeraSoft 3 Contact Lenses in Corneal Ectasia-Eye & Contact Lens 2014;40: 390–394.
Amit Jinabhai-Optical quality and visual performance with customised soft contact lenses for keratoconus-Ophthalmic Physiol Opt 2014; 34: 528–539

Introduction

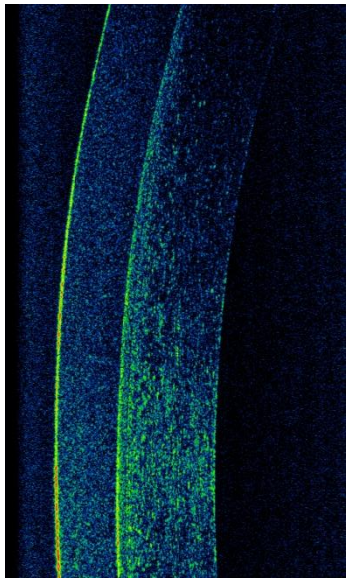
As a thinner lenses are more stable and better centered, would conform to distorted cornea and mimic its shape reducing the irregularities introduced by anterior cornea for effect of the small differences between corneal and material refractive index



White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Ömür Ö. Uçakhan- KeraSoft 3 Contact Lenses in Corneal Ectasia-Eye & Contact Lens 2014;40: 390–394.
Amit Jinabhai-Optical quality and visual performance with customised soft contact lenses for keratoconus-Ophthalmic Physiol Opt 2014; 34: 528–539

Introduction

The increased thickness prevents the majority of corneal irregularity is transferred to the front surface of the lens



White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Ömür Ö. Uçakhan- KeraSoft 3 Contact Lenses in Corneal Ectasia-Eye & Contact Lens 2014;40: 390–394.
Amit Jinabhai-Optical quality and visual performance with customised soft contact lenses for keratoconus-Ophthalmic Physiol Opt 2014; 34: 528–539

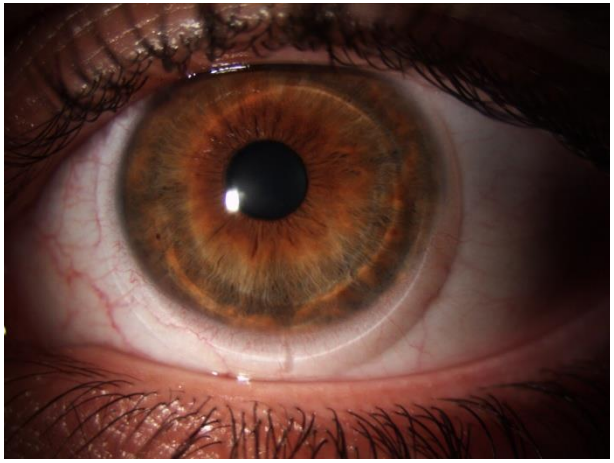
Introduction

To increase oxygen transmissibility, reduced by the thickness, many lenses are now available in high water content hydrogel or silicone hydrogel materials, allowing much longer wearing time.

White L- Soft contact lenses for irregular cornea – Optometry in practice; 2010;11:77–90.
Ömür Ö. Uçakhan- KeraSoft 3 Contact Lenses in Corneal Ectasia-Eye & Contact Lens 2014;40: 390–394.
Amit Jinabhai-Optical quality and visual performance with customised soft contact lenses for keratoconus-Ophthalmic Physiol Opt 2014; 34: 528–539

Purpose

In this study we evaluated the effects on visual performance and on HOAs of **Rose K2 Soft** (David Thomas Contact Lenses, Northampton, UK) a novel soft contact lens indicated for irregular corneas



Purpose

Rose K2 Soft presents a:

- **reverse geometry**
- **aspheric back optic zone,**
- **front surface toric and with spherical aberration control**
- **prism ballast stabilization,**

Parameter range	
Diameter	From 14.3 to 15.3 0.1 inc
Base Curves	From 7.4 to 9.0 0.2 inc
Power	any
Centre Thickness	0.35mm
Edge lift	5 options

Purpose

The material used is a silicone hydrogel named **mangofilcon A** (LSH, Lagado, Englewood,USA)

Material properties	
Wetting°	60 °
% Water	49%
n hydrated	1.413
DK	49
Modulus	0.8
UV filter	Yes

Methods

After a slit-lamp biomicroscope examination and a corneal topography evaluation to obtain the SimK values calculated were selected:

- **6 eyes with mild keratoconus**
- **4 eyes with moderate keratoconus**
- **5 eyes with penetrating keratoplasty**

Methods

Were excluded any subject with :

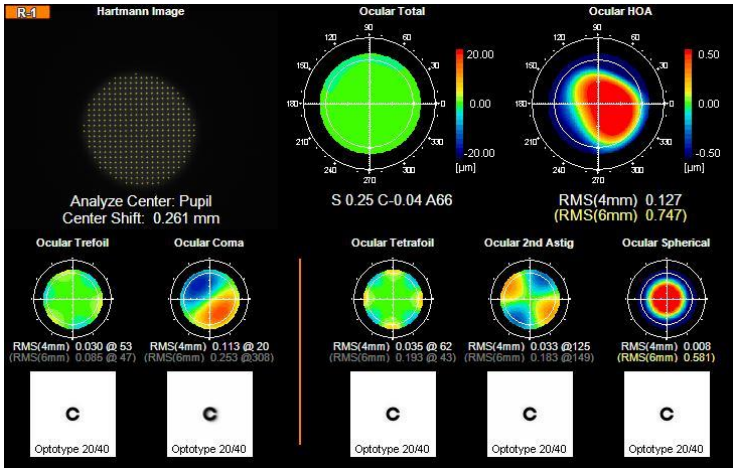
- **history of dry eye,**
- **amblyopia,**
- **central corneal scars,**
- **presence of any disease limiting visual acuity that could negatively impact clinical outcome.**

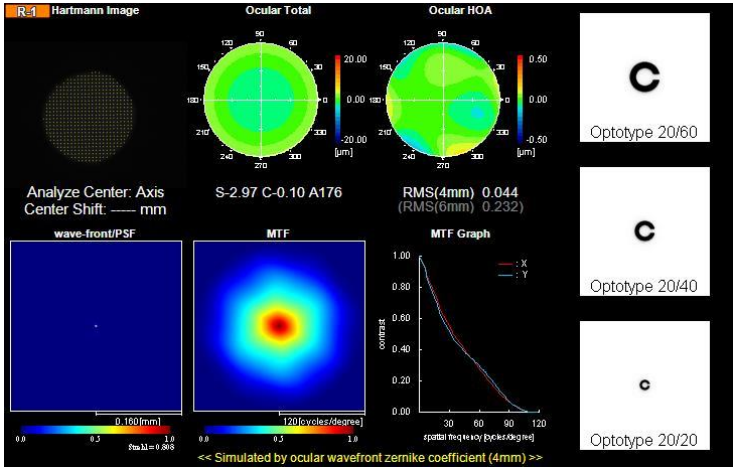
Methods

Prior to lens fitting and after a minimum of 30 minutes from its fitting we measured:

- **HOAs: Coma, Trefoil and Spherical aberration.**
- **Strehl Ratio**

using a Hartmann-Shack aberrometer (KR-1W, Topcon) for a pupillary diameter of 5mm





Methods

Prior to lens fitting and after a minimum of 30 minutes from its fitting we measured:

- **high and low (25% Michelson) contrast visual acuity**

for far (5 m) using a Bailey-Lovie chart

Results

All final CLs fitted were toric.

Their orientation were stable and the rotation not greater than 20° from 270”.

Considering the manufacturer fitting guide BCs used was accurate for KC but not for PK.

Poster #

Evaluation of a Novel Soft Contact Lens for the Management of the Irregular Cornea .

[1]Romero-Jiménez M., [2]Giancarlo Montani.

[1] BSc, MSc, PhD. Ophthalmology Service, MGR Doctores. Madrid, Spain.
[2] Optometrist FIACLE, FBCLA, Course of Optics and Optometry University of Salento Italy

Corresponding author: mrjlentes@gmail.com

INTRODUCTION

Contact lens fittings for irregular corneas represent one of the greatest challenges that practitioners have to face. In the past, only RGP contact lens were available to manage these complicate cases. Currently, advanced special soft lenses have probed to be useful on irregular corneas.[1,2] The most important complication of these designs is corneal hypoxia which could lead to corneal vascularization. To avoid this, new SiHy materials are used to manufacture the last designs. In the present study, we have evaluated the new Rose K Soft lens, manufactured in a SiHy material with 49% of water content , modulus 0.8, Dk 49 and wetting angle 60.

METHODS

The purpose was to evaluate the efficacy of the Rose K2 Soft contact lens (Menicon Co., Ltd., Nagoya, Japan) in the management of the irregular cornea. Twenty-four subjects (36 eyes) with irregular corneas referred for contact lens fitting were evaluated. A diagnostic trial set was used in the fitting process. Once the trial lens was considered optimal, a final lens was ordered from the manufacturer with the necessary changes in power, edge lift and diameter. We analyzed visual acuity, differences between back optic zone radius (BOZR) and central average corneal radius (ACR), number of lenses ordered and patients' ability to wear and handle lenses.

RESULTS

Thrty-six eyes were fitted with the Rose K2 Soft lens. Twenty-five eyes presented keratoconus (KC), 5 corneal graft, 2 intracorneal ring segment (ICRS) and 2 eyes corneal injury (CI). Average LogMAR VA without correction and with the lens was 0.82 and 0.09, respectively ($p<0.001$).

Ten and 26 final lenses were spherical and toric, respectively. An average of 1.81 ordered lenses (range 1-3) were necessary to achieve the optimal fit. Fifteen eyes (42%) were fitted with the first lens ordered. Two subjects (8%) had problems with lens handling, and four subjects (6 eyes) abandoned the wear of the lenses after three months due to discomfort (4 eyes) and unsatisfactory visual acuity (2 eye), respectively. Follow-up ranged from 6 to 9 months.

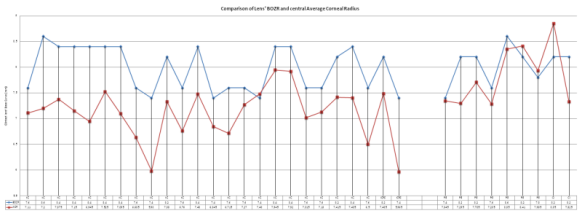


Table 1 shows the difference between lens' BOZR and central ACR. The difference was, on average 0.69 mm, which matched well with the fitting guide provided by the manufacturer (lens' BOZR must be between 0.8 and 1.0 mm flatter than ACR). When we analized by corneal pathology we found that (KC) and ICRS presented a difference of 1.02 mm and 1.08 mm, respectively, which in agreement with the fitting guide. However, PG and CI presented differences of -0.032 mm and 0.11 mm, respectively. These differences are attributed to the fact that in grafts and corneal injury, central cornea is flatter than mid periphery, in opposition to KC and ICRS, and, probably, there is some space between the lens and the central cornea, and this layer of tears masks central astigmatism in the former cases.

DISCUSSION

The Rose K Soft lens increased VA in eyes with irregular cornea, as expected. The lens is easy to fit for the practitioner and easy to handle for the patient. Most final lenses were toric and a relatively low number of ordered lenses were necessary to achieve the optimal fit, in comparison with other special soft lens designs.

On the other hand, the manufacturer fitting guide is accurate for KC and ICRS, but not for PG and corneal injury in this study. This might be due to the low number of eyes with PG and corneal injury.

Discomfort was the main cause of lens wearing drop-out. Other material different than SiHy could solve this issue.

CONCLUSIONS

Rose K2 Soft contact lens is a viable option to provide good visual acuity and comfort in patients with irregular corneas. The lens is very predictable with the second lens ordered and easy to fit and handle. Larger follow-up is necessary to assess potential complications

REFERENCES

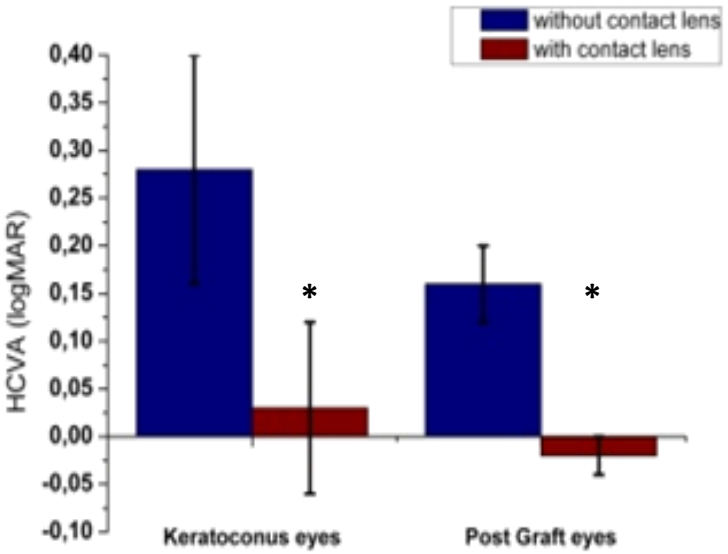
[1] Carballo-Álvarez J, et al. Soft contact lens fitting after intrastromal corneal ring segment implantation to treat keratoconus. Cont Lens Ant Aye 2014. Epub ahead of print.
[2] Jinabhai A, et al. Visual performance and optical quality with soft lenses in keratoconus patients. Ophtal & Physiol Optics 2012;32:100-116.

Acknowledgements

Authors do not have any financial interest on the products presented in this study.

Results

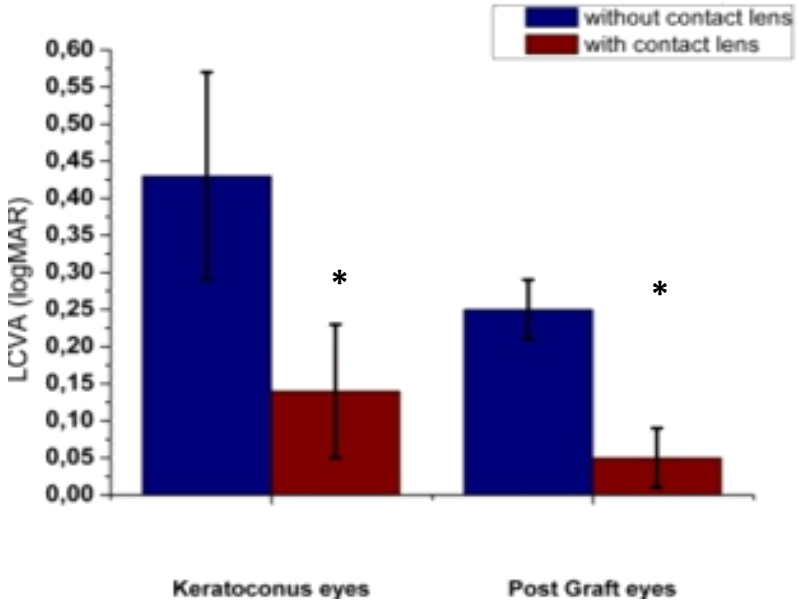
High contrast Visual Acuity



*p<0.05

	Without CL	With CL
KC	0.28±0.12	0.03±0.09
PK	0.16±0.04	-0.02±0.02

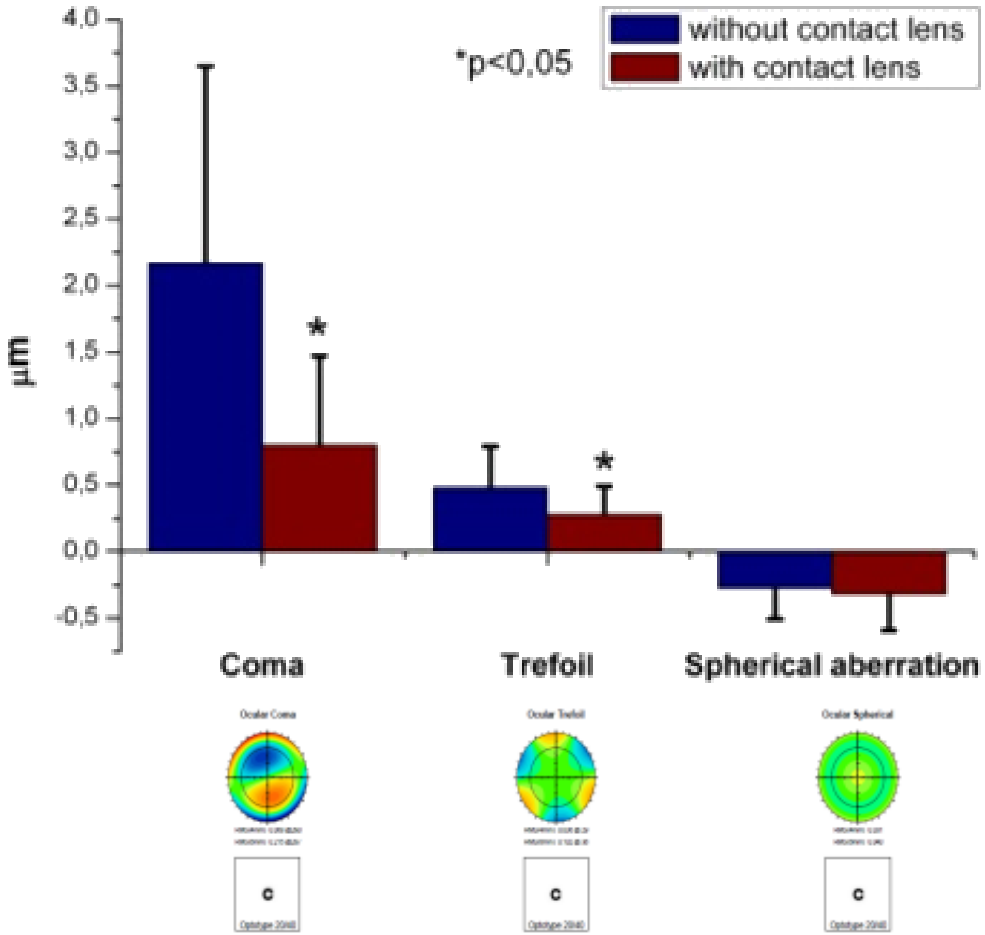
Low contrast Visual Acuity



	Without CL	With CL
KC	0.43±0.14	0.14±0.09
PK	0.25±0.04	0.07±0.04

Results

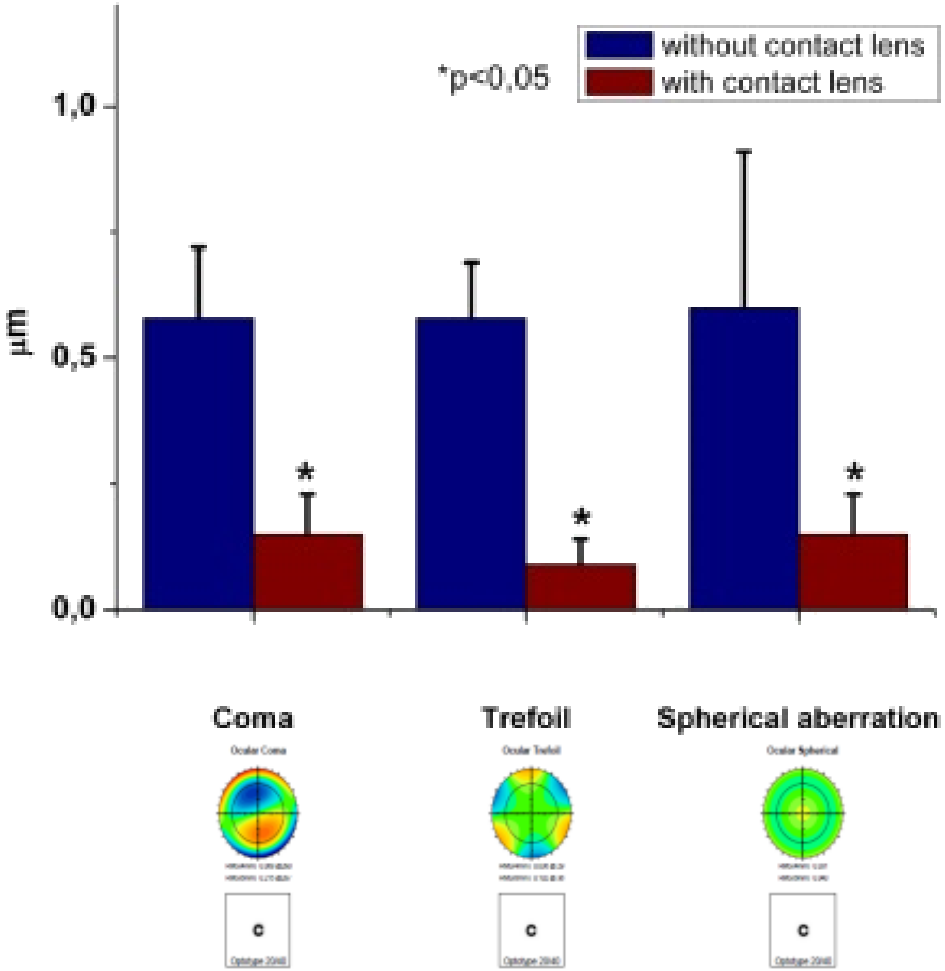
Keratoconus



	Without CL	With CL
Coma	2.17±1.48	0.80±0.67
Trefoil	0.48±0.31	0.28±0.21
Spherical aberration	-0.27±0.24	-0.32±0.27

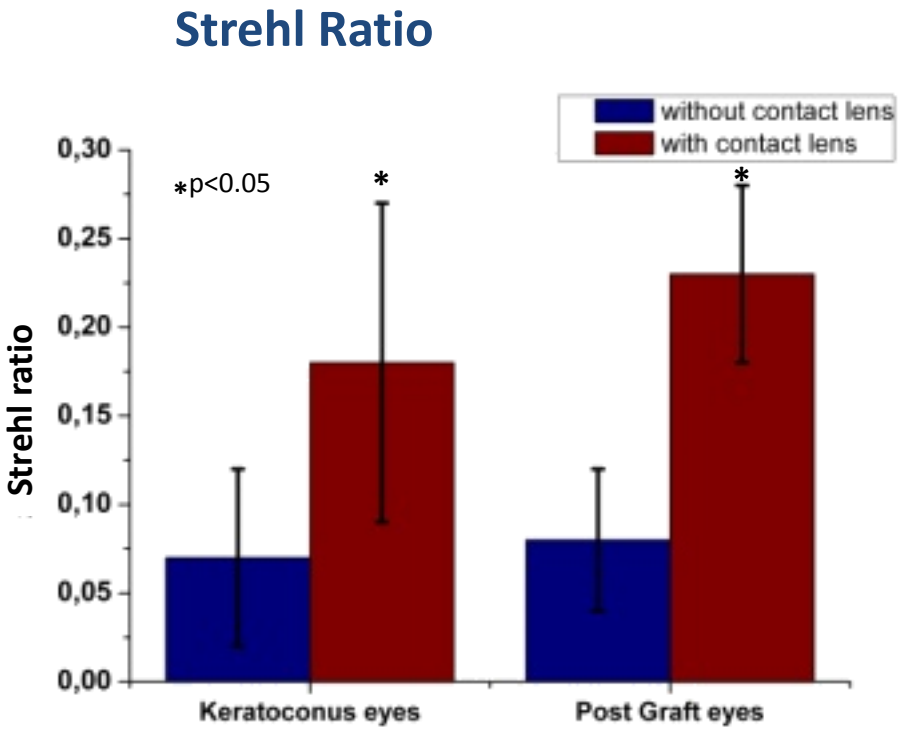
Results

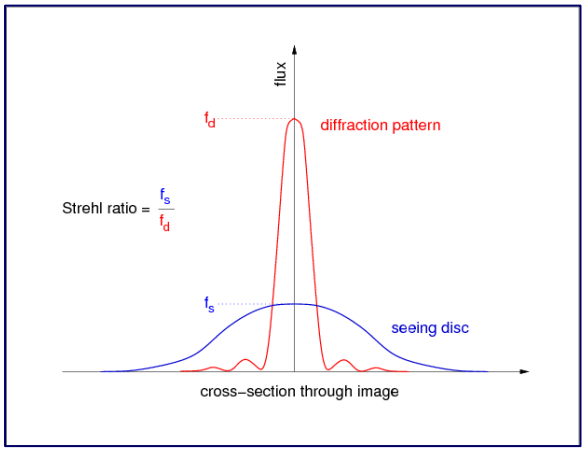
Penetrating Keratoplasty



	Without CL	With CL
Coma	0.58±0.14	0.15±0.08
Trefoil	0.58±0.11	0.09±0.05
Spherical aberration	0.60±0.31	0.15±0.08

Results





	Without CL	With CL
KC	0.07±0.05	0.18±0.09
PK	0.08±0.04	-0.23±0.05

Conclusions

Rose K2 Soft was effective in

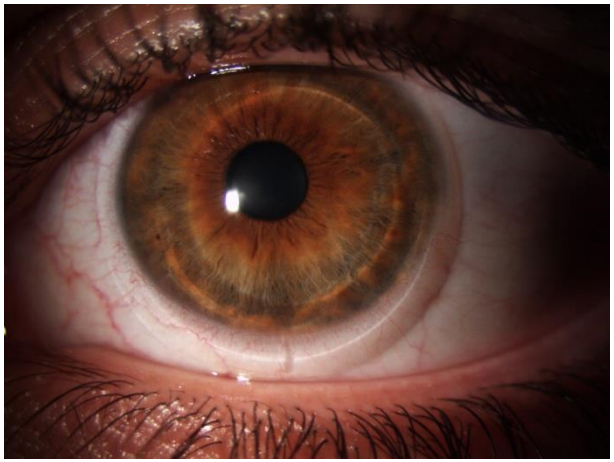
significantly reduce the most important

HOAs associated with

mild-to-moderate keratoconus or PK

corneas and increasing visual

performance in these patients.

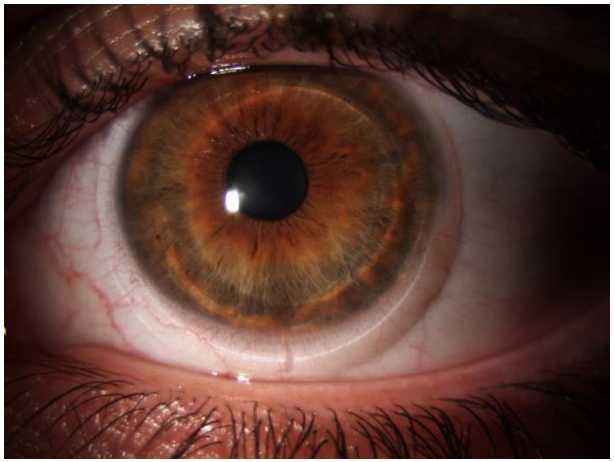


Conclusions

Although further studies needed to evaluate the effects over time this lens can be considered an effective alternative solution when RGP lenses are not tolerated, not stable or

when the patients particularly desire soft lenses for reasons such as

a dynamic lifestyle.



OPTICAL QUALITY AND VISUAL PERFORMANCE WITH A NEW SILICONE HYDROGEL CONTACT LENS FITTED ON IRREGULAR CORNEAS

Giancarlo Montani, Optom, FIACLE, FBCLA

Course of Optics and Optometry Università del Salento, Lecce, Italy

Miguel Romero-Jiménez

BSc, MSc, PhD. Ophthalmology Service, MGR Doctores. Madrid, Spain