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

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

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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

Introduction

Eyes with ICs present 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.

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
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.


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.
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.
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.
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.
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.
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.
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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>From 14.3 to 15.3</td>
</tr>
<tr>
<td></td>
<td>0.1 inc</td>
</tr>
<tr>
<td>Base Curves</td>
<td>From 7.4 to 9.0</td>
</tr>
<tr>
<td></td>
<td>0.2 inc</td>
</tr>
<tr>
<td>Power</td>
<td>any</td>
</tr>
<tr>
<td>Centre Thickness</td>
<td>0.35mm</td>
</tr>
<tr>
<td>Edge lift</td>
<td>5 options</td>
</tr>
</tbody>
</table>
Purpose

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

<table>
<thead>
<tr>
<th>Material properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetting°</td>
</tr>
<tr>
<td>% Water</td>
</tr>
<tr>
<td>( n ) hydrated</td>
</tr>
<tr>
<td>DK</td>
</tr>
<tr>
<td>Modulus</td>
</tr>
<tr>
<td>UV filter</td>
</tr>
</tbody>
</table>
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
Las Vegas 22-25 January 2015

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 #
Results

High contrast Visual Acuity

<table>
<thead>
<tr>
<th></th>
<th>Without CL</th>
<th>With CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC</td>
<td>0.28±0.12</td>
<td>0.03±0.09</td>
</tr>
<tr>
<td>PK</td>
<td>0.16±0.04</td>
<td>-0.02±0.02</td>
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</tbody>
</table>

Low contrast Visual Acuity

<table>
<thead>
<tr>
<th></th>
<th>Without CL</th>
<th>With CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC</td>
<td>0.43±0.14</td>
<td>0.14±0.09</td>
</tr>
<tr>
<td>PK</td>
<td>0.25±0.04</td>
<td>0.07±0.04</td>
</tr>
</tbody>
</table>

*p<0.05
Results

Keratoconus

<table>
<thead>
<tr>
<th></th>
<th>Without CL</th>
<th>With CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coma</td>
<td>2.17±1.48</td>
<td>0.80±0.67</td>
</tr>
<tr>
<td>Trefoil</td>
<td>0.48±0.31</td>
<td>0.28±0.21</td>
</tr>
<tr>
<td>Spherical aberration</td>
<td>-0.27±0.24</td>
<td>-0.32±0.27</td>
</tr>
</tbody>
</table>
Results

Penetrating Keratoplasty

<table>
<thead>
<tr>
<th></th>
<th>Without CL</th>
<th>With CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coma</td>
<td>0.58±0.14</td>
<td>0.15±0.08</td>
</tr>
<tr>
<td>Trefoil</td>
<td>0.58±0.11</td>
<td>0.09±0.05</td>
</tr>
<tr>
<td>Spherical aberration</td>
<td>0.60±0.31</td>
<td>0.15±0.08</td>
</tr>
</tbody>
</table>
Results

Strehl Ratio

* p<0.05

<table>
<thead>
<tr>
<th></th>
<th>Without CL</th>
<th>With CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC</td>
<td>0.07±0.05</td>
<td>0.18±0.09</td>
</tr>
<tr>
<td>PK</td>
<td>0.08±0.04</td>
<td>-0.23±0.05</td>
</tr>
</tbody>
</table>
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.
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